

RESEARCH ARTICLE

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New Bryaceae records to the moss flora of Libya

ABSTRACT:

Bryaceae includes up to 2,108 species worldwide. Only nine of its species are known from Libya. Bryaceae is reported mainly from the north of Libya near its Mediterranean coast. *Ptychostomum archangelicum* (Bruch & Schimp.) J.R. Spence and *P. imbricatum* (Müll. Hal.) Holyoak & N. Pedersen. are reported in this paper as new records raising the number of mosses known from Libya to 102 species. Descriptions and illustrations of these new records together with geographic distribution of all identified taxa and brief comments are given.

KEY WORDS:

Bryaceae, Al Ghariga, Beida, Al-Jabal Al-Akhdar, Libya.

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INTRODUCTION:

Bryaceae, worldwide includes 43 genera with a total of up to 2,108 accepted species names (The Plant List, 2013). Hitherto, only nine species under two genera had been reported from Libya, namely; *Bryum argenteum* Hedw. (Pampanini, 1931), *B. canariense* Brid. (Pampanini, 1931), *B. dichotomum* Hedw. (Baroni, 1892; Zodda, 1913, 1914, & 1926; Pampanini, 1917 & 1931; Bottini, 1914; Rungby, 1962), *B. radiculosum* Brid. (Pampanini, 1931; Zodda, 1913, 1914, & 1926), *B. valparaisense* Thér. (Arts *et al.*, 1995), *Ptychostomum boreale* (F. W eber & D. Mohr) Ochyra & Bednarek – Ochyra (Pampanini, 1931; Rungby, 1962), *P. capillare* (Hedw.) Holyoak & N. Pedersen (Müller, 1874; Ochi, 1972), *P. donianum* (Grev.) Holyoak & N. Pedersen (Zodda, 1926; Pampanini, 1931) and *P. torquescens* (Bruch & Schimp.) Ros & Mazimpaka (Bottini, 1914; Pampanini, 1931; Rungby, 1962).

According to the available literature (mentioned above) Bryaceae is reported mainly from the north of Libya at Darnah, Al Qubbah, Mechili, Wadi Marsa Susa, Shahet, Wadi Kouf, Tecniz, Al Marj, Tolmetta, Benghazi, Tripoli, Borgo, Gharian on the Mediterranean coast (Fig. 1). There are three other Bryaceae collection localities in the literature namely Bosco Zorda, Wadi Balgader and Wadi Sambar but the available maps do not contain their exact geographical positions.



Fig.1. Map showing the sites of old and new collections of Bryaceae specimens in Libya. 1- Darnah 2- Al Qubbah, 3- Mechili, 4- Wadi Marsa Susa, 5- Shahet, 6-Beida (a new site, the present work), 7- Wadi Kouf, 8- Tecniz, 9- Al Marj, 10- Tolmetta, 11- Benghazi, 12- Tripoli, 13- Borgo and 14- Gharian.

Bryaceae is the third largest family concerning number of species in the Libyan moss flora. It is preceded by two families namely Brachytheciaceae (18 species) (Youssef *et al.*, 2017a) and Pottiaceae (43 species) (Youssef *et al.*, 2017b) and followed by 13 families ranging between 1-5 species (Ros *et al.*, 2013).

One-hundred and eighty-nine moss specimens were collected by the second

author on the 29th and 30th of December 2004 from the six provinces to which Beida is divided (Fig. 2). From Zawya Al -Qadima (one of the six provinces of Beida) Youssef *et al.* (2017b) studied 28 specimens which resulted in the record of 20 species of Pottiaceae. The present paper is the second on mosses of Beida area and deals with specimens collected from of Al Ghariga, east of Beida (Fig. 2).

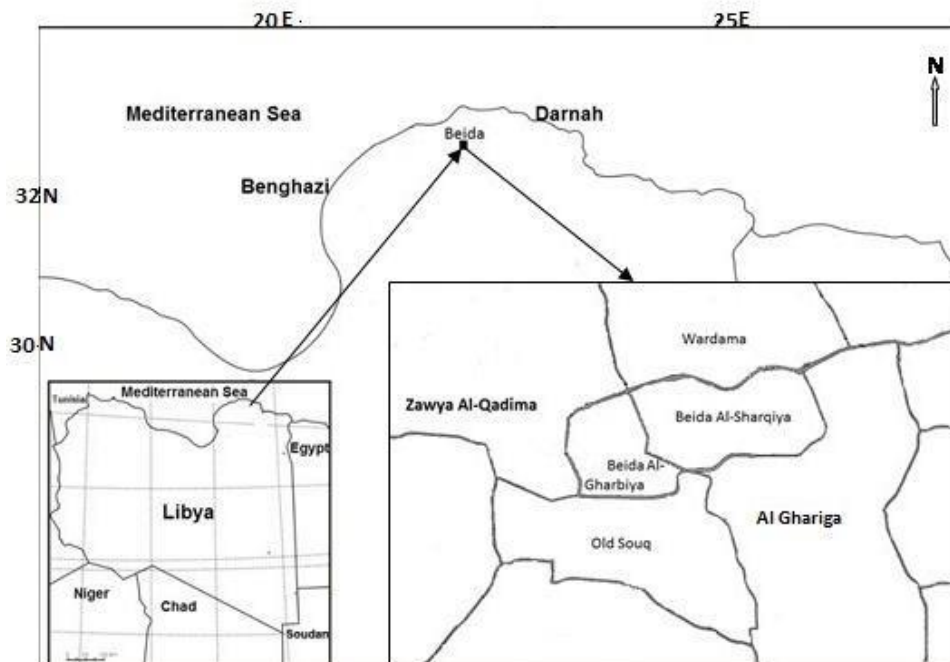


Fig. 2. Map showing the site of the study area (Al Ghariga) and the other provinces of Beida.

MATERIAL AND STUDY AREA:

The present work deals with 19 specimens collected from Al Ghariga, east of Beida. Beida is in the plateau of Al -Jabal Al- Akhdar in the north -east of Libya at an altitude of up to 625 meters above sea level and between the longitudes 32° 45' 59"N to 32° 76' 39"N and latitudes 21° 44' 30"E to 21° 74' 67"E between Benghazi and Darnah. Beida is considered one of the best towns in Libya in terms of nature and climate, where the climate is mild and cold to cool in the winter, and the average annual rainfall ranges between 450 - 650 mm, 24 - 30% falling in January. The temperature is 8 - 13°C in winter and 22 - 27°C in summer, while winds are Northern in winter but Southern and East Southern in other seasons. These climate conditions are suitable for a good bryophytes plant cover (Youssef *et al.*, 2017b).

Al Ghariga lies East of Beida at latitudes ca 32° 44' 59" N and longitudes ca 21° 45' 30" E. It is the most area in the Beida down from the sea level (ca 400 - 450 m) and there are the tombs of the city in it. Al Ghariga area consists of clay, rocks and stones with high and low water levels and is rich in arborescent seed plants belonging to *Olive*, *Ficus* and *Pinus* species.

RESULTS AND DISCUSSION:

After careful study of the 19 specimens it was found that 9 of them belong to Bryaceae, while the other 10 belong to four species of Pottiaceae recorded earlier by Ros *et al.* (2013) and Youssef *et al.* (2017b) namely; *Barbula convoluta* Hedw., *Crossidium squamiferum* (Viv.) Jur., *Didymodon vinealis* (Brid.) R.H.Zander, and *Microbryum starckeanum* (Hedw.) R.H.Zander. This means that Al Ghariga represents a new site of collection for these four Pottiaceae species. Only the 9 specimens of Bryaceae are dealt with here. From the investigation it was found that, they belong to 5 species namely; *Bryum argenteum* Hedw., *B. dichotomum* Hedw., *B. radiculosum* Brid., *Ptychostomum archangelicum* (Bruch & Schimp.) J.R. Spence and *P. imbricatum* (Müll. Hal.) Holyoak & N. Pedersen. The first three species represent old records to Libya while the two-other species are new records to it. This raised the number of Bryaceae known from Libya to 11 species and its known moss flora to 102 species.

Descriptions and Distribution:

Details about the recorded species are given below including; the number of gatherings and geographic distribution of all

species, while descriptions and illustrations are given for only the two new records. The number following each plant name is the specimen number which is followed by the acronym "YLG" where Y = Youssef - one of the authors of this paper, L = Libya and G = Al Ghariga.

***Bryum argenteum* Hedw. :**

One gathering (381 YLG), on clay and wet rocks:

Distribution:

In Libya; Al Marj and Bosco Zorda (Pampanini, 1931) and Al Ghariga (a new site, the present work).

In the Mediterranean region; in all 34 countries (Ros *et al.*, 2013).

In the world (Fig. 3); Australia, Brazil, Cameroon, Central African Republic, China,

Colombia, Costa Rica, Egypt, El Salvador, Gabon, Guatemala, Guinea, Hawaiian Isl, Honduras, Iraq, Japan, Madagascar, Mediterranean region, Mexico, Mongolia, New Zealand, Nicaragua, Panama, Philippines and United States (Bartram, 1949; Crum and Bartram, 1958; Bowers, 1970; Lawton, 1971; Agnew and Vondráček, 1975; El -Saadawi and Badawi, 1977; Bowers and Freckmann, 1979; Waard and Florschütz, 1979; Eversman and Sharp, 1980; Ketchledge, 1980; Abramov and Abramova, 1983; Crum, 1983; Morales and Griffin, 1983; Churchill 1985; Eckel, 1986; Noguchi and Iwatsuki, 1988; Beever *et al.*, 1992; Spence and Ramsay, 2002; Staples *et al.*, 2004; Forzza, 2010; Delgadillo Moya and Cárdenas Soriano, 2011). Briefly, cosmopolitan.

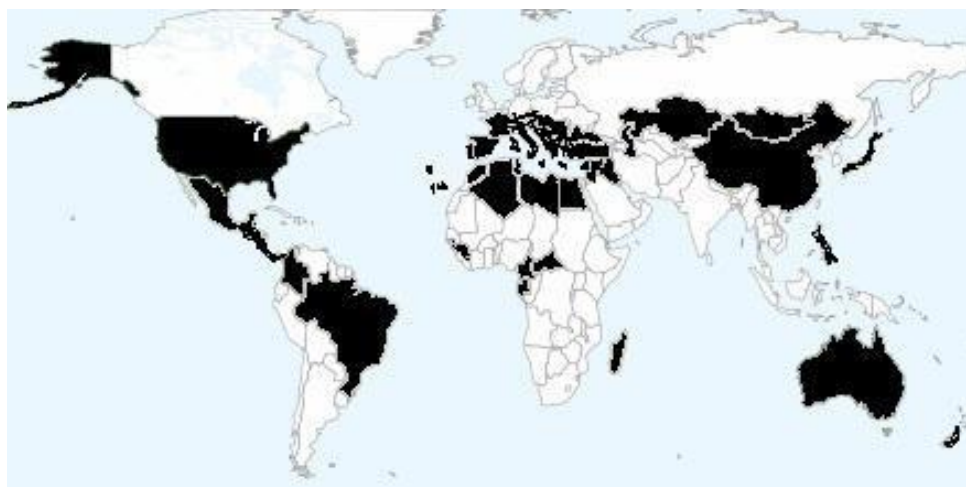


Fig. 3. Map showing the world distribution of *Bryum argenteum*.

***B. dichotomum* Hedw.**

Three gatherings (382 YLG - 384 YLG), on clay and wet rocks.

Distribution:

In Libya; Al Marj, Darnah, Benghazi, Al Qubbah, Mechili, Shahet, Tolmetta, Tecniz, Tripoli, Gharian, Bosco Zorda and Wadi Sambar (Baroni, 1892; Zodda, 1913, 1914, & 1926; Pampanini, 1917 & 1931; Bottini, 1914; Rungby, 1962) and Al Ghariga (a new site, the present work).

In the Mediterranean region; in all 34 countries (Ros *et al.*, 2013).

In the world (Fig. 4); Australia, Botswana, Chad, Colombia, Kazakhstan, Kenya, Madagascar, Mediterranean region, Namibia, New Zealand, Socotra, South Yemen, South Africa, Tanzania, Zimbabwe (Waard and Florschütz, 1979; Dalton *et al.*, 1991; Mies, 1994; O'Shea, 2006; Ros *et al.*, 2013).

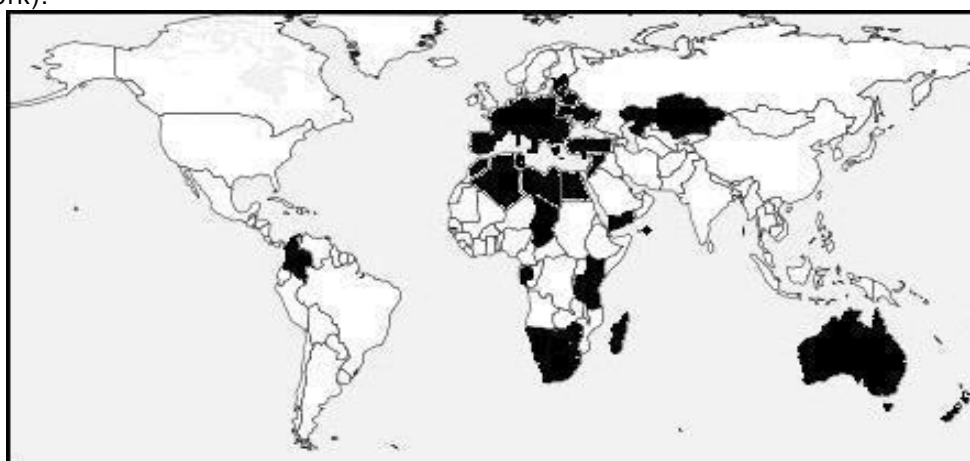


Fig. 4. Map showing the world distribution of *Bryum dichotomum*

***B. radiculosum* Brid.**

Two gatherings (385 YLG and 386 YLG), on wet rocks in shade under trees.

Distribution:

In Libya; Darnah, Shahet, Al Marj, Wadi Kouf, Borgo, Bosco Zorda and Wadi Balgader (Pampanini, 1931; Zodda, 1913, 1914, & 1926) and-Al Ghariga (a new site, the present work).

In the Mediterranean region; in 31 out of 34 countries (Ros *et al.*, 2013).

In the world (Fig. 5); Japan, Mediterranean region, Mexico, Namibia, New Zealand, South Africa, United states and Zimbabwe (Beever *et al.*, 1992; Spence, 2005, O'Shea, 2006; Ros *et al.*, 2013).

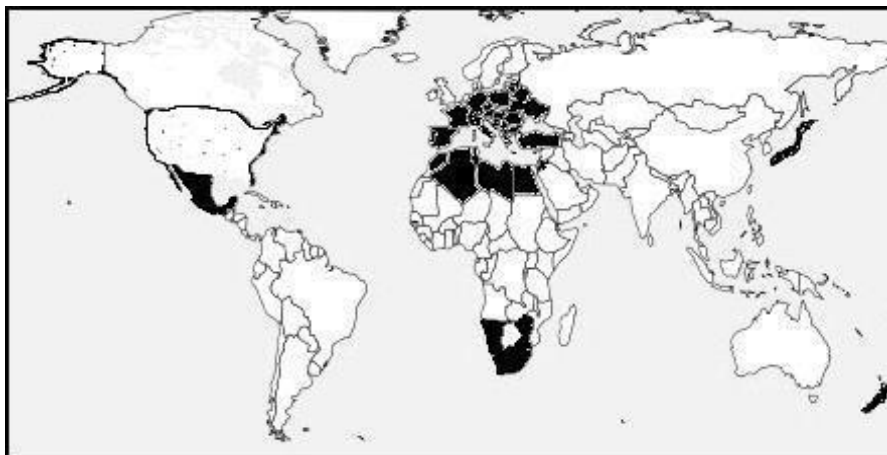


Fig. 5. Map showing the world distribution of *Bryum radiculosum*.

***Ptychostomum archangelicum* (Bruch & Schimp.) J.R.Spence**

One gathering (387 YLG), on clay wet soil in shade under trees.

Distribution:

In Libya; **new record to Libya**; Al Ghariga (the present work).

In the Mediterranean region; in 16 out of 34 countries (Ros *et al.*, 2013).

In the world (Fig. 6); Europe, Mediterranean region and United States (Spence, 2005, Ros *et al.*, 2013, Flora of North America Editorial Committee, 2014; Hodgetts, 2015).

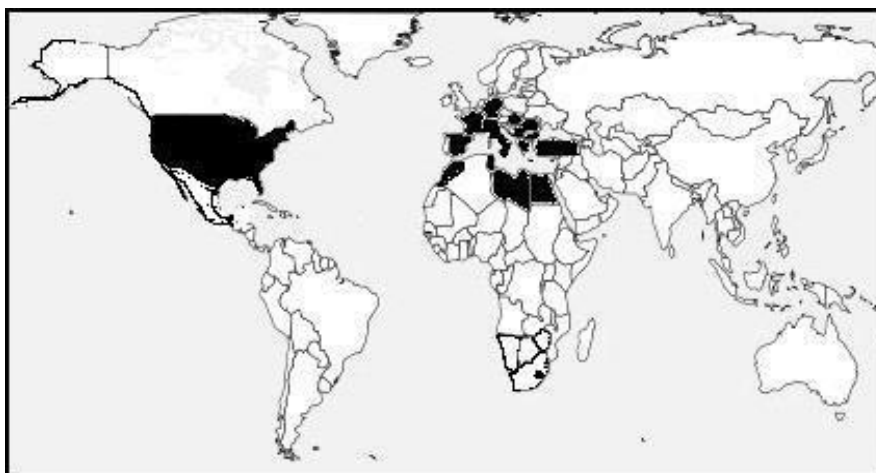


Fig. 6. Map showing the world distribution of *Ptychostomum archangelicum*.

Description:

Plants sterile, yellowish brown, up to 7 mm high. Stem brown, unbranched (Fig. 7a&b), hexagonal in cross section, central strand little developed, sclerodermis little differentiated (Fig. 7l). Leaves concave, imbricate, when dry, erecto-patent, or imbricate when moist, crowded at tip of the stems, ovate to ovate-lanceolate, 0.6 - 1 mm long, 0.3 - 0.4 mm wide, sometimes decurrent at base (Fig. 7h); apex acute to acuminate (Fig. 7e&f); margins plane

above, \pm recurved at middle and below, unistratose, border narrow, \pm distinct, \pm entire, serrulate at apex; costa long excurrent (0.15 - 0.2 mm long) to ending below apex in lower leaves, circular to semicircular toward apex in cross section, with thick steriads, 3 - 7 ventral epidermis in two layers and 6 - 9 dorsal epidermis; upper lamina cells rhomboidal to linear rhomboidal, 30-50 (60) μ m long, 6 - 10(12) μ m wide (Fig. 7h); basal lamina cells sub quadrate or short rectangular 24 - 30 (48) μ m long, 10 - 20 μ m wide (Fig. 7i).

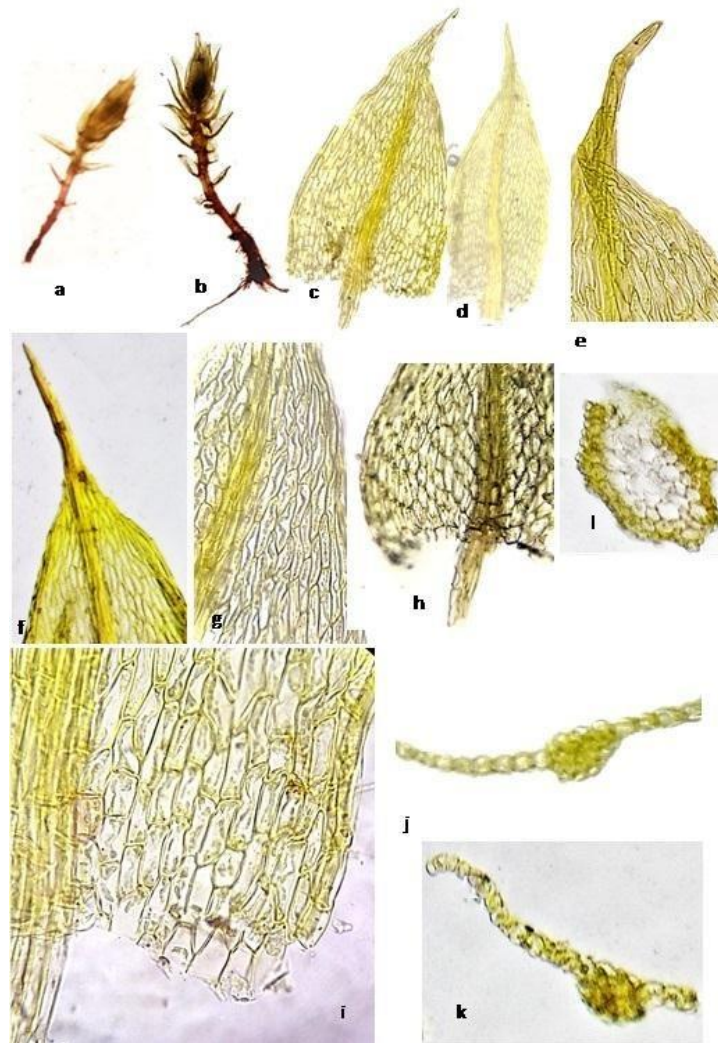


Fig. 7; *Ptychostomum archangelicum*: a- dry gametophyte. b - wet gametophyte. c, d- two forms of leaves. e, f - leaf apex. g - magnified upper leaf cells. h, i- cells at leaf base. j, k- parts of cross sections of leaf. l- cross section of stem. Scale bar = 1.6 mm (a), 1.4 mm (b), 116 μ m (c), 120 μ m (d), 127 μ m (e), 56 μ m (f), 32 μ m (g), 75 μ m (h), 45 μ m (i), 21 μ m (j), 19 μ m (k), 60 μ m (l).

***P. imbricatum* (Müll.Hal.) Holyoak & N.Pedersen**

Three gatherings (388 YLG -390 YLG), on clay and wet rocks in shade under trees.

Distribution:

In Libya; **new record to Libya**; Al Ghariga (the present work).

In the Mediterranean region; in 32 out of 34 countries (Ros *et al.*, 2013).

In the world (Fig. 8); Europe and Mediterranean region (Ros *et al.*, 2013; Hodgetts, 2015).

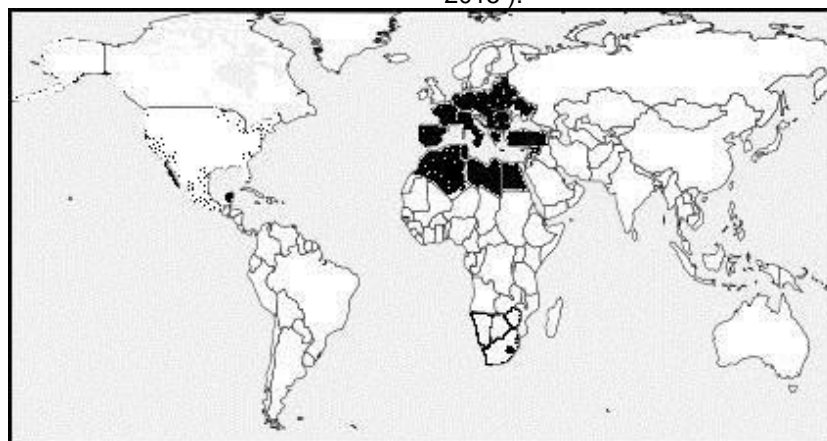


Fig. 8. Map showing the world distribution of *Ptychostomum imbricatum*

Description:

Plants sterile, olive green above and yellowish brown below, up to 15 mm high. Stem brown, unbranched (Fig. 9a&b), pentagonal in cross section, with central strand, sclerodermis clearly differentiated (Fig. 9i). Leaves more crowded at stem apex, imbricate, appressed when dry, erecto-patent to patent when moist, ovate-lanceolate, 0.5 - 0.6 mm long, 0.14 - 0.16 mm wide; apex acuminate; margins \pm entire, plane to slightly recurved, unistratose, 2 marginal rows narrower, poorly distinct border (Fig. 9d); costa long excurrent to a slightly

denticulate point up to 0.23 mm long (Fig. 9d&e), semicircular in cross section, undifferentiated, thick stiered band, 3 ventral epidermis, 7 dorsal epidermis (Fig. 9h); upper laminal cells linear rhomboidal to elongated hexagonal, narrower toward margin, 36 - 60 μ m long, 10 - 12 μ m wide (Fig. 9f); basal lamina cells quadrate, rectangular to pentagonal, 21 - 45 μ m long, 12 - 20 μ m wide, lax at basal margins (Fig. 9g). Rhizoids red brown, coarsely papillose (Fig. 9k), frequently bearing gemmae (Fig. 9j); gemmae brown, spherical, smooth, stalked, 60-85 μ m in diameter.

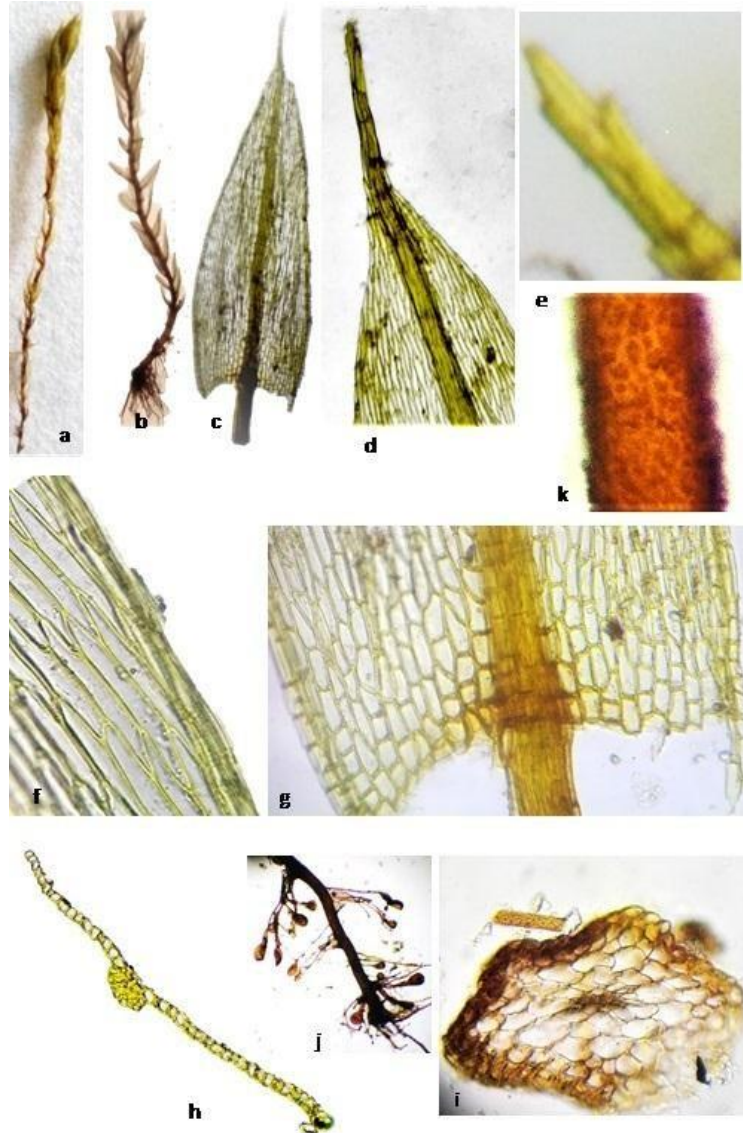


Fig. 9; *Ptychostomum imbricatum*: a- dry gametophyte. b – wet gametophyte. c- leaf. d, e- leaf apex. f- upper marginal leaf cells. g- cells at leaf base. h- cross section of a leaf. i- cross section of a stem. j- rhizoids with gemmae. k- magnified rhizoid showing papillae.

Scale bar = 2 mm (a), 2 mm (b), 80 μ m (c), 77 μ m (d), 41 μ m (e), 33 μ m (f), 48 μ m (g), 60 μ m (h), 46.5 μ m (i), 360 μ m (j), 6 μ m (k).

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رصد أنواع من الفصيلة البرياوية جديدة على الفلورا الحزازية بلبيبا

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Ptychostomum archangelicum (Bruch & Schimp.) J.R. Spence and *P. imbricatulum* (Müll. Hal.) Holyoak & N. Pedersen اللببية هما (Bruch & Schimp.) J.R. Spence and *P. imbricatulum* (Müll. Hal.) Holyoak & N. Pedersen الجديدين مع الاشارة الى التوزيع الجغرافي وتعليقات موجزة على جميع الانواع التي تم رصدها.

تحتوي الفصيلة البرياوية على ما يصل الى 2,108 نوعا منتشرة في جميع انحاء العالم. وسجل فقط تسعة انواع منها في ليبيا. والفصيلة البرياوية في ليبيا منتشرة اساسا في الشمال بالقرب من ساحل البحر المتوسط. وسجل في هذا البحث نوعان جديداً على الفلورا الحزازية