

Three New Records of Pottiaceae (Musci) from Egypt

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ABSTRACT

Three taxa of Pottiaceae; *Barbula sardoa* (Schimp.) J.P. Frahm, *Didymodon ceratodentus* (Müll.Hal.) Dixon and *Syntrichia fragilis* (Taylor) Ochyra collected from Nile Delta are new records to Egypt. This increases the number of taxa known from Egypt to 187. *D. ceratodentus* and *S. fragilis* are new records to North Africa.

KEYWORDS: mosses, *Barbula sardoa*, *Didymodon ceratodentus*, *Syntrichia fragilis*, Nile Delta.

INTRODUCTION

Pottiaceae is one of the largest families of the acrocarpous mosses. Its species represent more than 10% of the moss species known, up till now, from the whole world (Buck & Goffinet 2000), and they are widespread in all phytogeographical regions of the world.

In Egypt Pottiaceae, as in some other countries of similar latitude (e.g. North Africa: Ros *et al.* 1999; Iraq: Agnew & Vondracek 1975; Kuwait: El-Saadawi 1976 and Texas: Magill 1976), is the largest family of mosses. It represents over 42% (79 taxa) of the known moss flora of Egypt which consists of 184 entities, belonging to 48 genera, 15 families and nine orders.

Pottiaceae in Egypt consists of four subfamilies i.e. Merceyoideae, Pottioideae, Trichostomoideae and Timmielloideae. Merceyoideae and Pottioideae are represented by 35 taxa each, Trichostomoideae by eight taxa and Timmielloideae by only one taxon. Pottiaceae genera also have the highest representation in Egypt where 19 out of the 48 genera reported from Egypt belong to it. *Didymodon* Hedw. is the largest (17 taxa) followed by *Tortula* Hedw. (13 taxa), *Barbula* Hedw. (nine taxa) then *Crossidium* (seven taxa). The remaining genera of the Pottiaceae are represented by a small number of taxa (1-4). Pottiaceae genera reported in this paper are *Barbula*, *Didymodon* and *Syntrichia*. The first two genera are widespread in Egypt but *Syntrichia* is represented by only two taxa from Southern Sinai (El-Saadawi *et al.* 2003; Shabbara & El-Saadawi 2006, Shabbara 2006, Shabbara 2007).

Because Pottiaceae taxa may be easily confused with one another in Egypt (because of the rarity of sporophytes), they need intensive investigation as well as periodic revision. As a start we began to revise herbarium specimens of Pottiaceae taxa collected from Kalyubieh (a province of Nile Delta). The revision resulted in some corrections and additions which proved the presence of three taxa new to Egypt. This paper is concerned only with these three new records. The rest of the corrections will be dealt with in a forthcoming publication.

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MATERIALS AND METHODS

Kalyiubieh is one of Lower Egypt governorates, a pear-shaped area in the south-eastern part of the Nile Delta occupying about 945 km². It is located on the east side of the Nile River (Domieta branch) between longitudes 31° 5' E and 31° 25' E, and latitudes 30° 07' N and 30° 35' N, limited by Cairo province southward, Dakhlieh northward, Sharkieh eastward and Menufieh westward. The annual mean temperature is 20.2°C and varies between 5.4°C and 29.7°C during winter and 17°C to 34.5°C during summer. The rainfall in the Delta is low and takes place only during the period from November to February. The total annual rainfall of Kalyiubieh is ca. 35 mm (Abd El-Aal 1983).

Generally the soils of Kalyiubieh, are nonsaline with some exceptional patches of saline soils and with low content of organic matter due to rapid decomposition of organic material. pH values of the soils range between 7.2 and 8.3; soils are usually alkaline (Abd El-Aal 1983).

The three taxa were found as small patches growing among other taxa. They were found in the four following samples.

- Sample no. R1002(a)/2: collected from Nile Delta, Kalyiubieh, Benha, El-Manshiya, ca 30° 26' N, 31° 16' E, on a limestone wall, 16/6/1980, leg. Refai.
- Sample no. R1048(a)/2: collected from Nile Delta, Kalyiubieh, Benha, El-Manshiya, ca 30° 26' N, 31° 16' E, on a red-brick wall of the railway beside a water tap., 6/2/1980, leg. Refai.
- Sample no. R1048(b)/2: collected from Nile Delta, Kalyiubieh, Benha, El-Manshiya, , ca 30° 26' N, 31° 16' E, on a red-brick wall of the railway beside a water tap., 6/2/1980, leg. Refai.
- Sample no. R1050(a)/2: collected from Nile Delta, Kalyiubieh, Abou El- Mooga at ca 30° 13' N, 31° 8' E, on a red-brick wall of a mosque, 4/3/1980, leg. Refai.

RESULTS

Intensive investigation of the four samples showed that they represent three taxa; *Barbula sardoa* (Schimp.) J.P. Frahm (R1002(a)/2), *Didymodon ceratodentus* (Müll.Hal.) Dixon (R1048(b)/2) and (R1050(a)/2) and *Syntrichia fragilis* (Taylor) Ochyra (R1048(a)/2). These three taxa represent new records to Egypt (see El-Saadawi *et al.* 2003; Shabbara & El-Saadawi 2006, Shabbara 2006, Shabbara 2007).

These taxa will be described, illustrated and discussed on the following pages. Distribution of these three taxa is also mentioned, based mainly on Wijk *et al.* (1959-1969), Frey & Kürschner 1991, Zander 1993, O'Shea 1999, Ros *et al.* 1999, Kürschner 2000 and Cortini Pedrotti 2001.

Barbula sardoa (Schimp.) J.P. Frahm, 2004 (Figure 1)

Plants olive green, 6.5 mm high. Stems 5 mm high, rounded in cross section, with central strand, sclerodermis little differentiated. Leaves concave, heteromallus, imbricate to contorted when dry, appressed to weakly spreading when moist, ± spatulate, widest above the middle, up to 1.3 mm long, 0.4 mm wide, concave above mid; apex rounded; margins revolute, entire, ± undulate above; costa vanishing at near half of the leaf, superficial cells quadrate to short rectangular above middle, rounded in cross section, with 2 guides, ± two equal small bands, dorsal band crescent, epidermis differentiated ventrally and dorsally; upper laminal cells irregular, quadrate to short rectangular, 8-12 µm long, (4)-8 µm wide, strongly convex to flat near costa on both sides, papillae absent, thick walled; basal laminal cells rectangular to elongate, 40-52 µm long, 16 µm wide, smooth, thinner, ± lax. Dioecious, perichetia terminal on main axis, perichetial leaves different in morphology and size,

lanceolate 1.6 mm long, 0.2 mm wide, apex obtuse, costa ending by cells below apex, archegonium 80 µm in long.

Distribution: Northern Africa (Morocco), South-western Asia (Lebanon, Turkey) and Europe. This taxon may be confused with *Barbula convoluta* var. *convoluta* recorded in Southern Sinai (Abou Salama, 1991). However, the latter has lanceolate leaves, acuminate apex, plane margins and stem without central strand. The diagnostic characters of *Barbula sardoia* were obvious in the studied specimen. They are (according to Frahm and Ahmed, 2004) spatulate leaves, obtusely acuminate apex, ± undulate margins, transparent lamina having areolation visible under the light microscope and stem with central strand.

Didymodon ceratodentus (Müll.Hal.) Dixon, 1932. (Figure 2)

Plants light green above, light brown below, 5 mm high. Stems 2.5 mm high, ± rounded in cross section, with decayed central strand, sclerodermis little differentiated. Leaves concave, slightly contorted to imbricate when dry, appressed to weakly spreading when moist, broadly lanceolate from ± ovate base, 0.6-0.8 mm long, 0.2-0.3 mm wide, broadly concave above mid; apex rounded to obtuse, sometimes acute; margins recurved, entire; costa ending below apex by 3-9 cells, superficial cells quadrate to short rectangular, toothed dorsally, rounded to semicircular in cross section with weak above dorsal band, ventral band weak above but absent below, 2-3 guides, epidermis differentiated ventrally and dorsally; upper laminal cells quadrate, hexagonal, short rectangular, 4-8 µm long, (4)-8 µm wide, weakly convex on both sides or only in dorsal side above middle, papillae absent, sometimes few low blunt papillae appear from dorsal side in cross section, thick walled above become thinner toward base; basal laminal cells quadrate to rectangular, 12-20 µm long, 4-8 µm wide, smooth.

Distribution: Central Africa (Mozambique, Zimbabwe), Southern Africa, South-western Asia (Turkey).

This taxon may be confused with *Didymodon tophaceus* (Brid.) Lisa reported from many sites in Egypt particularly that illustrated from Southern Sinai (Abou salama, 1991) because of the similarity in leaf shape. However, *D. tophaceus* has two stereid bands in cross section of costa while the present one has only one dorsal faint stereid band, in addition to other diagnostic characters (according to Magill, 1981) of *D. ceratodentus* i.e. variation of leaf shapes and rounding of the leaf apex on same plant, costal anatomy; and appearance of a few blunt papillae scattered on dorsal side of lamina.

Syntrichia fragilis (Taylor) Ochyra, 1847. (Figure 3)

Plants yellowish green to light brown, 1.5-2 mm high. Stems 0.5-1 mm high, rounded in cross section, with central strand, sclerodermis not differentiated. Leaves keeled, contorted when dry, appressed to weakly spreading when moist, lingulate to oblong elliptical, 0.7 mm long, 0.3 mm wide, broadly concave above mid; apex rounded- apiculate; margins plane, crenulate-papillose above, ± entire below; costa stronge, percurrent, finely papillose at back, superficial cells quadrate to short rectangular above mid, semicircular in cross section, with large reniform dorsal stereid band, 4 guides in 2 layers, epidermis not differentiated ventrally and dorsally; upper laminal cells quadrate to short rectangular, with broader c-shaped papillose marginal cells, 4-12 µm long, 4-8 µm wide, strongly convex on both sides, papillose, bifid, one or two per lumen, thin to evenly thick walled; basal laminal cells quadrate to transverse rectangular, horizontal wall much thicker than vertical, 8-12(16) µm long, 12 µm wide, smooth, shorter toward margins. Propagula present, 8 gemmae born on leaf costa or lamina cells of upper two leaves of one individual, on the 1/3 upper part of leaf; stalked, dark brown, 4-8 cells, ovate, 24 µm long, 16 µm wide; paraphysis, 52-64 µm long.

Distribution: Central Africa (widespread, Nile basin i.e. Eritrea, Ethiopia, Kenya, Uganda, Zambia), Southern Africa, India, South-western Asia (Afghanistan, Saudi Arabia, Syria,

Yemen Arab Republic), Europe (Italy), North and Central America, Colombia and Peru. This taxon may be confused with *Syntrichia inermis*, recorded in Southern Sinai (Abou Salama, 1985), because of the similarity in leaf shape. However, *S. inermis* is larger than *S. fragilis* in height (10 mm viz. 2 mm in the present specimen), in leaf length (3.3 mm viz. 0.7), in lamina upper cell width (14 μm viz. 8) and basal cell length (35 μm viz. 16). Also, *S. inermis* leaf margin is recurved along the whole leaf while plane to slightly recurved at base in *S. fragilis*. Other diagnostic characters of the gametophyte of *Syntrichia fragilis* (according to Crum and Anderson, 1981; Magill, 1981 and Mishler, 1994) are quite clear in the present specimen namely; strong costa which is papillose at back, densely papillose leaf and differentiated basal laminal cells and absence of hair point.

DISCUSSION

It may not be strange to find these three taxa in Egypt since they exist in neighbouring phytogeographical regions with rather similar climate (*Barbula sardoa*), in other African regions (*Didymodon ceratodentus*) or widespread in Nile basin countries (*Syntrichia fragilis*). Thus, diaspores may come via winds (long dispersal) or water and mud of Nile. But these taxa have some differences from those recorded in other countries due to adaptation to new habitat.

The studied *Barbula sardoa* specimen is more or less similar to that recorded in Germany and Britain and Ireland, but differs in leaf shape, lingulate in Britain and Ireland while spatulate in Qaleobiya province.

Although *Didymodon ceratodentus* (according to Magill 1981) has great variation in size, leaf shapes and rounding of the leaf apices, the Egyptian specimen has great similarity with those recorded in Southern Africa except in size of plant (5 mm in Egypt viz. 10-50 mm in South Africa) and leaf length (0.6-0.8 mm long in Egypt viz. 1-1.8 mm in South Africa).

Also, *Syntrichia fragilis* in Egypt is much smaller than those recorded in South Africa (Magill 1981), Eastern North America (Crum and Anderson, 1981) and Mexico (Mishler 1994). Although dimensions of *S. fragilis* recorded in South Africa are larger than those in America, dimension of this taxon in Egypt are lower than those in America. The minimum recorded size in Mexico and Eastern North America is 5 mm, while in Egypt 2 mm long, also leaf length is 2 mm in these two regions while 0.7 mm in Egypt. However, lamina cell size in Egypt lie in the world range except the extreme small size. Mishler (1994) commented that this plant shows considerable variability in size and leaf shape according to habitats. On the other hand, the record of gemmae on the lamina of Egyptian material is not reported elsewhere. This makes us compare it with *Syntrichia rigescens* (the *Circum-Tethyan* taxon) and *S. papillosa* which have this type of gemmae. *S. rigescens* (according to Gallego *et al.* 2002) is considerably higher (10-20mm) having larger leaves (1.6-2.8 x 0.5-0.9mm) and bistratose. Although *S. papillosa* is small in size (1-2 mm), in Eastern North America (Crum & Anderson 1981) and Mexico (Mishler 1994), as the studied taxon but its upper lamina width is large (14-22 μm viz. 4-8 μm in the studied taxon). That in addition to the presence of long hair point in *S. papillosa*. Also, confusion may occur with *S. pagorum* for its small size, of plants, leaves and cells. But this latter taxon is distinguished by the presence of fusiform, leaf like ecostate propagule.

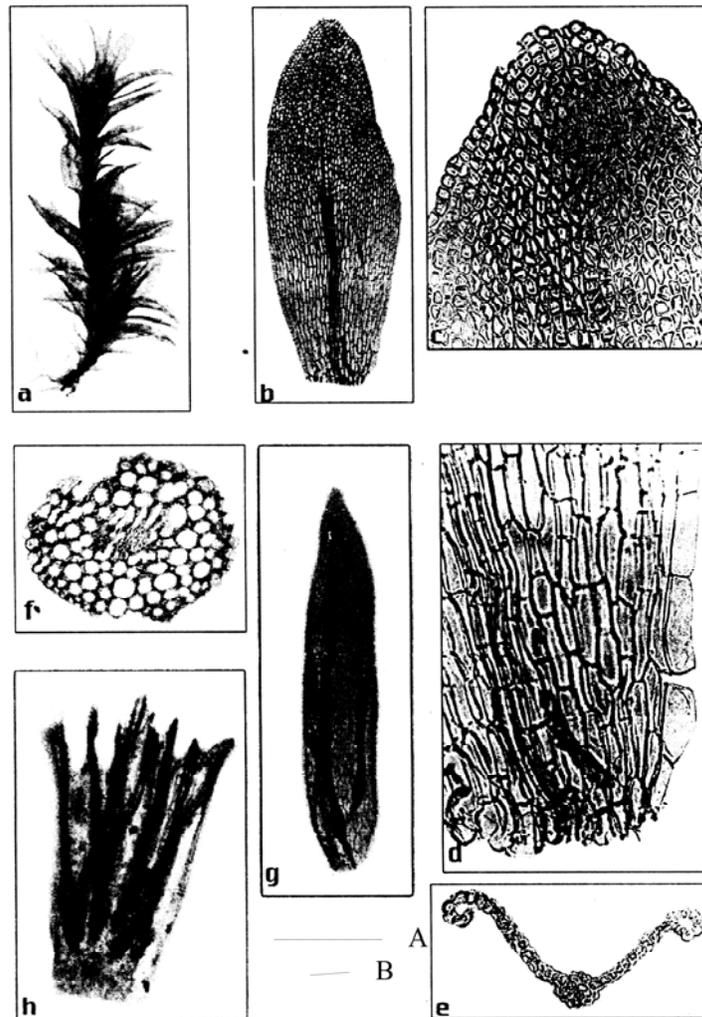


Figure 1: *Barbula sardoa*. **a.** whole plant. **b.** stem leaf. **c.** stem leaf apex. **d.** stem leaf base. **e.** cross section of stem leaf. **f.** cross section of stem. **g.** perichetial leaf. **h.** archegonia. A= 1.05 mm (a), 0.2 mm (b), (g). B= 20 μ m (c), 17 μ m (d), 28 μ m (e), 32 μ m (f). 35 μ m.

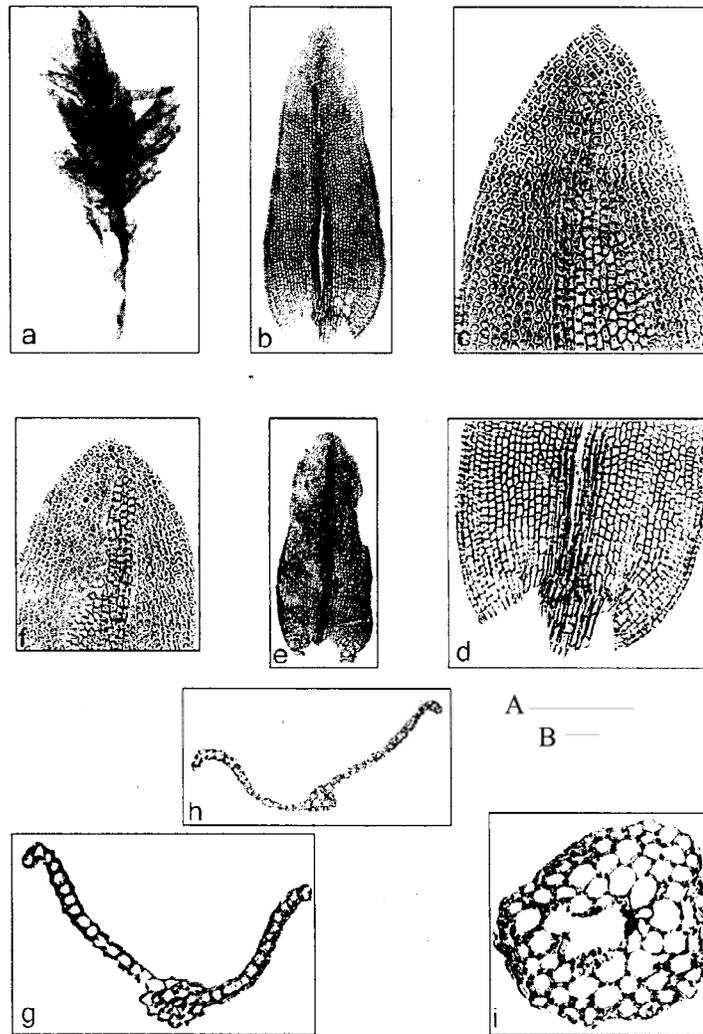


Figure 2: *Didymodon ceratodentus*. **a.** whole plant. **b.** stem leaf. **c.** stem leaf apex. **d.** stem leaf base. **e.** another stem leaf. **f.** leaf apex of the another leaf. **g.** cross section of leaf in the upper part. **h.** cross section of stem leaf in the middle part. **i.** cross section of stem. A= 0.66 mm (a), 0.2 mm (b), 0.23 mm (e). B= 20 μ m (c), 40 μ m (d), 28 μ m (f), 14.5 μ m (g), 26.6 μ m (h), 17.6 μ m (i).

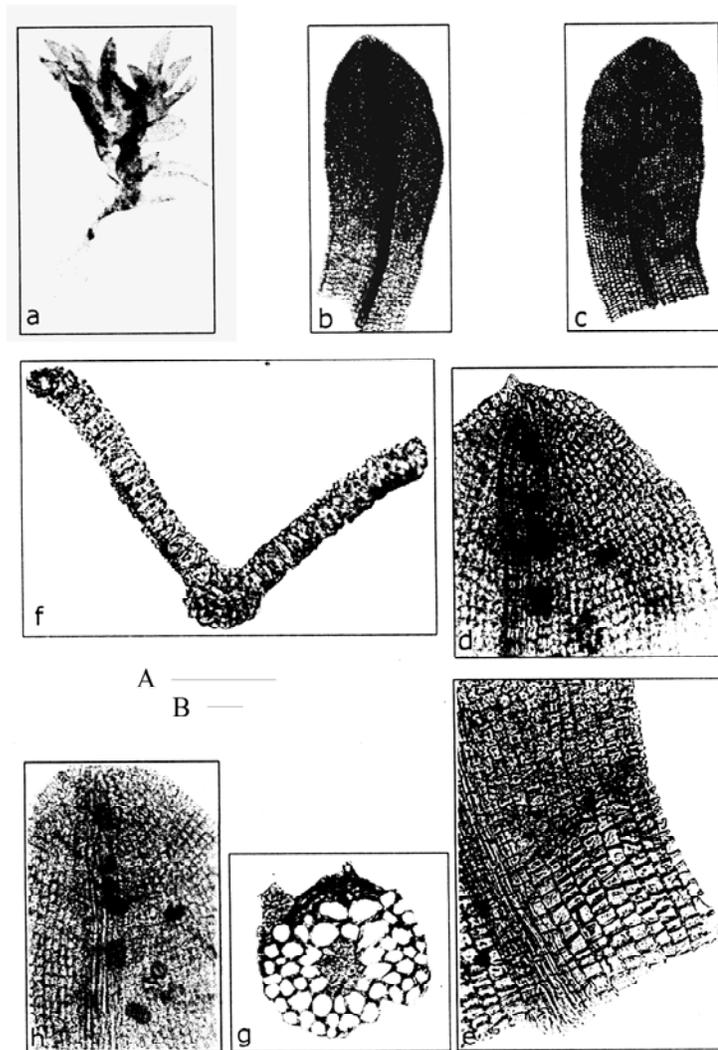


Figure 3: *Tortula fragilis*. **a.** whole plant. **b.** stem leaf. **c.** another leaf with laminal and costal gemmae. **d.** stem leaf apex of the another leaf. **e.** stem leaf base of the another leaf. **f.** cross section of stem leaf. **g.** cross section of stem. **h.** magnified part of upper part of leaf showing gemmae. A= 0.63 mm (a), 0.16 mm (b), 0.18 mm (c). B= 20µm (d), 15µm (e), 12.3µm (f), 21.2µm (g), 24 µm (h).

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Barbula sardo (Schimp.) J.P. Frahm,)

(*Syntrichia fragilis* (Taylor) Ochyra

Didymodon ceratodentus (Müll.Hal.) Dixon

Syntrichia fragilis

Didymodon ceratodentus