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Three New Pottiaceae Records to the Bryoflora of Libya

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THREE TAXA of Pottiaceae; *Crossidium laevipilum* Thér. & Trab., *Didymodon umbrosus* (Müll.Hal.) R.H.Zander and *Tortula brevissima* Schiffn. are new records to the moss flora of Libya bringing the number of mosses known from this country to 105 taxa. Furthermore, the present work adds 14 moss taxa to Gharyan area which raises the moss known from it to 27 taxa. Descriptions, illustrations, floristic and distribution remarks are provided for the three new records to Libya.

Keywords: Pottiaceae, Bryoflora, Libya, Gharyan, New records**.**

Introduction

Libya is located in the north of Africa on the Mediterranean coast, encompasses a geographical area estimated at about 1, 750, 000km^2, between 19–34° N and 9–26°E (Fig. 1). Libya is an area of particular interest as it includes areas which experience both Mediterranean and North African climates (semi-arid and arid climates) (Ageena et al., 2014); roughly 90.5% of the area is hyper-arid, 7.5% is arid, 1.5% semi-arid, and 0.5% is classified as sub-humid (Ben-Mahmoud, 1993); with the sub-humid region located in northeast Libya near the cities of Shahhat and Al-Bayda (Ageena et al., 2014).

The moss flora of Libya attracted the attention of a number of European botanists between the late 19th and the late 20th centuries followed by mainly Egyptian botanists in the present century. The first was Müller (1874) thereafter the work was continued by many researchers, i. e., Ascherson (1881), Baroni (1892), Durand & Barratte (1910), Hariot (1913), Zodda (1913), Bottini (1914), Zodda (1914), Pampanini (1917), Zodda (1926), Pampanini (1930-1931), Andreánszky (1934), Rungby (1962), Ochi (1972), Bizot (1973), Arts et al. (1995), Gallego et al. (1999), Ros et al. (1999), Shabbara & Youssef (2006), Youssef et al. (2009 a, b), Ros et al. (2013), Khalil & Youssef (2017), El-Saadawi et al. (2017) and Youssef et al. (2017, 2018). The list of mosses of the Mediterranean area published by Ros et al. (2013) showed that a total of 91 taxa were known from Libya. Records continued and the number of mosses known from Libya reached 102 taxa in the latest list published by El-Saadawi et al. (2017). The 102 taxa belong to 45 genera, in 16 families and 8 orders all under class Bryopsida. The 16 families (arranged in a descending order according to the number of taxa each includes) are: Pottiaceae 43 taxa, Brachytheciaceae 18, Bryaceae 11, Fissidentaceae and Funariaceae each 5 taxa, Orthotrichaceae 4, Grimmiaceae 3, Dicranaceae, Ditrichaceae, Encalyptaceae, and Mniaceae each 2 taxa, Amblystegiaceae, Fabroniaceae, Hypnaceae, Leptodontaceae and Ptychomitriaceae each one taxon.

Pottiaceae is the largest moss family not only in Libya but also in the whole world (Buck & Goffinet, 2000); it includes 3223 accepted species names (and 238 accepted infraspecific names) belonging to 138 genera (The plant List, 2013). In Libya, family Pottiaceae includes 43 taxa belonging to 16 genera representing about 42% and 35%, respectively of the total number of moss taxa and genera known from Libya. *Didymodon* Hedw. (Pottiaceae) is the largest genus recorded in Libya being represented by 7 species. Pottiaceae in Libya consists of four subfamilies, i. e., Pottioideae (20 taxa in seven genera), Merceyoideae (14 taxa in five genera), Trichostomoideae (8 taxa in three genera) and Timmielloideae (one taxon).

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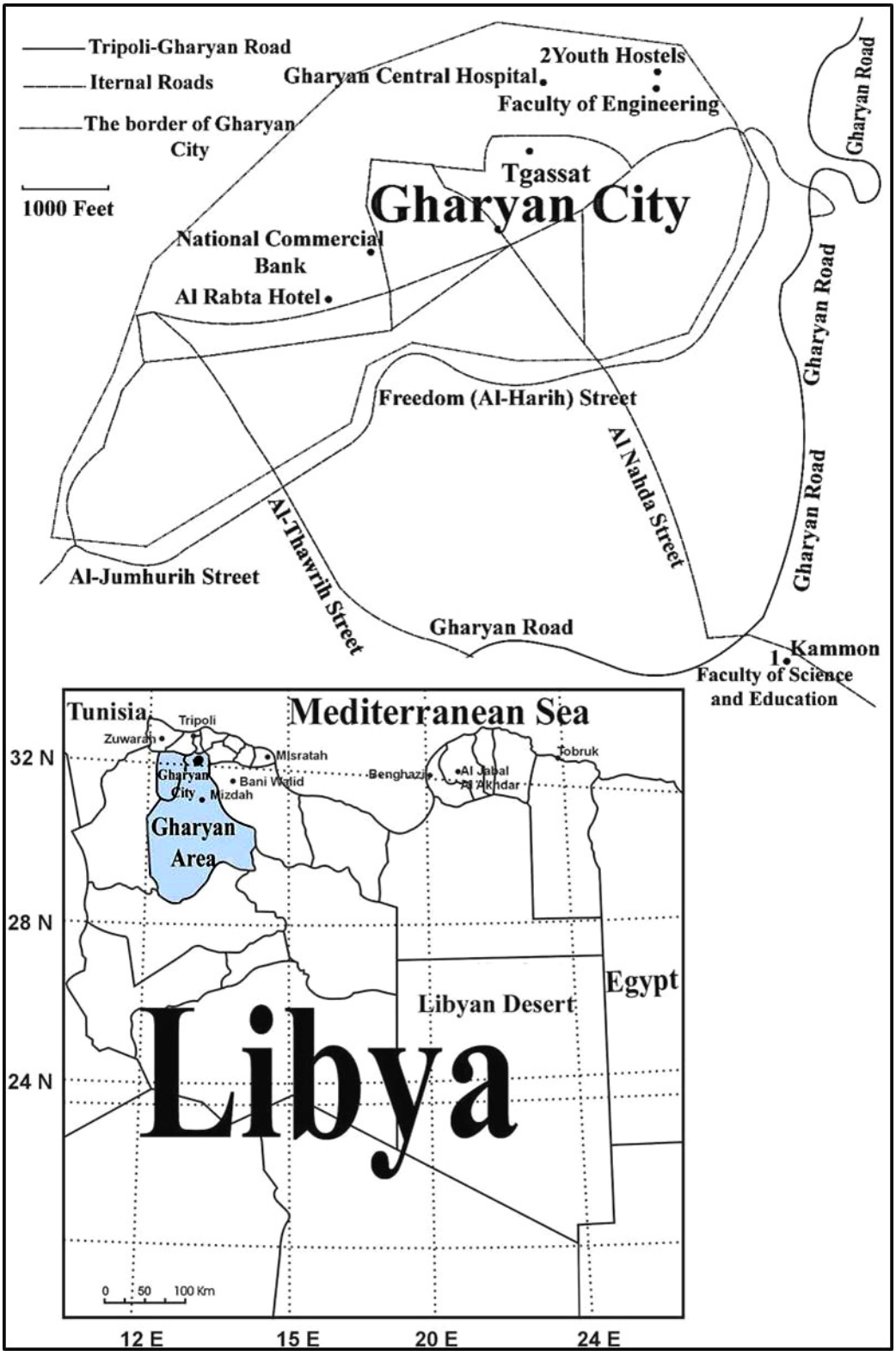

Fig. 1. Map of Libya showing the study area in Gharyan area (Al-Jabal Al-Gharbi District); 1: Faculty of Science and Education, Al-Jabal Al-Gharbi University, Kammon city and 2: Youth Hostels, Tgassat, Gharyan city.

According to Saito (1975) the large number of pottiaceous taxa and their wide spectrum of spreading all over the world were rendered to their efficient tolerance to low humidity in xeric habitats, adaptation to climatic changes, withstanding pollution conditions and exhibition

of a wide range of morphological variations. According to El- Saadawi et al. (2017) Pottiaceae exist in the north of Libya mainly at Tobruk, Darnah, Al-Qubbah, Susa (or=Soash), Shahhat, Beida (or=Al-Bayda), Al-Jabal Al-Akhdar District (i. e., Mas'sa, Haniya), Wadi Kouf, Al-Marj, Benghazi, Wadi Bey Al-Kabir (or=Wadi Belgadir), Tripoli and Gharyan (or =Gharyain) on the Mediterranean coast (Fig. 2).

The aim of the present work is to foster our knowledge about the Pottiaceae of Libya, Gharyan area (Kammon and Gharyan cities).

Study Area

The study area included Gharyan area (Al-Jabal Al-Gharbi District) of Libya. The study focused on two cities in this region namely; Gharyan and Kammon cities.

Gharyan city (Fig. 1) is the capital of Gharyan area (Al-Jabal Al-Gharbi District) and lies in northwestern Libya, about 90km south of Tripoli (Coordinates: 32°65′10″N 13°48′59″E; and about 710m above sea level). Gharyan is one of the largest towns (4660km^2) in the Western Mountains; in Al-Jabal Al-Gharbi District. Gharyan city is bordered by Jafara–north, Tarhuna and Msalata–east, Bani Walid-southeast (at a quadripoint), Mizdah–south, Yafran-west (Shahran et al., 2017; Weatherbase, 2018). Kammon city (Coordinates: 32°17′50″N 13°59′28″E; and about 665m above sea level) is located southeast of Gharyan city.

The Libyan terrain is divided into highlands, plains and desert; Gharyan area is located mainly in the highlands and partly in the desert terrains. The highlands include the Green Mountains in the north-east, the western mountains in the north-west and the Tibesti highlands in the south of the country. The Desert terrain (90% of the country land) can be divided into three sections: Western, Middle and the Eastern sections. Gharyan area is located mainly in the western mountains of the highlands terrain and partly in the western section of the desert terrain, starting from the top and all the way down to Acacus (Mossa, 2014).

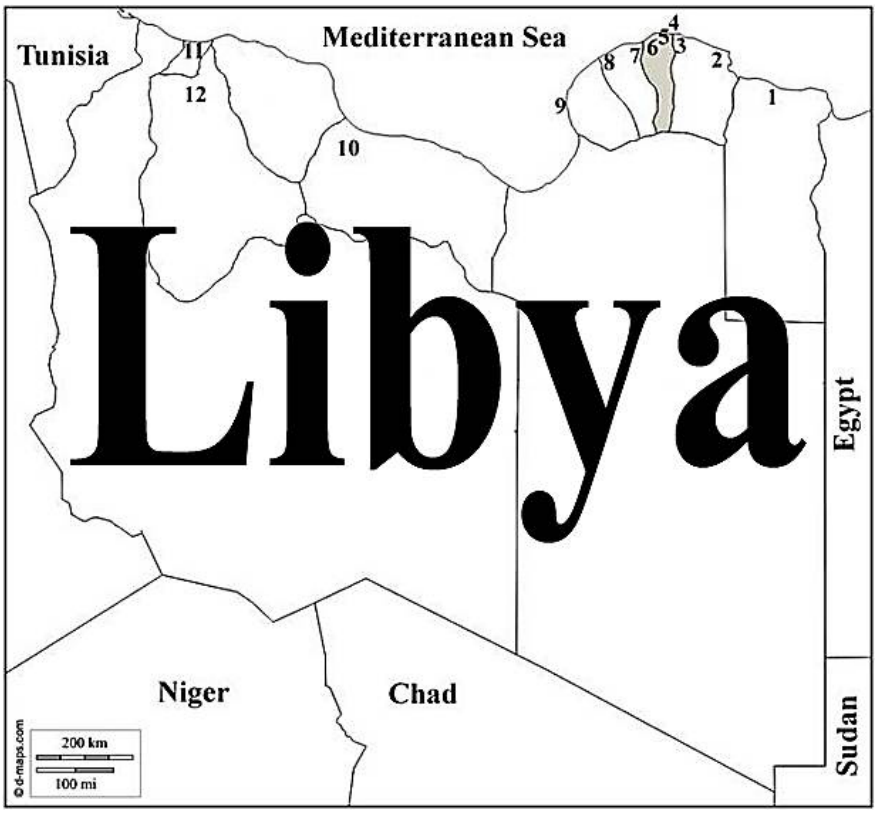

Fig. 2. Map showing the mainly sites of Pottiaceae record in Libya; 1: Tobruk, 2: Darnah, 3: Al-Qubbah, 4: Susa (or= Soash), 5: Shahhat, 6: Beida (or= Al-Bayda), 7: Wadi Kouf, 8: Al-Marj, 9: Benghazi, 10: Wadi Bey Al-Kabir (or= Wadi Belgadir), 11: Tripoli, 12: Gharyan (or= Gharyain) [Shaded area on map is Al-Jabal Al-Akhdar District (i. e., Mas'sa, Haniya)].

Generally, the climate of Gharyan area is characterized by extremely variable temperature conditions, with annual means decreasing and annual ranges increasing pole ward, and relatively little precipitation. This climate is typically located deep within the interiors of continents and is contiguous with the tropical desert climates of North and South America and of central Asia. This region type owes its origins to locations deep within continental interiors, far from the windward coasts and sources of moist, maritime air. Remoteness from sources of water vapor is enhanced in some regions by mountain barriers upwind (Weatherbase, 2018). According to Köppen (1936), the climate in Gharyan could be Mid-Latitude Steppe and Desert Climate. The average temperature for the year in Gharyan is 19.6°C. The warmest month, on average, is August with an average temperature of 27.7°C. The coldest month on average is January, with an average temperature of 10.8°C. The average amount of precipitation for the year in Gharyan is 302.3mm. The month with the most precipitation on average is January with 53.3mm of precipitation. July is the rainless month (Weather base, 2018).

But specifically, the climate of Gharyan area in January 2008 (date of collection) was as follows: Average of maximum temperature 16°C, average of minimum temperature 7°C, average of mean temperature 12°C (Wunderground, 2018).

Hitherto, the bryoflora known from Gharyan area includes 13 taxa belonging to four families, all reported by Bottini (1914); Family Bryaceae: i. e., *Bryum dichotomum* Hedw., Family Encalyptaceae: i. e., *Encalypta rhaptocarpa* Schwägr. var. *leptodon* Lindb., Family Grimmiaceae: i. e., *Grimmia orbicularis* Bruch *ex* Wilson, Family Pottiaceae: i. e., *Aloina rigida* (Hedw.) Limpr., *Crossidium squamiferum* (Viv.) Jur., *Didymodon fallax* (Hedw.) R.H.Zander, *D. insulanus* (De Not.) M.O.Hill, *D. luridus* Hornsch., *D. tophaceus* (Brid.) Lisa, *D. vinealis* (Brid.) R.H.Zander, *Pseudocrossidium hornschuchianum* (Schultz) R.H.Zander, *Tortula revolvens* (Schimp.) G.Roth and *Trichostomum crispulum* Bruch.

Materials

Field trips were carried out in January 2008 by Mahmoud Refai (Faculty of Science, Ain-Shams University). Samples were collected in two different localities in Gharyan area; i. e., the botanical garden of Faculty of Science and Education of Al-Jabal Al-Gharbi University in Kammon city (at latitude 32°44′ 48″N and longitude 13° 55′ 29″ E and 664m above sea level) and the Youth Hostels, Tgassat in Gharyan city (at latitude 32° 39′ 37″ N and longitude 13°45′ 35″ E; and 707m above sea level) (Fig. 1). A total of 6 samples were collected: 5 from Kammon city and one from Gharyan city. All of them were deposited at CAIA. Sample number was followed by the acronym "R" denoting Refai (the collector) and "L" denoting Libya.

The five Kammon city samples were with numbers 1RLa-f, 2RLa-e, 3RLa-c, 4RLa-f, 5RLa-d and the Gharyan city sample was with number 6RLa-f. Samples number 1RL and 2RL were found on thin sandy soil crust, sample 3RL grows on clay, sample 4RL on sand and on limestone and samples 5RL and 6RL on a thick layer of aggregated sandy soil.

Results and Comments

The identification of the mosses showed that they belong to 15 taxa in two families as presented in Table 1. Three out of the 15 taxa were new records to Libya which raised the number of moss taxa known from Libya to 105.

The most common species was *Tortula brevissima* because it was found in the study area five times. It comes in the second rank *Aloina ambigua*, *Bryum dichotomum* and *Didymodon umbrosus*. They were found four times in the study area. The rest of the recorded species were found only once or twice.

Most mosses known from Libya are quite old records. In this connection El- Saadawi et al. (2017) stated that more than 50% of the Libyan moss flora had been reported before 1962 and not again. This is despite the many new records to the bryoflora of Libya published by Shabbara & Youssef (2006), Youssef et al. (2009 a, b), Khalil & Youssef (2017) and Youssef et al. (2017, 2018).

The current work added three new records to the bryoflora of Libya (namely *Crossidium laevipilum*, *Didymodon umbrosus* and *Tortula brevissima*) and confirmed the existence of three taxa that are quite old records (reported before 1931) namely *Acaulon triquetrum*, *Gymnostomum*

calcareum and *Tortula atrovirens* and one taxon namely; *Aloina ambigua*, being recorded by Rungby (1962), Bizot (1973) and Gallego et al. (1999). The remaining mosses had been recorded recently by Khalil & Youssef (2017) and Youssef et al. (2018).

TABLE 1. Names of the 15 species of mosses found in Kammon and Gharyan cities (Gharyan area). Their families and sample numbers are also provided. New records are marked with an asterisk (*).

Taxa Name	Sample number					
	1a-f	2a-e	3a-c	4a-f	5a-d	6a-f
Pottiaceae taxa						
1. *Acaulon triquetrum* (Spruce) Müll.Hal.					a	
2. *Aloina ambigua* (Bruch & Schimp.) Limpr.	d	b			d	c
3. *Crossidium crassinervium* (De Not.) Jur.		c				
4. *C. squamiferum* (Viv.) Jur. var. *squamiferum*		e		c		
5. **C. laevipilum* Thér. & Trab.				e		
6. *Didymodon acutus* (Brid.) K.Saito		a				
7. **D. umbrosus* (Müll.Hal.) R.H.Zander	c		c	f		d
8. *Gymnostomum calcareum* Nees & Hornsch.						e
9. *Microbryum starckeanum* (Hedw.) R.H.Zander						f
10. *Tortula atrovirens* (Sm.) Lindb.				b		
11. **T. brevissima* Schiffn.	f	d	a	d		a
12. *T. muralis* Hedw.	a				c	
Bryaceae taxa						
1. *Bryum dichotomum* Hedw.			b	a	b	b
2. *B. radiculosum* Brid.	e					
3. *Ptychostomum imbricatulum* (Müll.Hal.) Holyoak & N.Pedersen.	b					

It is worth mentioning that all the taxa reported in this work are recorded here for the first time from Gharyan area except *Bryum dichotomum* (El- Saadawi et al., 2017). The only earlier work on Gharyan was that of Bottini (1914). The present work, therefore, adds 14 moss taxa (13 species and one variety namely; *Crossidium squamiferum* var. *squamiferum*) to Gharyan area which raises the moss known from it to 27 taxa.

In this paper only the three new records for the country were described, and illustrated. Floristic and distribution remarks were also provided for them.

Descriptions, illustrations, distribution and floristic remarks for the three new records

It is not surprising to find the three new records in Libya, such as *Crossidium laevipilum*, *Didymodon umbrosus* and *Tortula brevissima*. These species are known from North Africa and from Mediterranean countries (8, 11, 14 out of 34 countries, respectively) (Ros et al., 2013).

Crossidium laevipilum Thér. & Trab. (Plates 1, 2; Figs. 1-18)

-*Crossidium crassinervium* var. *laevipilum* (Thér. & Trab.) Delgad

Plants (Figs. 1, 2) dioecious, yellowish green (above) reddish brown (below), up to 2.5mm high (excluding seta). Stem un-branched, semi-rounded in cross section, central strand present, sclerodermis poorly differentiated (Fig. 14). Leaves tumid or turgid, erecto-patent when moist, keeled, imbricate, when dry, broad ovate to oblong, lingulate (Figs. 3-9), 0.5-1.3mm long including excurrent costa hair point (if present), 0.3-0.7mm wide; apex obtuse to rounded, cucullate (Fig. 3); margins **(**Figs. 16-17) more or less strongly recurved to revolute, entire or weakly denticulate near apex (Fig. 11); costa in upper leaves excurrent in a smooth hair (0.1-0.5mm long), as long as half lamina or shorter, costa in lower leaves mucronate to apiculate (Figs. 3, 7, 8), filaments (Figs. 15-18) thin-walled, simple, 3-9 (10) cells high, terminal cell cylindrical, conical with 2-4 short papillae (Fig. 15); upper lamina cells (Figs. 11, 12) more or less incrassate, quadrate sometimes irregularly quadrate or short rectangular 9-15 (18)µm long, 9-15µm wide, more or less papillate; basal lamina cells (Fig. 13) more or less incrassate, sub quadrate to rectangular, oblong or pentagonal, (12) 18-36 (48)µm long, 18-24µm wide, smooth. Perichaetia (Fig. 10) terminal on main axis (0.1-0.4mm long), red in color, perichaetial leaves 0.6-1mm long including hair point (0.1-0.3mm long). Sporophyte without capsule detected (calyptra present); seta up to 4.3mm long, reddish brown, cylindrical, erect, smooth; calyptra (Fig. 2) up to 2mm, cylindrical, reddish brown.

Comment: Crossidium laevipilum leaves being 0.5-1.3mm long (including hair point if present) are shorter (especially lower leaves) than those described by Heyn & Herrnstadt (2004) (0.75-1.25mm long without hair point) and longer than ones described by Cano et al. (1993) (0.4-0.7mm long).

Floristic element: according to Heyn & Herrnstadt (2004) *Crossidium laevipilum* is considered a variety of *C. crassinervium* (*C. crassinervium var. laevipilum*); Kürschner (2008) mentioned that *C. crassinervium* is a Circum-tethyan element so according to this *C. laevipilum* would be considered a Circum-tethyan element too.

Distribution (Figs. 3, 4): Afr1 (Algeria, Egypt, Morocco, Tunisia), Afr2 (Kenya), As5 (Jordan), Eur. (Baleares, Italy, Spain) (Cano et al., 1993; Zander, 1993; O'shea, 2006 and Ros et al., 2013).

Didymodon umbrosus (Müll.Hal.) R.H.Zander (Plate 3; Figs. 1-10)

-*Trichostomopsis australasiae* var. *umbrosa* (Müll. Hal.) Düll

-*Trichostomopsis trivialis* (Müll. Hal.) H. Rob.

-*Trichostomopsis umbrosa* (Müll. Hal.) H. Rob.

-*Barbula umbrosa* Müll. Hal.

-*Didymodon australasiae* var. *umbrosus* (Müll. Hal.) R.H. Zander

-*Didymodon trivialis* (Müll. Hal.) J. Guerra.

Plants (Fig. 1) sterile, yellowish green to olive green, up to 3.5mm high. Stem un-branched, rounded in cross section, central strand more or less developed, sclerodermis poorly differentiated or undifferentiated, hyalodermis present **(**Fig. 8). Leaves erecto-patent, spreading, incurved to recurved contorted when moist, keeled incurved and twisted when dry, linear, more or less long lanceolate (Figs. 2, 3), more or less slightly ovate at base 1-1.8mm long, 0.2-0.3mm wide at mid; apex narrowly acute; margins bistratose, more or less plane above (Fig. 9), plane to slightly recurved at middle (Fig. 10), unistratose below;

costa ending below apex, sometimes percurrent, superficial cells quadrate to short rectangular, semicircular or oval in cross section, with 2-4 guides, only dorsal steried band thick and large, upper epidermal cells elongated & larger than lower ones, with papillae above; upper lamina cells (Figs. 4, 5) quadrate to short rectangular, 10-14µm long & wide, with more or less papillae on both surfaces, bistratose; basal lamina cells (Figs. 6, 7) sharply differentiated across the leaf or in median region, elongated inflated at middle, quadrate, short rectangular toward margins (become narrowly toward margins) (14) 20-34 (54)µm long, 10-17 (20)µm wide.

Comment: Propagules not seen in the present specimens of *Didymodon umbrosus*. According to Juan (2006) *Didymodon umbrosus* has marginal basal cells elongated and clearly differentiated in several rows, while Crum & Eckel (1994) described the basal marginal cells of *D. umbrosus* as narrowly rectangular in several rows whereas the basal laminal cells were usually inflated, short-rectangular and usually more or less bulging. *D. umbrosus* of Libya resembles that of Mexico described by Crum & Eckel (1994).

Floristic element: Circum-tethyan (Circum-Mediterranean origin) (Kürschner, 2008); however according to Casas (1970) and Hill et al. (1992) this species may has an American origin.

Distribution (Figs. 3, 5): Afr1 (Egypt), Afr4 (Lesotho, South Africa), Am1 (United States: California, New York, Texas), Am 2 (Mexico), Am 4, Am 6, As5 (Jordan, Turkey), Eur. (Baleares, Canary Islands, France, Greece, Montenegro, Portugal, Sicily, Spain) (Magill, 1981; Zander, 1993; O'shea, 2006; Boufford, 2007 and Ros et al., 2013).

Tortula brevissima Schiffn. (Plate 4; Figs. 1-17)

Plants (Fig. 1) dioecious, reddish brown to brownish green 2-3mm high (excluding seta 7 mm; capsule ca. 2.2mm). Stem semi-rounded in cross section, central strand present, sclerodermis less differentiated (Fig. 11). Leaves erecto-patent, spreading when moist, keeled, appressed or imbricate when dry, lingulate-apiculate **(**Fig. 5), broad ovate to oblong mucronate (Figs. 2-4), 0.9-1.5mm long (including excurrent costa awn), 0.45-0.5mm wide; apex rounded, less emarginated, sometimes asymmetrical; margins (Fig. 8) more or less strongly recurved (except near distal base), papillose above, entire or nearly so below; costa strong excurrent in a smooth hair point 0.1-0.5mm long, slightly thickened and wider in upper part, semicircular in cross section, with enlarged epidermal cells on ventral surface (Figs. 9, 10), 2 guides, only dorsal steried band present; upper lamina cells (Fig. 6) quadrate sometimes irregularly quadrate or hexagonal, 7-17µm long, 10-13.5µm wide, with multifid (3-4 per lumen) c-shaped papillae on both surfaces; basal lamina cells (Fig. 7) oblong to sub quadrate or rectangular, 27-54.5 (68)µm long, 13.5-20.5µm wide, smooth. Rhizoidal gemma recorded with some variations in shape and size of as globose (Fig. 12), club or oval (widest part above and become narrowly below or at the end), 126-196µm in diameter, reddish-brown or yellowish-brown, multicellular, usually stalked. Perichaetal leaves (Fig. 13) broad oblong up to 1.6mm long; Perigonial leaves (Fig. 14) ovate to short oblong up to 1.3mm long (including hair point), antherdia in cluster green with multicellular hyaline filaments (axillary paraphyses). Seta (Fig. 1) erect, yellowish, more or less red below; capsules (Fig. 1) erect, cylinderical up to 2mm long; lid (Fig. 15) more or less long conical-rostrate, ca. 1mm long; peristome (Fig. 16) with a very short basal membrane (one cell), teeth twisted; spores (Fig. 17) smooth, rounded 7-20µm in diameter.

Comment: The present specimens of *T. brevissima* were similar to that of Spain in presence of rhizoidal gemmae, but differ in its diameter (the Libyan one were larger). According to Heyn & Herrnstadt (2004) leaves of plants growing under more favourable conditions may reach twice the length of those from arid habitats. In Germany and Israel, the length of the hair points was usually more than half of the lamina length whereas in Libya, the hair point does not reach up to half of the lamina length but in most distal leaves longer.

Floristic element: Circum-tethyan element (Circum-Mediterranean origin) (Kürschner, 2008).

Distribution (Figs. 3, 6): Afr1 (Egypt), As3 (Kyrgyzstan, Tadjikistan, Turkmenistan), As5 (Jordan, Iraq, Israel, Syria, Turkey), Eur. (Canary Islands, Corsica, France, Germany, Greece, Italy, Sardinia, Serbia, Sicily, Spain, (Agnew & Vondráček, 1975; Zander, 1993; Heyn & Herrnstadt, 2004; Ignatov et al., 2006 and Ros et al. (2013).

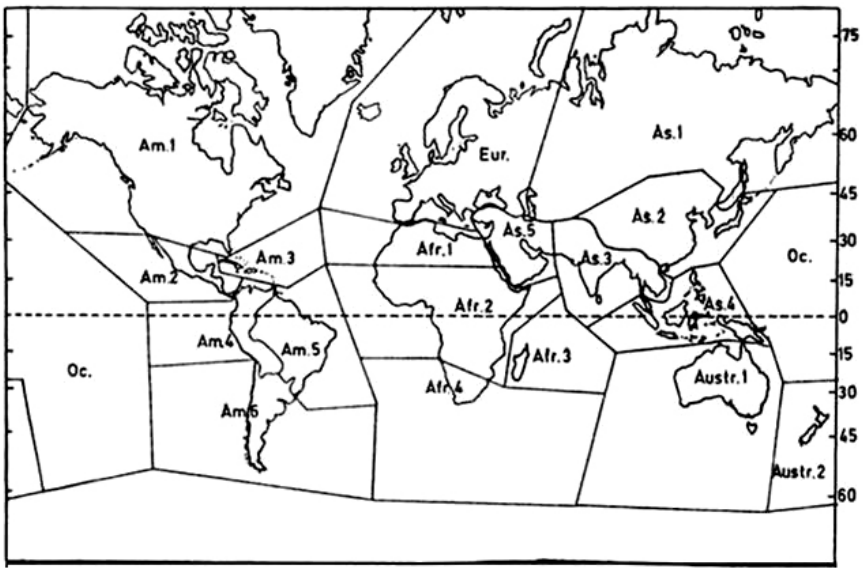

Fig. 3. A map showing phytogeographical regions of mosses of the world (after index Muscorum; Wijk, 1959-1969). Afr.1: N. Africa, Madeira, Azores, Canary Islands; Afr.2: Central Africa, St. Helena Islands; Afr.3: Madagascar, Mauritius, Reunion Islands; Afr.4: S. Africa, Kergulen Islands; Am.1: N. America, Greenland, Allutian Islands, Bermudez; Am.2: Central America; Am.3: West Indian Islands (Antilles, Greater and lesser Bhamas); Am.4: Venezuela, Colombia, Peru, Bolivia, Ecuador, Galapagos Islands; Am.5: Brazil, Paraguay, Guinea, Trinidad; Am.6: Chile, Argentina, Urugay, Falkland Islands, Continent of Antarctica; As.1: N. Asia including Sakhalin; As.2: China, Monogolia, Jaban, Korea, Formosa; As.3: India, Pakistan, Bangladesh, Ceylon, Burma, Siam, Indo-China; As.4: Indonesia, Malaya, Philippine Islands, New Guinea; As.5: Asiatic part of the Middle-east, including Cyprus; Austr.1: Australia, Tasmania; Austr.2: New Zealand; OC- Pacific Ocean Islands; Eur- Europe.

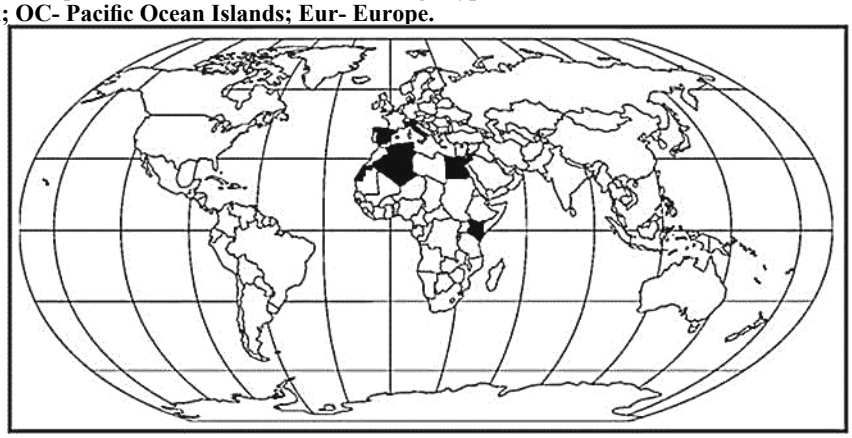

Fig. 4. A map showing distribution of *Crossidium laevipilum* Thér. & Trab.

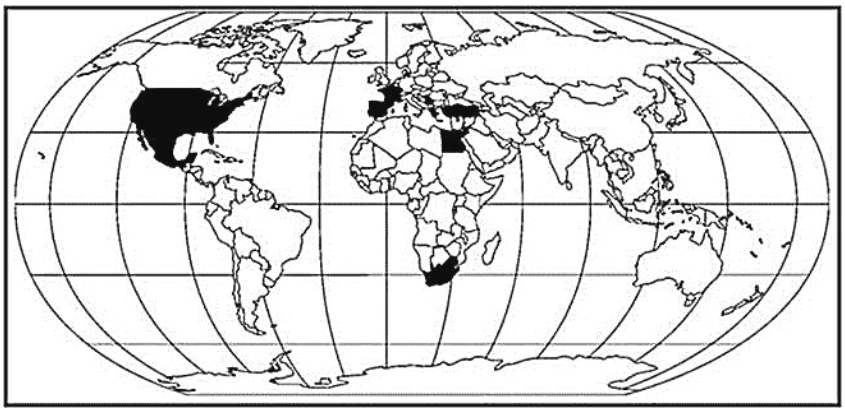

Fig. 5. A map showing distribution of *Didymodon umbrosus* (Müll.Hal.) R.H.Zander

Fig. 6. A map showing distribution of *Tortula brevissima* Schiffn.

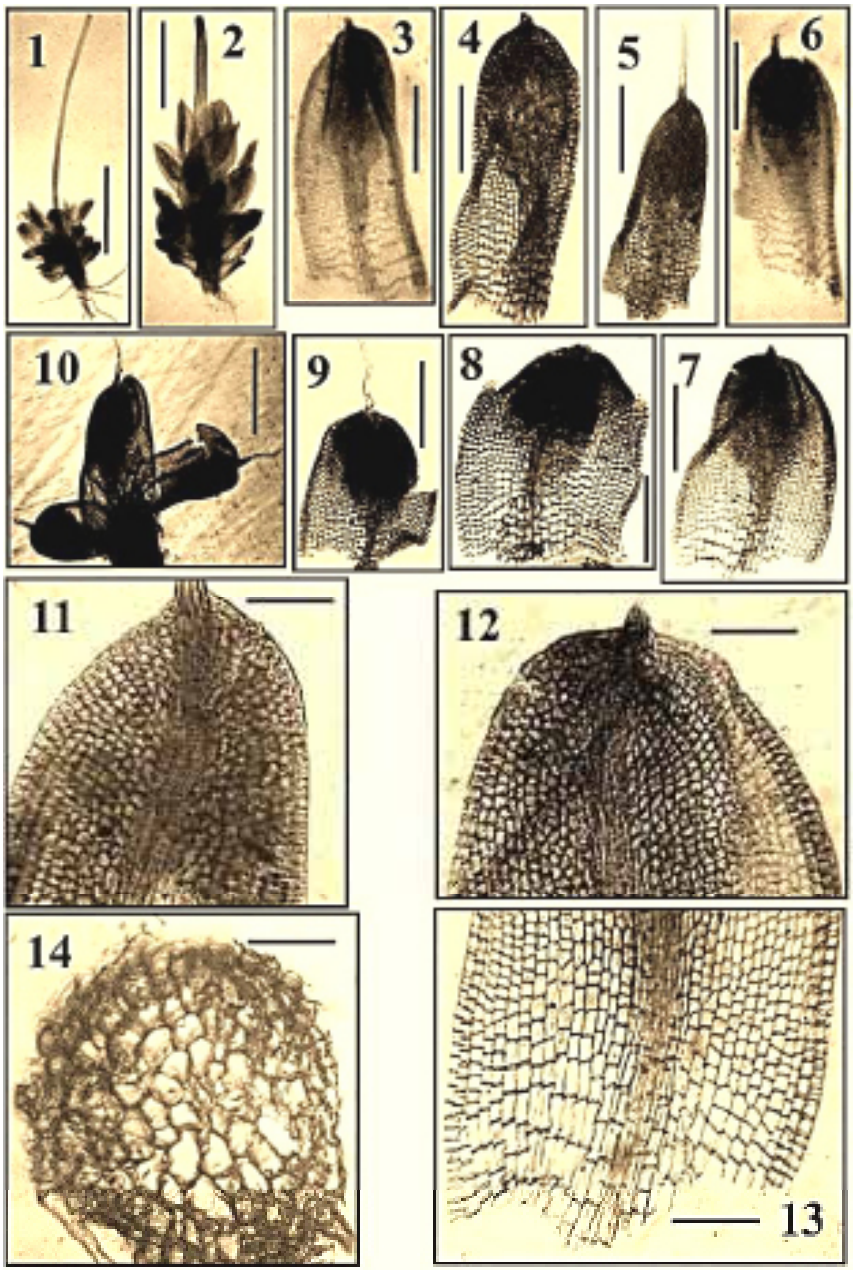

Plate 1

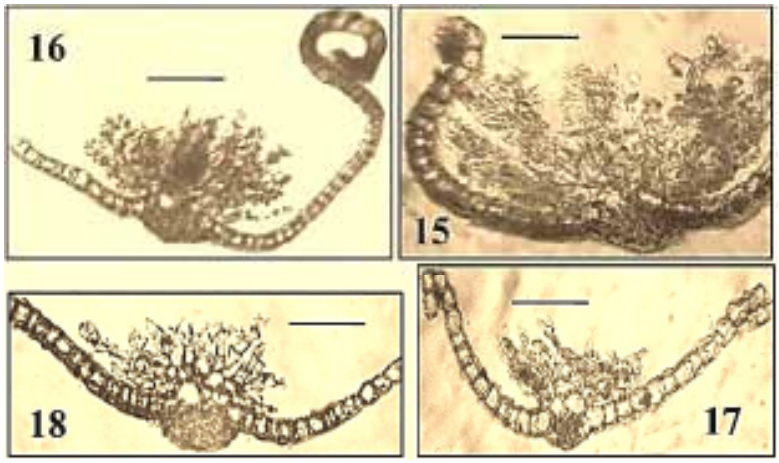

Plate 2

Plates 1, 2 (Figs. 1-18). ***Crossidium laevipilum*** **Thér. & Trab. [Scale bar: Fig. 1: Whole plant with seta= 2mm, Fig. 2: Whole plant with calyptra= 1mm, Figs. 3-9: Different leaves= 275, 206, 360, 297, 300, 210, 320µm, respectively, Fig. 10: Pericheatial leaf with archegonia= 466µm, Figs. 11, 12: Upper part of leaf= 93, 98µm, respectively, Fig. 13: Basal part of leaf= 166µm, Fig. 14: Stem section= 64µm, Fig. 15: Leaf section showing papillose terminal cell of costal filaments= 58µm, Fig. 16: Leaf section showing revolute margin= 90µm, Fig. 17: Leaf section showing recurved margin= 79µm and Fig. 18: Leaf section showing short costal filaments (3-5 cell high)= 70µm].**

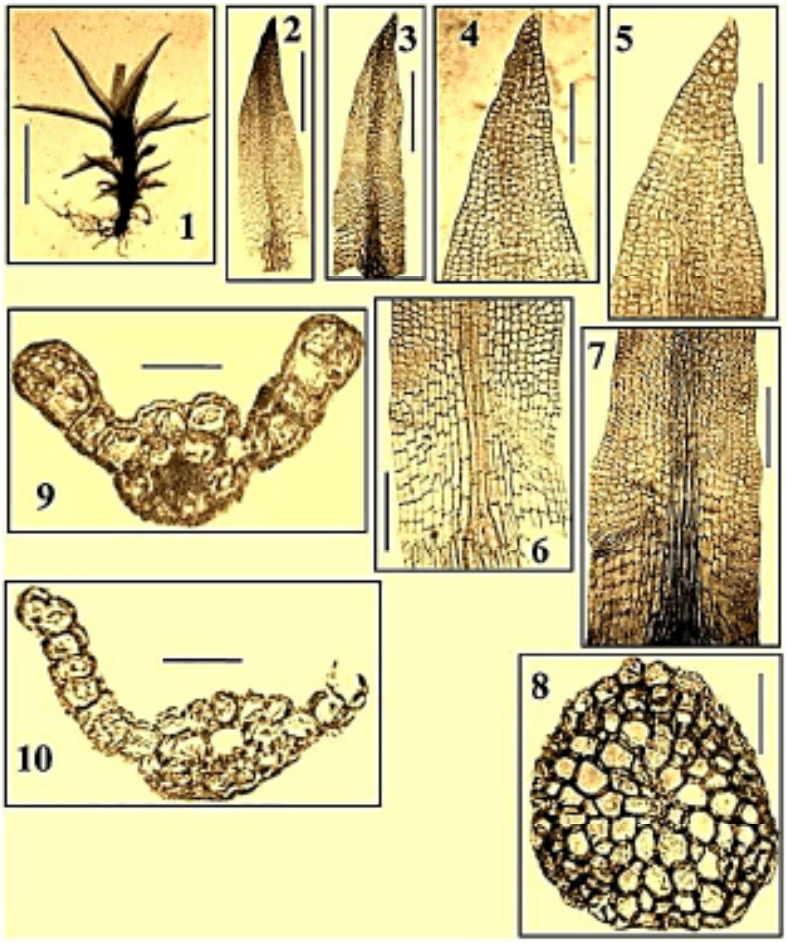

Plate 3 (Figs. 1-10). ***Didymodon umbrosus*** **(Müll.Hal.) R.H.Zander [Scale bar: Fig.1: Whole plant= 1.2mm, Fig. 2: Leaf1= 206µm, Fig. 3: Leaf2= 257µm, Fig. 4: Upper part of leaf1= 68µm, Fig. 5: Upper part of leaf2= 62µm, Fig. 6: Basal part of leaf1 showing basal cells become narrowly toward margins= 116µm, Fig. 7: Basal part of leaf2= 105µm, Fig. 8: Stem section= 43µm, Fig. 9: Leaf section at upper part showing bistratose margins= 34µm and Fig. 10: Leaf section at middle =42µm].**

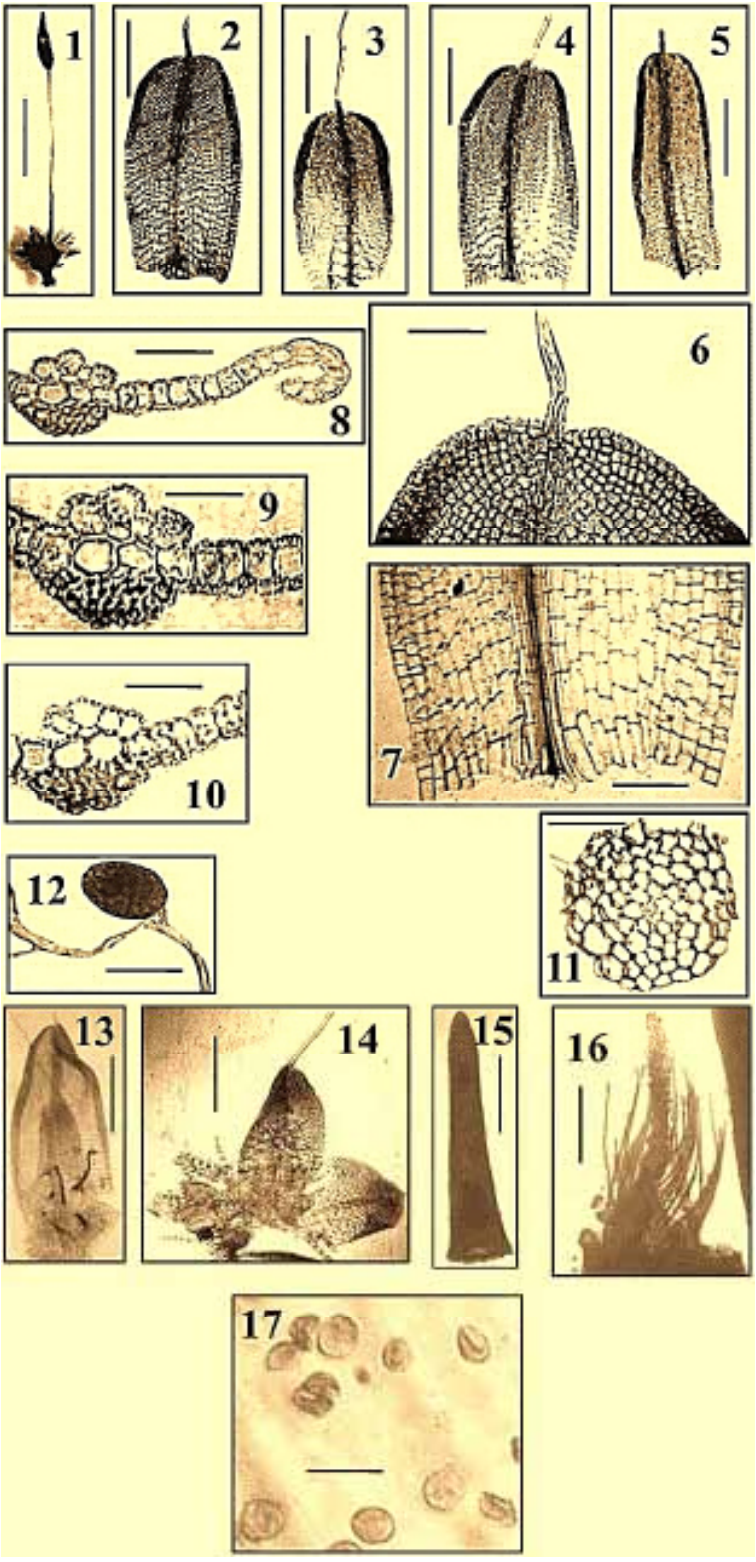

Plate 4 (Figs. 1-17). ***Tortula brevissima*** **Schiffn. [Scale bar: Whole plant= 3mm, Figs. 2-5: Different Leaves= 260, 433, 270, 425µm, respectively, Fig. 6: Upper part of leaf= 96µm, Fig. 7: Basal part of leaf= 100µm, Fig. 8: Leaf section= 66µm, Figs. 9, 10: Magnified costa sections showing enlarged epidermal cells on ventral surface= 39, 60µm, respectively, Fig. 11: Stem section= 93µm, Fig. 12: Rhizoidal gemma= 245µm, Fig. 13: Perichaetial leaves with archegonia= 521µm, Fig. 14: Perigonial leaves with antheridia= 532µm, Fig. 15: Lid =311µm, Fig. 16: Peristome teeth= 205µm and Fig. 17: Spores= 26µm.]**

Conclusion

The present work threw more light on our knowledge about Family Pottiaceae in Libya; now 48 taxa of Pottiaceae were recorded from this country (Pottioideae raised from 20 to 22 taxa and Merceyoideae from 14 to 15 taxa). The study also improved our knowledge about the moss flora of Gharyan area (raised from 13 to 27 taxa). This foregoing information showed how far the moss flora of Libya requires further exploration.

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ثلاث أنواع من الفصيلة البوتياويه جديده على الفلورا الحزازيه فى ليبيا

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ثلاث أنواع من الفصيليه البوتياويه وهى:

Crossidium laevipilum Thér. & Trab., *Didymodon umbrosus* (Müll.Hal.) R.H.Zander and *Tortula brevissima* Schiffn.

تعد تسجيلا جديدا على الفلورة الحزازيه فى ليبيا وبذلك أصبح عدد الحزازيات القائمة المسجلة بهذة الدولة 105 وحدة تصنيفية. علاوة على ذلك، يضيف العمل الحالي 14 وحدة تصنيفيه من الحزازيات القائمة إلى منطقة غريان التي ترفع عدد الحزازيات المعروفة منها إلى 27 وحدة تصنيفيه. تم وصف وتصوير وذكرملاحظات فلورية و توزيع الأنوع الثلاثه الجديدة على ليبيا.