



NOTE

Newly recorded corticolous lichens for Vietnam

Thi Thanh Van LE^{1,*}, Thanh Luc NGUYEN², Nguyen Khanh Trinh TRAM¹, Thien Tam LUONG^{1,3},
Thi Phi Giao VO¹

1. Department of Ecology-Evolutionary Biology, University of Science, Vietnam National University Ho Chi Minh City, 227 Nguyen Van Cu, District 5, Ho Chi Minh City, Vietnam. 2. Southern Institute of Ecology, Institute of Applied Materials Science, Vietnam Academy of Science and Technology, 1D, TL29 Street, Thanh Loc Ward, District 12, Ho Chi Minh City, Vietnam. 3. Biodiversity Unit, FI-20014 University of Turku, Finland. *Corresponding author's email: thanhvanle0812@gmail.com; Phone no.: +84 352250901

(Manuscript received 1 September 2023; Accepted 22 December 2023; Online published 8 March 2024)

ABSTRACT: This study contributes to the diversity of Vietnamese lichens with four new records for the country, including *Nigrovothelium bullatum* and *Pyrenula confinis* in urban areas and *Leptogium phyllocarpum* and *Gabura fascicularis* in central highlands. Amongst these, *G. fascicularis* is the first record of Arctomiaceae in Vietnam. The morphology, distribution, ecology and illustrations of all four species are provided.

KEY WORDS: Arctomiaceae, Collemataceae, Gabura, Ho Chi Minh City, new records, Pyrenulaceae, Trypetheliaceae, urban lichen.

INTRODUCTION

The first paper on the lichenized fungi (commonly known as lichen) of Vietnam dates back to 150 years ago, of Krempelhuber (1873). Thereafter, the number of recorded species had slowly arisen by sporadic reports mainly by foreign lichenologists (Müller, 1889, 1891; de Lesdain, 1908; Ahti, 1961; Culberson and Culberson, 1968; Culberson and Hale, 1973). The voucher specimens were collected by French and scattered in herbaria all over the world, such as BM, EGR, G, H, PC, TUR. After the interruption during the French colonial time and the Vietnam war, Vězda (1977) added 41 species to the epiphyllous lichens to Vietnam, including three new species, based on the collection of T. Pócs, Gy. Topál, and J. Zsolt; Ahti (1986, 1991) also examined Vietnamese specimens of *Cladonia* which included two new species. Studies on Vietnamese lichen started to bloom after the publication of the first checklist for the country by Aptroot and Sparrius (2006). They recognized 275 species and estimated 1,000 species in total to occur. Since then, several studies on various groups of Vietnamese lichens have been published not only by foreign lichenologists but also by Vietnamese ones, which resulted in 189 new records for the country and 11 new species for science (Vo, 2009; Nguyen *et al.*, 2010, 2011a,b; Jayalal *et al.*, 2013; Joshi *et al.*, 2013a,b,c,d, 2014, 2015a,b,c, 2017, 2018, 2019; Gueidan *et al.*, 2014).

Most of the surveys of Vietnamese lichens were based on specimens collected in rural or low-human-impacted areas like forests and mountains. As a result, the urban lichens have been overlooked but new things are waiting to be discovered. In 2020, we collected more than 60 species of lichens and bryophytes in Ho Chi Minh City (one of the biggest urban cities in Vietnam known as Saigon) in the project aimed to study the relationship between lichens-bryophytes and air quality. Soon after

then, records of bryophytes for Vietnam from this project were published (Nguyen *et al.*, 2021) while all lichen specimens need treating more. This paper discusses four new records for corticolous lichen in Vietnam, including two species recorded in that project together with two species from the Central Highlands.

MATERIALS AND METHODS

Materials in the study were collected in Ho Chi Minh City from 2019 to 2020, which have been preserved in the herbarium of University of Science–Vietnam National University Ho Chi Minh City (PHH), except *Leptogium phyllocarpum* (Pers.) Mont. and *Gabura fascicularis* (L.) P.M. Jørg, collected in Lam Dong Province in 2020 and 2022, respectively and deposited in the herbarium of Southern Institute of Ecology (SGN).

The identification was done with morphological and anatomical characters. Spot-test reactions on the surface of thallus were observed based on methods using potassium hydroxide solution (K) and sodium hypochlorite solution (C) (Orange *et al.*, 2001). Free-hand sections of apothecia and thallus were examined with Lactophenol cotton blue (LCB) and Lugol's Iodine (0.3% IKI) regarded as staining solutions for hyphae and ascospores in order. These processes are done with a Kruss MSZ5000-IL stereo microscope and a Nikon model eclipse E400 optical microscope. Simultaneously, microscopic details were captured by using a Leica DM750 compound microscope with an attached digital camera Leica DFC290HD. The key to genera of Bogor, Cibodas and Singapore (2003), accessed at <https://archive.bgbm.org/Sipman/keys/Javagenera.htm> and the world keys for each genus were mainly utilized if applicable. The results would be compared with original descriptions and confirmed by consultation with experts afterward.

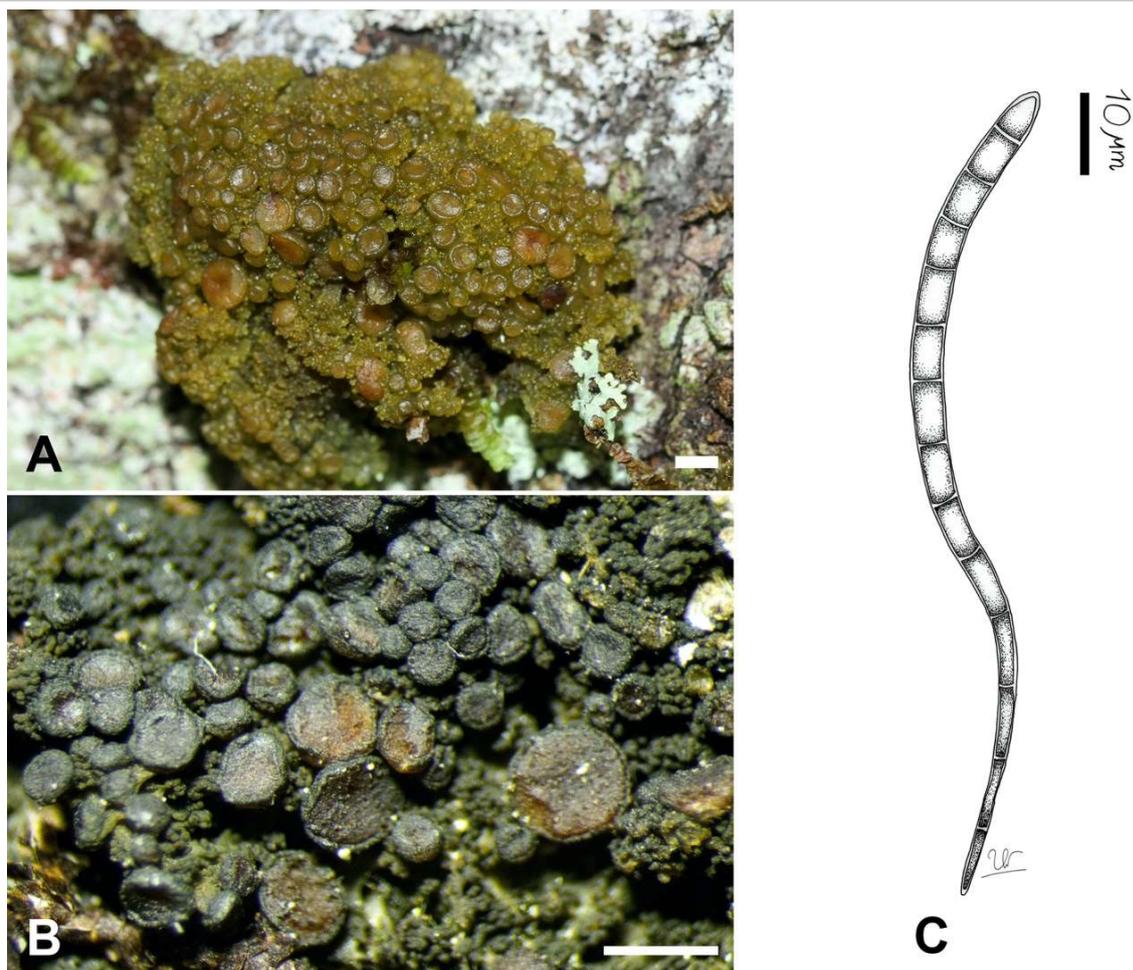


Fig. 1. *Gabura fascicularis* A. fresh thallus in the natural habitat; B. dry thallus; C. an acicular ascospore. Scale: A, B = 1 mm; C = 10 µm.

TAXONOMIC TREATMENT

Gabura fascicularis (L.) P.M. Jørg. [as 'fasciculare'], Lichenologist 46(4): 594 (2014) **Fig. 1A–C**

≡ *Arctomia fascicularis* (L.) Otálora & Wedin, Lichenologist 45(3): 302 (2013)

Thallus crustose to subfoliose, approximately 1 cm in diameter, cushion-shaped, closely attached, gelatinous, olive-green when wet, black when dry, ecorticate. Lobes undeveloped; margin indistinct. Photobiont *Nostoc*. Apothecia several, sessile, lecanorine, 0.3–0.8 mm in diam.; margin smooth. Discs concave to flat, red-brown to dark-brown when dry. Hymenium hyaline, I+ blue; epihymenium brown pigmented, I-. Asci cylindrical, 8-spored. Ascospores persistently hyaline, acicular, 90–96 × 3–6 µm, transversely 8–15 septate, with thin wall and septa.

Chemistry: Thallus K-, C-, KC-, UV-

Distribution and ecology: Its occurrence has been reported widely in mild-temperate regions and also found in Thailand's tropical forests (Aptroot *et al.*, 2007). We found this species growing on an exposed branch in the

secondary forest with sunny, semi-dry, and humid circumstances, in the central highlands of Vietnam.

Specimen examined: VIETNAM: LAM DONG. Bidoup-Nui Ba National Park, Krong No Ranger Forest Station (N12°15'43", E108°26'35"), on bark, 687 m elev., 3 May 2022, T.L. Nguyen B-2022467 (SGN).

Remarks: This is the first report of the Arctomiaceae for the country. Our material has poorly developed thallus and indistinct lobes, compared to specimens recorded in some regions. This species is separated from the *Collema* by its small size, cushion-shaped thallus and extremely narrow ascospores.

Leptogium phyllocarpum (Pers.) Mont., Anns Sci. Nat., Bot., sér. 3 10: 134 (1848)

Fig. 2A–C

Thallus foliose, corticate, wrinkled on both surfaces, gelatinous and swelling when wet, grey, sometimes pale yellow near the margin. Lobes developed, ascending. Soredia, isidia absent. Photobionts in chains of *Nostoc*. Apothecia usually near the lobe margin, sessile, 1.5–2 mm wide; disc red-brown to dark-brown, slightly concave to flat; margin thalline, with swelling, wrinkled

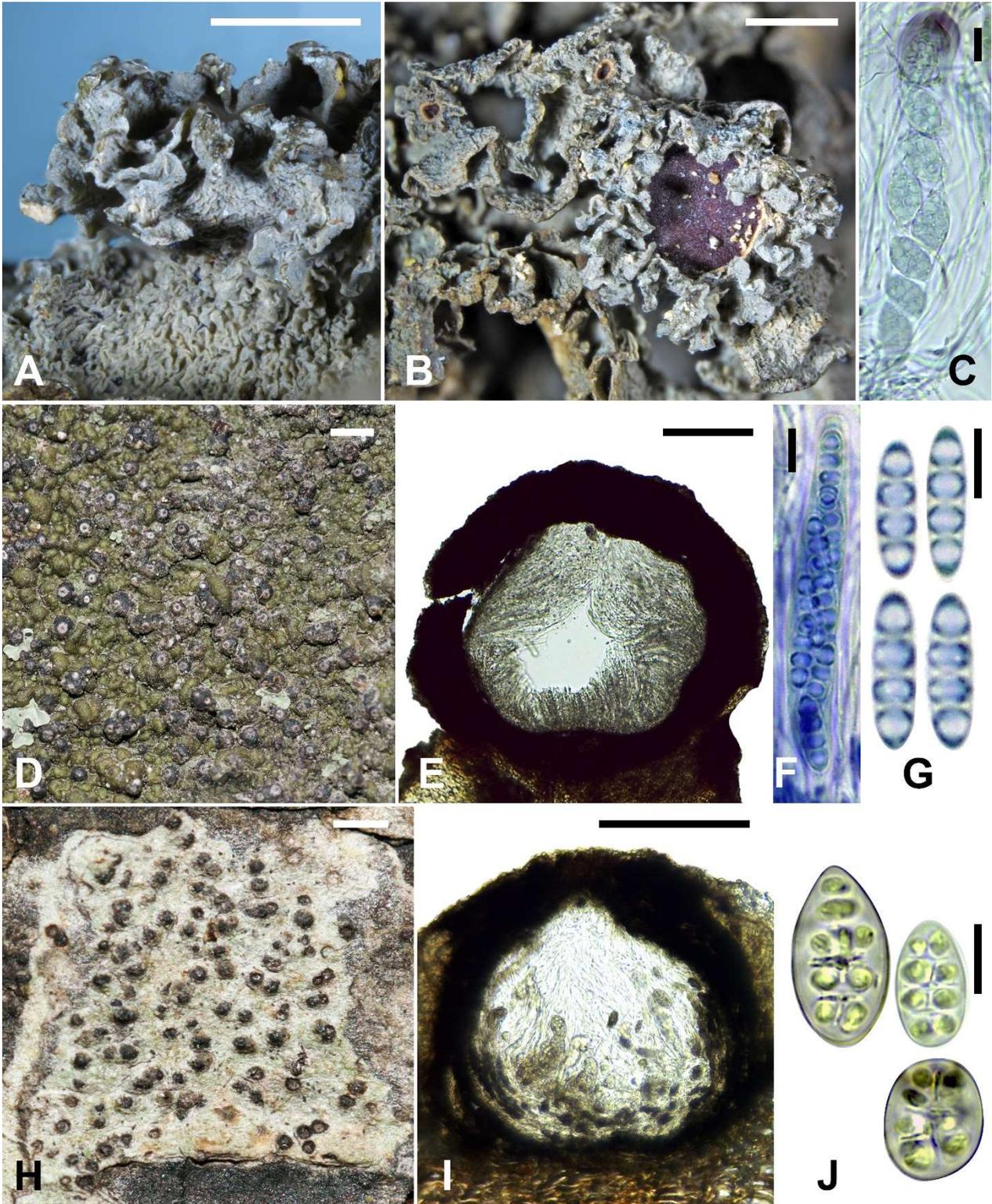


Fig. 2. A–C. *Leptogium phyllocarpum* (A, B. thallus with marginal apothecia; C. eight muriform ascospores within ascus; D–G. *Nigrovothelium bullatum* (D. habitus; E. vertical section of perithecium; F. ascus with 8 spores; G. transversely septate spores); H–J. *Pyrenula confinis* (H. habitus; I. vertical section of perithecium; J. muriform spores). Scale: A, B, D, H = 1 mm; C, F, G, J = 10 μ m; E, I = 100 μ m. (C, F, G, LPCB preparation; E, I, J, water preparation)



and persistent lobules. Hymenium hyaline; epihymenium slightly brown; hamathecium not anastomosing. Asci cylindrical-clavate, 120–140 × 15–25 µm, I+ blue in outer layer and apical structure after treating with KOH, 8-spored. Ascospores uniseriate, hyaline, 15–25 × 10–12 µm, muriform with 4–5 transverse septa, 1–2 longitudinal ones, I-.

Chemistry: Thallus K-, C-, KC-, UV-

Distribution and ecology: Its occurrence has been reported in the pantropical and subtropical areas (Nash, 2004). The Vietnamese material was found on a twig in the evergreen broad-leaved forest mixed with conifers, with the monthly average humidity around 83.9–97.1%.

Specimen examined: VIETNAM: LAM DONG. Bidoup-Nui Ba National Park, The Bidoup Forest Dynamics Plot (N 12°10'28", E108°41'12"), on twig, 1553 m elev., 10 July 2020, *T.L. Nguyen F-2020136* (SGN).

Remarks: *Leptogium phyllocarpum* can be easily distinguished by anastomosing lobes and the apothecia forming lobate thalline margin among the species of this genus in Vietnam.

Nigrovothelium bullatum Lücking, Upreti & Lumbsch, in Lücking, Nelsen, Aptroot, Benatti, Binh, Guédan, Gutiérrez, Jungbluth, Lumbsch, Marcelli, Moncada, Naksuwankul, Orozco, Salazar-Allen & Upreti, *Lichenologist* 48(6): 655 (2016) **Fig. 2D–G**

Thallus shiny, olive-green or yellow, verrucose-bullate, corticate, thick. Medulla white. Ascomata perithecial, free to fused, sessile, carbonized, exposed by a small dot; ostioles apical, separate. Hymenium not interspersed; hamathecium branched, anastomosing. Asci clavate. Ascospores hyaline, fusiform, 20–22.5 × 5–7.5 µm, 3-septate with diamond-shaped locules.

Chemistry: Thallus K-, C-, KC-, UV-

Distribution and ecology: *Nigrovothelium bullatum* was described based on specimens collected from India and Thailand (Lücking *et al.*, 2016). The specimens from Vietnam were collected on exposed bark in semi-dry to dry habitats.

Specimens examined: VIETNAM: Ho Chi Minh CITY. Thu Duc City: University of Science (N10°52'30", E106°47'49"), on the bark of *Hopea odorata* Roxb., 33 m elev., 17 February 2020, *Nguyen, Tram, Le & Vo VU20061* (PHH). District 7: Tan Thuan Export Processing Zone (N10°45'56", E106°44'58"), on the bark of *Enterolobium cyclocarpum* (Jacq.) Griseb., 3 m elev., 24 March 2020, *Nguyen, Tram, Le & Vo VU20180a* (PHH). Go Vap District: Gia Dinh park (N10°48'44", E106°40'31"), on the bark of *Hopea odorata* Roxb., 12 m elev., 18 March 2020, *Nguyen, Tram, Le & Vo VU20155* (PHH).

Remarks: All of the three *Nigrovothelium* species are present in Vietnam, including *N. tropicum* (Ach.) Lücking, M.P. Nelsen & Aptroot (Aptroot and Sparrius, 2006), *N. dispersotropicum* Aptroot & Diederich (Gotham *et al.*, in prep.), and *N. bullatum* that is newly reported here.

Nigrovothelium bullatum resembles *N. tropicum* but the latter differs in smooth thallus instead of strongly verrucose-bullate one (Aptroot and Lücking, 2016).

Pyrenula confinis (Nyl.) R.C. Harris, *More Florida Lichens*, Incl. 10 Cent Tour Pyrenol. (New York): 109 (1995) **Fig. 2H–J**

Thallus immersed to the substrate, greyish to yellowish or pale green, smooth, ecorticate, thin. Ascomata perithecial, black, solitary, open with black, apical ostioles, prominent on the thallus, emergent, carbonized. Hymenium clear; hamathecium unbranched, I-. Asci 8-spored. Ascospores brown, oval to ellipsoid with rounded ends, 15–21 × 10–13 µm, muriform, 3 transverse and frequently 2 longitudinal septa; locules rounded, lenticular.

Chemistry: Thallus K-, C-, KC+ slightly red, UV+ yellow.

Distribution and ecology: This is a pantropical species (Aptroot *et al.*, 2008). The Vietnamese specimens are observed on tree trunks in a couple of plantations at an altitude of 03–33 m.

Specimen examined: VIETNAM: Ho Chi Minh CITY. Thu Duc City: University of Science (N10°52'30", E106°47'49"), on the bark of *Mimusops elengi*, 33 m elev., 16 February 2020, *Nguyen, Tram, Le & Vo VU20034, VU20037, VU20040* (PHH). District 6: Phu Lam Park (N10°44'50", E106°37'28"), on the bark of *Peltophorum pterocarpum* (DC.) Backer ex K. Heyne, 3 m elev., 21 February 2020, *Nguyen, Tram, Le & Vo VU20102, VU20104* (PHH).

Remarks: *Pyrenula confinis* is distinguished from most *Pyrenula* species recorded in Vietnam by its brown, muriform ascospores. *Pyrenula macularis* (Zahlbr.) R. C. Harris also shares these characteristics, yet it can be distinguished from the present species by larger ascospores (longer than 30 µm) with more transverse septa (8 septa) (Aptroot *et al.*, 2008).

ACKNOWLEDGMENTS

We are deeply grateful to Robert Lücking, André Aptroot, Mónica A. G. Otálora for their support for identification, and helpful comments from Hiroshi Hadara on the manuscript. The authors thank the managers and staff of Bidoup – Nui Ba National Park for their collecting permits. This study was supported by Youth Science and Technology Development Center (project no. 25/2019/HĐ-KHCN VU), and partly by the project “Innovative Approaches to Biodiversity Discovery and Characterisation in Vietnam” (VIETBIO) under grant number 01DP17052.

LITERATURE CITED

- Ahti, T. 1961 Taxonomic studies on reindeer lichens (*Cladonia*, subgenus *Cladonia*). *Ann. Bot. Soc. Zool. Bot. Fenn.* "Vanamo" **32**(1): 1–160.
- Ahti, T. 1986 New species and nomenclatural combinations in the lichen genus *Cladonia*. *Ann. Bot. Fenn.* **23**(3): 205–220.
- Ahti, T. 1991 Some species of *Cladoniaceae* (lichenized ascomycetes) from China and adjacent countries. *Mycosystema* **4**: 59–64.
- Aptroot, A., Sparrius, L.B. 2006 Addition to the lichen flora of Vietnam, with an annotated checklist and bibliography. *Bryologist* **109**(3): 358–371.



- Aptroot, A., Saipunkaew, W., Sipman, H.J. M., Sparrius, L.B., Woleseley, P.A. 2007 New lichens from Thailand, mainly microlichens from Chiang Mai. *Fungal Divers.* **24**: 75–134.
- Aptroot, A., Lücking, R., Sipman, H.J.M., Umaña, L., Chaves, J.L. 2008 A first assessment of the lichen biodiversity inventory in Costa Rica: Pyrenocarpous lichens with bitunicate asci. *Bibl. Lichenol.* **97(100)**: 97.
- Aptroot, A., Lücking, R. 2016 A revisionary synopsis of the Trypetheliaceae (Ascomycota: Trypetheliales). *The Lichenologist* **48(6)**: 763–982.
- Consortium of Lichen Herbaria. 2023 Available from <http://lichenportal.org/portal/index.php> (Accessed on July 03)
- Culberson, W.L., Culberson, C.F. 1968 The lichen genera *Cetrelia* and *Platismatia* (Parmeliaceae). *Contr. U.S. Natl. Herb.* **34(7)**: 1–558.
- Culberson, C.F., Hale Jr, M.E. 1973 4-O-Demethylnotatic acid, a new depsidone in some lichens producing hypoprotocetraric acid. *Bryologist* **76(1)**: 77–84.
- de Lesdain, M.L.M.B. 1908 Notes lichénologiques. *Bull. Soc. Bot. France* **56(2)**: 170–175.
- Gueidan, C., Truong, V.D., Lu, N.T. 2014 Phylogeny and taxonomy of *Staurothele* (Verrucariaceae, lichenized ascomycetes) from the karst of northern Vietnam. *The Lichenologist* **46(4)**: 515–533.
- Jayalal, U., Aptroot, A., Nguyen, T.T., Dzung, N.A., Joshi, S., Oh, S.O., Hur, J.S. 2013 Further additions to the macrolichen mycota of Vietnam. *Mycotaxon* **124(1)**: 51–59.
- Joshi, S., Jayalal, U., Oh, A.O., Nguyen, T.T., Dzung, N.A., Hur, J.S. 2013a The lichen genus *Graphis* from Vietnam. *Mycotaxon* **125(1)**: 69–80.
- Joshi, S., Jayalal, U., Soon-Ok, O. H., Koh, Y. J., Nguyen, T. T., Dzung, N. A., Jae-Seoun, H. U. R. 2013b New species and new records in the family Graphidaceae (Ascomycota: Ostropales) from Vietnam. *The Lichenologist* **45(5)**: 599–609.
- Joshi, S., Nguyen, T.T., Dzung, N.A., Jayalal, U., Oh, S.O., Hur, J.S. 2013c The lichen genus *Fissurina* (Graphidaceae) from Vietnam. *Mycotaxon* **124(1)**: 309–321.
- Joshi, S., Nguyen, T. T., Dzung, N. A., Jayalal, U., Oh, S. O., Hur, J. S. 2013d New records of corticolous lichens from Vietnam. *Mycotaxon* **123(1)**, 479–489.
- Joshi, S., Jayalal, U., Oh, S.O., Nguyen, T.T., Dzung, N.A., Hur, J.S. 2014 A new species of *Graphis* and new lichen records from Vietnam, including a second worldwide report of *Sarcographina cyclospora*. *Mycobiology* **42(1)**: 17–21.
- Joshi, S., Upreti, D.K., Nguyen, T.T., Nguyen, A.D., Oh, S.O., Hur, J.S. 2015a A new species of *Fissurina* and new records of Graphidaceae from Vietnam. *Cryptogam. Mycol.* **36(4)**: 383–397.
- Joshi, S., Upreti, D. K., Oh, S. O., Nguyen, T. T., Nguyen, A. D., Hur, J. S. 2015b New records of crustose lichens and a lichenicolous *Arthonia* from Vietnam. *Mycotaxon* **130(2)**: 329–336.
- Joshi, S., Upreti, D. K., Plata, E. R., Nguyen, T. T., Nguyen, A. D., Oh, S. O., Hur, J. S. 2015c *Ocellularia lumbschii* and *O. saxicola* spp. nov. from Vietnam. *Mycotaxon* **130(3)**: 911–919.
- Joshi, S., Upreti, D.K., Hur, J.S. 2017 Key to the lichen families Pyrenulaceae and Trypetheliaceae in Vietnam, with eight new records. *Mycotaxon* **132(4)**: 957–969.
- Joshi, S., Gun, L.B., Upreti, D.K., Hur, J.S. 2018 New records of Arthoniaceae from Vietnam. *Mycotaxon* **133(1)**: 103–112.
- Joshi, S., Upreti, D.K., Hur J.S. 2019 Lichen genus *Porina* in Vietnam. *Kor. J. Mycol.* **47(4)**: 303–311.
- Knudsen, K., Kocourková, J. 2012 The annotated checklist of lichens lichenicolous and allied fungi of Channel Islands National Park. *Opuscula Philolichenum* **11**: 145–302.
- Krempelhuber, A.V. 1873 Chinesische Flechten. *Flora* **56**: 465–472.
- Lücking, R., Nelsen, M.P., Aptroot, A., Benatti, M.N., Binh, N.Q., Gueidan, C., Gutiérrez, M.C., Jungbluth, P., Lumbsch, H.T., Marcelli, M.P., Moncada, B., Naksuwankul, K., Orozco, T., Salazar-Allen, N., Upreti, D.K. 2016 A pot-pourri of new species of Trypetheliaceae resulting from molecular phylogenetic studies. *The Lichenologist* **48(6)**: 639–660.
- Muller, J. 1889 Lichenologische Beiträge XXXI. *Flora* **72**: 142–147.
- Muller, J. 1891 Lichenes Schenckiani. *Hedwigia* **30(5)**: 219–243.
- Nash, T.H. 2004 Lichen flora of the greater Sonoran desert region - Volume 2. Lichens Unlimited, Arizona State University.
- Nguyen, T.L., Luong, T.T., Tram, N.K.T., Pócs, T., Le, M.N. 2021 Bryophytes of Ho Chi Minh City, Vietnam. *Ann. Bot. Fenni.* **58(1–3)**: 101–132.
- Nguyen, T.T., Joshi, Y., Lücking, R., Wang, X.Y., Dzung, N.A., Koh, Y.J., Hur, J.S. 2010 Notes on some new records of foliicolous lichens from Vietnam. *Taiwania* **55(4)**: 402–406.
- Nguyen, T.T., Joshi, Y., Lücking, R., Nguyen, A.D., Wang, X.Y., Jin Koh, Y., Hur, J.S. 2011a Seven new records of foliicolous lichens from Vietnam. *Mycotaxon* **117(1)**: 93–99.
- Nguyen, T.T., Joshi, Y., Dzung, N.A., Hur, J.S. 2011b First report of a fertile specimen of *Coenogonium disciforme*: a species new to the Vietnamese lichen flora. *The Lichenologist* **43(2)**: 184–186.
- Orange, A., James, P.W., White, F.J. 2001 Microchemical methods for the identification of lichens. British Lichen Society.
- Sipman, H. 2003 Key to the lichen genera of Bogor, Cibodas and Singapore. Available from <https://archive.bgbm.org/Sipman/keys/Javagenera.htm> (Accessed 12 December 2018)
- Vězda, A. 1977 Beitrag zur Kenntnis foliikoler Flechten Vietnams. *Časopis Slezského Muzea, ser. A.* **26**: 21–33.
- Vo, T.P.G. 2009 New records of lichens from Vietnam. *Science & Technology Development* **12(9)**: 54–60.