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Research Article

Occurrence of 26 new additional records to the lichen biota of Assam

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ABSTRACT

The present study deals with 26 new records of lichens to Assam belonging to 14 genera, 9 families and one under *Arthoniales* from Ultapani Forest Range under Haltugaon Forest division of Kokrajhar district. The crustose lichen showed their dominance in the area with the percentage of 89% and foliose 11%. The members of *Diploschistaceae* family showed their dominance with three genera and 8 species followed by *Graphidaceae* with 6 species and *Collemataceae*, *Pyrenulaceae* and *Thelotremataceae* with two species each. The genera *Hemithecium* exhibited luxuriant growth with five species followed by *Ocellularia* with four species and *Rhabdodiscus* with three species. The present study reflects the richness of lichens in the study area. The dominance of *Diploschistaceae* and *Graphidaceae* member establishes the existence of semi-evergreen forest in the region and the presence of *Ocellularia* indicates healthy forest with ecological continuity.

Key words: Biodiversity, Graphidaceae, Kokrajhar, Lichenized fungi, Saralpara, Ultapani

INTRODUCTION

North-east India is one of the biodiversity rich region in the world which shares its landmass with two biodiversity hot spots - Himalaya and Indo-Burma (www.conservation.org). Assam, a prominent state in North-east India is sandwiched between these two biodiversity hotspots. The state is geographically positioned between 24°2′–27°6′N latitudes and 89°8′–96°E longitudes and has an area of 78,523 km^2. Although the state has witnessed a fast pace of urbanization in the recent years, but still harbors about 34% (26,832km^2) of forest area with rich floral and faunal diversity (Gupta & Sinha, 2018).

The lichens of Assam were first investigated by Stirton (1881) where he described 39 species from tea plants. Singh & Sinha (2010) enumerated 141 species of lichens from Assam in their book 'Indian lichens –An annonated checklist'. Gupta & Sinha (2018) reported 300 species of lichens belonging to 83 genera and 26 families from Assam. Thereafter, Gogoi *et al*. (2019) added 25 species of lichen species as new records to the state. Mishra *et al*. (2019) enumerated 142 lichen species from Dima Hasao district, of which 98 species were new additions to Assam. Behera *et al*. (2021) reported 138 species from Goalpara, Kamrup, Nagaon, Karbi Anglong and Golaghat from Assam, of which 37 are new to the state. Some parts of the state such as Sonitpur, Nagaon, Baksa, Kamrup and Southern Assam are fairly well explored for lichens (Choudhury *et al*., 2016a; Choudhury *et al*., 2016b; Daimari *et al*., 2014, 2017; Das *et al*., 2012; Dey *et al*., 2015; Hazarika *et al*., 2011; Rout *et al*., 2005, 2010, 2012). However, it is clear from these studies that exploration of lichen in Assam is not complete and still good number of districts and ecologically interesting areas has not yet been explored. Kokrajhar is one such district of Assam situated in the foothills of Bhutan with conducive ecological conditions for the growth of lichens, but so far only eight species of lichen are reported from here (Gupta & Sinha, 2018).Therefore, the present study has been undertaken to explore the lichens of Kokrajhar district from Ultapani Forest Range (UFR) of Haltugaon Forest Division.

MATERIALS AND METHODS

The collection of lichen was carried out from Ultapani and Saralpara of UFR of Kokrajhar district of Assam that falls under Haltugaon Forest Division. The specimens were air dried and placed in herbarium packets. The morphological characterizations were done by Leica EZ4W stereo-zoom microscope. The anatomical details of thin sections of apothecia using water and lactophenol cotton blue as mounting media were observed under Leica DM750 trinocular microscope. For the chemistry, spot tests were done using some reagents K (aqueous solution of potassium hydroxide), C (aqueous solution of calcium hypochlorite) and P (0.5g of para phenylenediamine dissolved in 5ml of ethanol). The thin layer chromatography was performed for the identification of the lichen substances in solvent system A, following Orange *et al*. (2010). Literatures (Awasthi, 2007; Upreti, 1994; Makhija & Adawadkar, 2007; Lücking *et al*., 2009; Upreti *et al*., 2011; Aptroot, 2012; Sharma *et al*., 2012; Sobreira *et al*., 2015; Jagadeesh Ram & Sinha, 2016; Joshi *et al*., 2018) were consulted for the identification of species. The nomenclature of the lichen species followed indexfungorum.org and the classification was updated following the literature of Wijayawardene *et al*. (2020). A set of voucher specimens were deposited in herbarium LWG of CSIR-National Botanical Research Institute herbarium, Lucknow.

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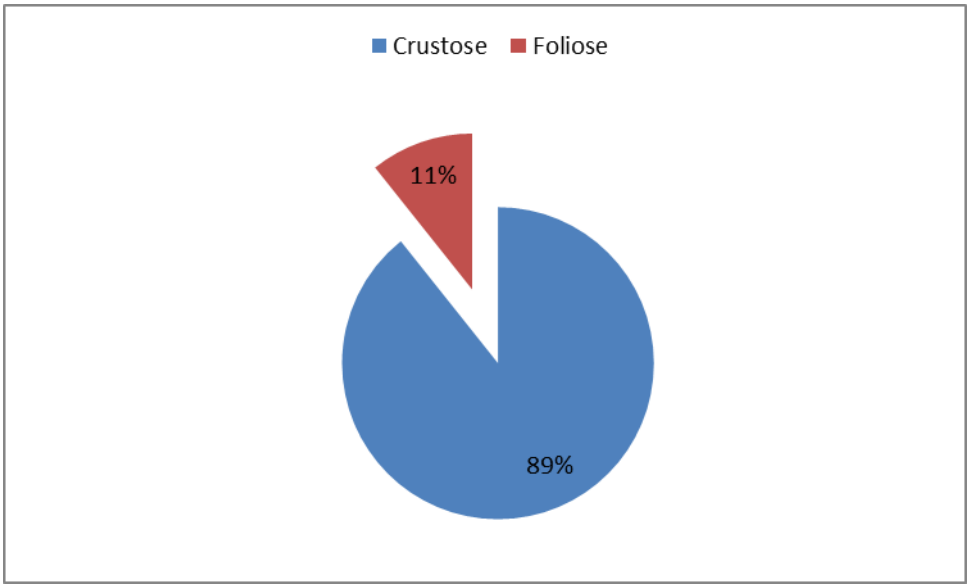

Figure 1. Representation of the growth form of lichens

RESULTS AND DISCUSSION

Enumeration of the new records

Family Arthoniaceae

1. *Myriostigma candidum* Kremp.,Lich. Foliic. Leg. Beccari: 22 (1874) (Figure 3F)
Thallus crustose, corticolous, green with black margin, lacking isidia or soredia. Photobiont layer and medulla with dense calcium oxalate crystals. Ascigerous areas or ascomata in stroma, rounded, flat, distinctly raised with densely white pruna, K-. Asci globular, 60–70 x 50–55 µm, 8-spored, frequent, aggregated in ascigerous areas and visible externally as dots. Ascospores curved shaped, thick-walled, hyaline and muriform, 46–60 x 14 –18µm.

Chemistry: Thallus K+ olive green, C+ red, P-, UV- with 2'-*O*-methylanziaic and 2'-*O*-methylperlatolic acid.

Distribution: Gabon, Netherland, Uganda, Vietnam, India (Arunachal Pradesh, Sikkim, Darjeeling).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.290′ E090°16.806′on the bark of *Syzygium fermosum*, 172 m altitude, 10/10/2020, coll. Pungbili Islary.

Incertae sedis under Arthoniales

2. *Bactrospora arthonioides* Egea & Torrente, Lichenologist 25(3): 221 (1993) (Figure 2B)

Thallus crustose, corticolous, white, glossy, apothecia round, flat and black. Excipulum thin, not inspersed IKI/KOH-, subhymenium IKI/KOH+ pale blue, paraphyses branched. Asci 60–85 x 12–14 µm, ascospores hyaline, transversely 10–16-septate without constrictions, 42–57 x 3–4 µm.

Chemistry: Thallus K-, C-, P-, UV-, no substance detected.

Distribution: Tasmania.

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.146′, E090°17.336′ on bark of *Syzygium fermosum*, 164m altitude, 14/07/2020, coll. Pungbili Islary.

3. *Bactrospora metabola* (Nyl.) Egea & Torrente, mycotaxon 53: 58 (1995) (Figure 2C)

Basionym: Melaspilea metabola Nyl., Bull. Soc. linn. Normandie, sér. 2 2: 69 (1868)
Thallus crustose, corticolous, smooth, greenish grey with carbonaceous margin, apothecia round flat and black, photobiont layer and medulla with dense calcium oxalate crystals. Excipulum and subhymenium IKI/KOH+ deep blue, hymenium without gel, paraphyses branched. Asci 150–224 x 23–33 µm, ascospores hyaline, transversely 22–36-septate, with one or more constrictions at some septa, 60–129 x 6–8 µm.

Chemistry: Thallus K+ slightly olive, C-, P-, UV-, no substance detected.

Distribution: Florida, Puerto Rico, Brazil, India (Kerala).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.011′, E090°16.929′ on the bark of *Ilex* sp., 178m altitude, 16/10/2020, coll. Pungbili Islary.

Family Collemataceae

4. *Leptogium denticulatum* Nyl., Ann. Sci. Nat., Bot., Sér. 5(7): 302 (1867) (Figure 3C)
Thallus foliose, corticolous, adnate, upper side lead grey to darker grey, lower side paler and etomentose, wrinkled slightly, lacking sorediate, isidia squamiform, lobes orbicular, 2–7 mm wide, margins isidiate. Apothecia absent.

Chemistry: Thallus K-, C-, P-, UV-, no substance detected.

Distribution: Bhutan, Colombia, Mexico, New Zealand, Taiwan and U.S.A., India (Andaman & Nicobar, Arunachal Pradesh, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Sikkim, Darjeeling, Tamil Nadu, West Bengal -hills).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.262′, E090°16.847′on the bark of *Ficus* sp., 157m altitude, 10/10/2020, coll. Pungbili Islary.

5. *Leptogium ulvaceum* (Pers.) Vain., Ann. Acad. Sci. fenn., Sér. A 15(6): 38 (1921) (Figure 3D)

Basionym: *Collema ulvacea* Pers., in Gaudichaud-Beaupré in Freycinet, Voy. Uraine., Bot. 4: 203 (1827)
Thallus foliose, corticolous, loosely adnate, lead grey, corticated on both sides, lacking isidia or soredia, lobes orbicular. Apothecia laminal, vertically stipe on the thallus, disc pale yellow, 0.6–1.8 mm wide. Epihymenium colourless to pale yellow, hymenium colourless, clear, 120–140 µm high, hypothecium colourless to pale yellow, paraphyses simple. Asci 8-spored, ascospores colourless, muriform, 30–36 x 10–12 µm.

Chemistry: Thallus K-, C-, P-, UV-, no substance detected.

Distribution: South East Asia, India (Arunachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Nagaland, Tamil Nadu).

Species examined: INDIA: Assam, Kokrajhar district, Saralpara, N26°51.009′, E090°14.588′ on bark of *Ficus* sp., 257 m altitude, 24/01/2021, coll. Pungbili Islary.

Family Diploschistaceae

6. *Nadvornikia hawaiensis* (Tuck.) Tibell, Beih. Nova Hedwigia 79: 672 (1984) (Figure 3G)

Basionym: *Acolium hawaiense* Tuck., Proc. Amer. Acad. Arts & Sci. 7: 232 (1868)

Thallus crustose, corticolous, white, spongy, glossy, smooth to uneven. Photobiont layer and medulla with dense calcium oxalate crystals. Apothecia emergent, rounded, mazaediate, 0.8–1.8 mm diam, disc exposed, appearing black and powdery due to accumulation of ascospores, margin entire to fissured and later appearing coronate, fused to partially free apically. Columella absent. Excipulum paraplectenchymatous, colorless, periphysoids absent, hymenium disintegrating, paraphyses simple. Asci 8-spored but later expelled and accumulating above asci, ascospores dark brown, transversely1-septate, oval to ellipsoid, with thick septa and walls, 6–10 × 3–5µm.

Chemistry: Thallus K+ yellow, C-, P+ light brown, UV - with stictic and constictic acid.

Distribution: Australia, Brazil, Hawaii and New Caledonia, Costa-Rica, India (Andaman & Nicobar, Karnataka).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.055′, E090°17.559′on the bark of *Syzygium fermosum*, 161m altitude, 26/07/2020, coll. Pungbili Islary.

7. *Ocellularia andamanica* (Nyl.) Tat. Matsumoto & Dequchi, Bryologist 102(1): 89 (1999) (Figure 3H

Basionym: *Thelotrema andamanicum* Nyl., Bull. Soc. linn. Normandie, Sér.2 7: 167 (1873)

Thallus crustose, corticolous, pale grey to greenish grey, slightly glossy, smooth, continuous to verruculose. Ascomata inconspicuous, round, immersed to emergent 0.1–0.3 mm wide pore. Columella absent or sometimes rarely developed. Excipulum non carbonized, hymenium clear, paraphyses simple. Asci 6–8-spored, ascospores hyaline, submuriform, subglobose to ovoid, becomes brown when maturity, 25–40 × 10–15 µm, I+ violet blue.

Chemistry: Thallus K+ pale yellow, C-, P+ yellow, UV - with psoromic acid.

Distribution: Japan, Philippines, Sri Lanka, India (Andaman & Nicobar, Western Ghats).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.253′, E090°16.842′on the bark of *Cinnamomum cicicodaphne*, 139m altitude, 10/10/2020, coll. Pungbili Islary.

8. *Ocellularia diacida* Hale Mycotaxon 7(2): 378 (1978) (Figure 4A)

Thallus crustose, corticolous, grey to greenish grey, dull to glossy, whitish to pale orange medulla. Ascomata rounded, immersed to emergent, 0.5–0.8 mm wide pore. Columella carbonized, excipulum apically carbonized, hymenium inspersed and 125–135 µm high, paraphyses simple. Asci 8-spored, ascospores hyaline, transversely 5–7-septate, lens shaped lumina, 29–38 × 7 –9 µm, I+ violet blue.

Chemistry: Thallus K+ yellowish, C-, P+ yellow, UV- with hirtifructic acid.

Distribution: Sri Lanka, India (Karnataka).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.004′, E090°17.389′on the bark of *Messua ferrea*, 173m altitude, 24/11/2020, coll. Pungbili Islary.

9. *Ocellularia terebrata* (Ach.) Müll. Arg., Flora, Regensburg 70: 398 (1887) (Figure 4B)

Basionym: *Thelotrema terebratum* Ach., K. Vetensk-Akad. Nya Handl. 33: 88 (1812)
Thallus crustose, corticolous, greyish to light yellow-olive, uneven, prosoplectenchymatous cortex. Ascomata erumpent, rounded, 0.1–0.2 mm wide pore. Columella white pruina, irregular, carbonized, exciple carbonized, hymenium clear 100–118 µm high. Asci 8-spored, ascospores hyaline, ellipsoid, transversely 5–8-septate, lens shaped lumina, 15–22 × 6–10 µm with locules, I+ violet blue.

Chemistry: Thallus K+ slightly brownish, C-, P+ yellow, UV- with psoromic acid.

Distribution: Costa Rica, India (Andaman & Nicobar Islands, Western Ghats).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.176′, E090°17.371′on the bark of *Ilex* sp., 133m altitude, 22/07/2020, coll. Pungbili Islary.

10. *Ocellularia violacea* Räsänen, Suom. Elain-ja Kasvit. Seuran Van. Tiedon. Pöytäkirjat 3: 184 (1949) (Figure 4C)

Thallus crustose, corticolous, grey-olive, dense, paraplectenchymatous cortex, photobiont layer with clusters of calcium oxalate crystals. Apothecia immersed to semi emergent, angular-rounded, disc covered by narrow, 0.1–0.2 mm wide pore, filled by brown, Columella with white-pruna, simple, carbonized, excipulum brown, hymenium clear, paraphyses simple, periphysoid sabsent. Asci 8-spored, ascospores ellipsoid, hyaline, transversely 5–6-septate, lens-shaped locules, 15–25 × 7–8 µm, I+ violet-blue.

Chemistry: Thallus K-, C-, P+ yellow, UV- with protocetraric acid.

Distribution: Costa Rica, India (Karnataka, Kerala).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°45.974′, E090°16.970′ on the bark of *Ilex* sp., 160m altitude, 16/10/2020,coll. Pungbili Islary.

11. *Rhabdodiscus asiaticus* (Vain.) Rivas Plata, Lücking & Lumbsch, Taxon 61(6): 1175 (2012) (Figure 4F)

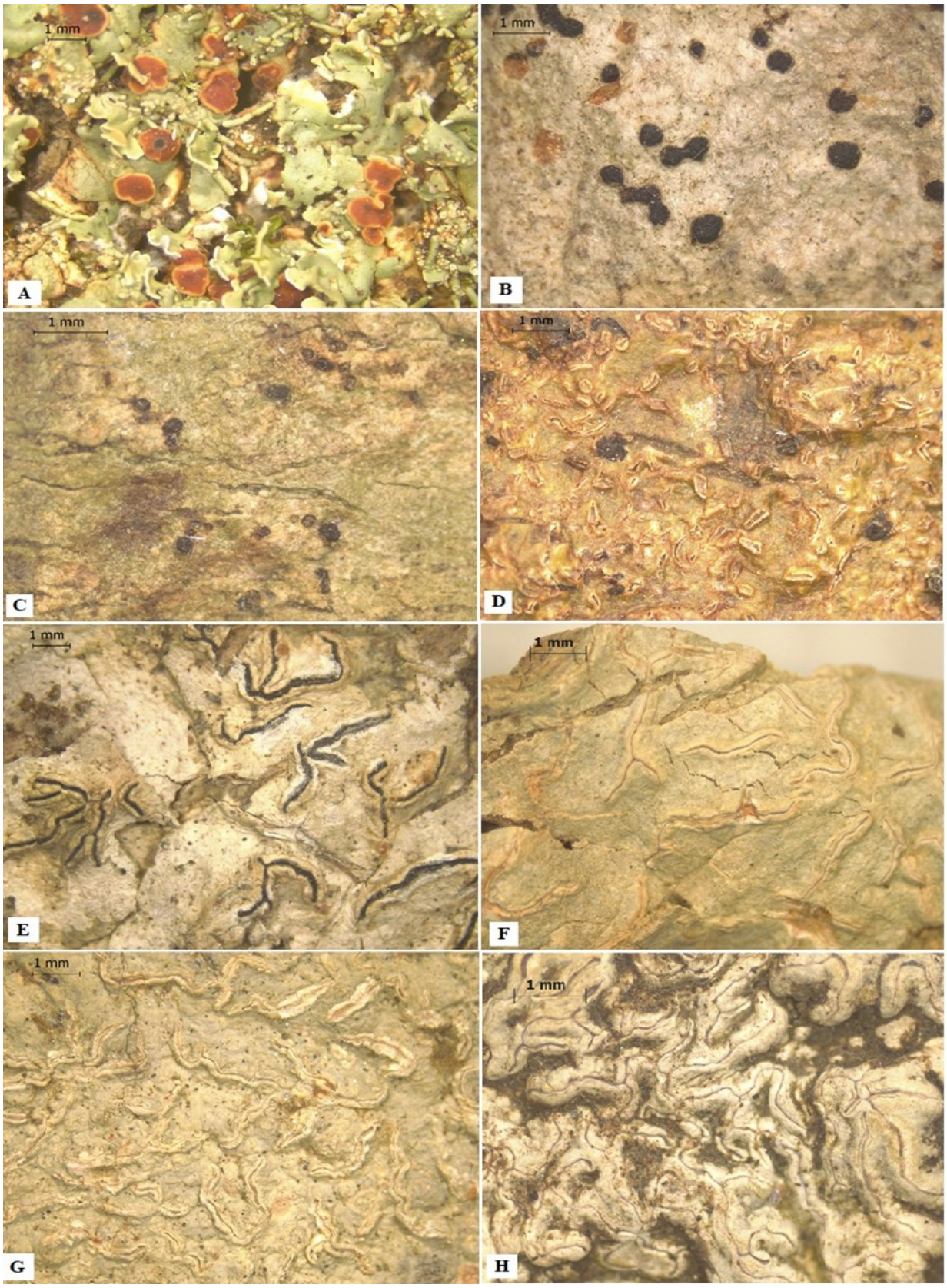

Figure 2. (A-H) Habitus A- *Anzia ornatoides*, B- *Bactrospora arthonioides*, C- *Bactrospora lamprospora*, D- *Fissurina rugosa*, E- *Graphis japonica*, F- *Hemithecium aphaneomicrosporum,* G- *Hemithecium aphanes*, H- *Hemithecium balaghatense*

Basionym: *Thelotrema asiaticum* Vain., Hedwigia 46: 175 (1907)

Thallus crustose, corticolous, corticated, greyish to pale greenish to olive, glossy, smooth. Ascomata semi-emergent to emergent, 1–2 mm wide pore, photobiont layer and medulla with crystals. Columella entirely pruinose, carbonized, exciple brownish to carbonized, Hymenium clear, I+ yellow, paraphyses simple. Asci 8-spored, ascospores hyaline, fusiform, transversely septate to indistinctly submuriform, sometimes pale brownish, 10–19 × 5–7 µm, I+ violet blue.

Chemistry: Thallus K+ slightly yellowish, C-, P+ yellow, UV- with psoromic acid.

Distribution: Thailand, India (Andaman & Nicobar, Kerala, Arunachal Pradesh).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.138′, E090°17.358′ on the bark of *Aloecarpus* sp., 152m altitude, 26/07/2020, coll. Pungbili Islary.

12. *Rhabdodiscus epitrypus* (Nyl.) Vain., Ann. Acad. Sci. fenn., Sér. A 15(6): 184 (1921) (Figure 4G)

Basionym: *Thelotrema epitrypum* Nyl., Acta Soc. Sci. fenn. 7(2): 454 (1863)

Thallus crustose, corticolous, greenish grey, smooth, glossy. Ascomata emergent,0.5–1 mm wide pore, medulla and photobiont layer with calcium oxalate crystals, columella entire with pruna and carbonized, proper exciple carbonized, hymenium clear, I+ yellow. Asci 8-spored, ascospores submuriform, hyaline to brown, transversely-septate, 15–20 × 6–8 µm, I+ violet blue.

Chemistry: Thallus K+ yellow, C-, P+ yellowish, UV- with psoromic acid.

Distribution: Thailand, India (Andaman & Nicobar, Kerala, Tamil Nadu).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.274′, E090°16.812′on the bark of *Aloecarpus* sp., 167m altitude, 10/10/2020, coll. Pungbili Islary.

13. *Rhabdodiscus marivelensis* (Vain.) Rivas Plata, Lücking & Lumbsch, Taxon 61(6): 1176 (2012) (Figure 4H)

Basionym: *Thelotrema marivelense* Vain., Ann. Acad. Sci. fenn., Ser. A 15(6): 176 (1921)

Thallus crustose, corticolous, olive green to green, glossy and smooth to verrucose, photobiont layer and medulla with calcium oxalate crystals. Ascomata emergent, 0.5–1.0 mm wide pore, columella entire with pruna amd carbonized, proper exciple carbonized, hymenium clear, I+ yellow, paraphyses simple. Asci 8-spored, ascospores hyaline, submuriform to muriform, brownish when maturity, 12–22 × 6–8 µm, I+ violet blue.

Chemistry: Thallus K+ brown, C-, P+ yellow, UV- with psoromic acid.

Distribution: Thailand, India (Kerala).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.049′, E090°16.311′ on bark of *Ilex* sp., 181m altitude, 28/10/2020, coll. Pungbili Islary.

Family Fissurinaceae

14. *Fissurina rugosa* C. Knight, Trans. New Zealand Inst. 16: 404 (1884) (Figure 2D)

Thallus crustose, corticolous, olive green to greenish brown, apothecia lirellate 0.3–1.0 mm long, semi-immersed to immersed, simple to rarely branched, disc narrow. Exciple colourless to pale yellow, not distinct at the base, hymenium clear, 56–82 µm high, paraphyses simple. Asci 8-spored, ascospores ovoid, ellipsoid to globose, outer wall jelly like, hyaline, rarely brownish at maturity, locules lens shaped to globose, transversely 3-septate, 19–21 x 6–8 µm, I+ reddish.

Chemistry: Thallus K-, C-, P-, UV-, no substance detected.

Distribution: New Zealand, India (Tamil Nadu).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.346′, E090°16.769′, on the bark of *Macaranga denticulata,*192m altitude, 10/10/2020, coll. Pungbili Islary.

Family Graphidaceae

15. *Graphis japonica* (Müll. Arg.) A.W. Archer & Lücking, Lichenologist 41(4): 437 (2009) (Figure 2E)

Basionym: *Graphina japonica* Müll. Arg., Flora, Regensburg 74: 113 (1891)

Thallus crustose, corticolous, olive green, smooth, glossy with carbonaceous margin. Ascomata lirellate, erumpent with thick lateral to complete thalline margin (*subserpentina-morph,* sensu Lücking et al. 2009). Labia entire, excipulum laterally carbonized, hymenium clear and I+ yellow. Asci 2-spored, ascospores hyaline, muriform, 73–84 x 22–28µm, I+ violet blue.

Chemistry: Thallus K+ yellow, C-, P-, UV- with stictic and constictic acid.

Distribution: Vietnam, India (Arunachal Pradesh, Darjeeling, Sikkim, Uttar Pradesh).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.352′, E090°16.760′on the bark of *Ilex* sp., 159m altitude, 10/10/2020, coll. Pungbili Islary.

16. *Hemithecium aphaneomicrosporum* Makhija & Adaw., Mycotaxon 91: 348 (2005) (Figure 2F)

Thallus crustose, corticolous, grey, smooth, photobiont layer and medulla with dense crystals, apothecia lirellate, 3.0–7.0 mm long, semi-emergent to emergent, simple and branched. Excipulum entire, brown, paraphyses simple, hymenium clear, 98–140 µm high. Asci 8-spored, ascospores hyaline, transversely 6–9- septate, 22–45 x 4–6 µm, I+ violet blue.

Chemistry: Thallus K+ yellow, C-, P+ yellow, UV- with stictic and constictic acid.

Distribution: India (Andaman & Nicobar, Arunachal Pradesh). Endemic.

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°45′55.74″, E090°17′30.01″, on the bark of *Stereospermum chelonoides*, 176m altitude, 26/06/2020, coll. Pungbili Islary.

17. *Hemithecium aphanes* (Mont. & Bosch) M. Nakan. & Kashiw., Bull. natn. Sci. Mus., Tokyo, B 29(2): 88 (2003) (Figure 2G)

Basionym: *Graphis aphanes* Mont. & Bosch, Pl. Jungh. 4: 474 (1856)

Thallus crustose, corticolous, yellowish grey, smooth, apothecia lirellate, 0.6–15.0 mm long, branched, erumpent, disc open. Excipulum entire, brown, hymenium clear, paraphyses simple. Asci 4-spored, ascospores hyaline, transversely 16–22-

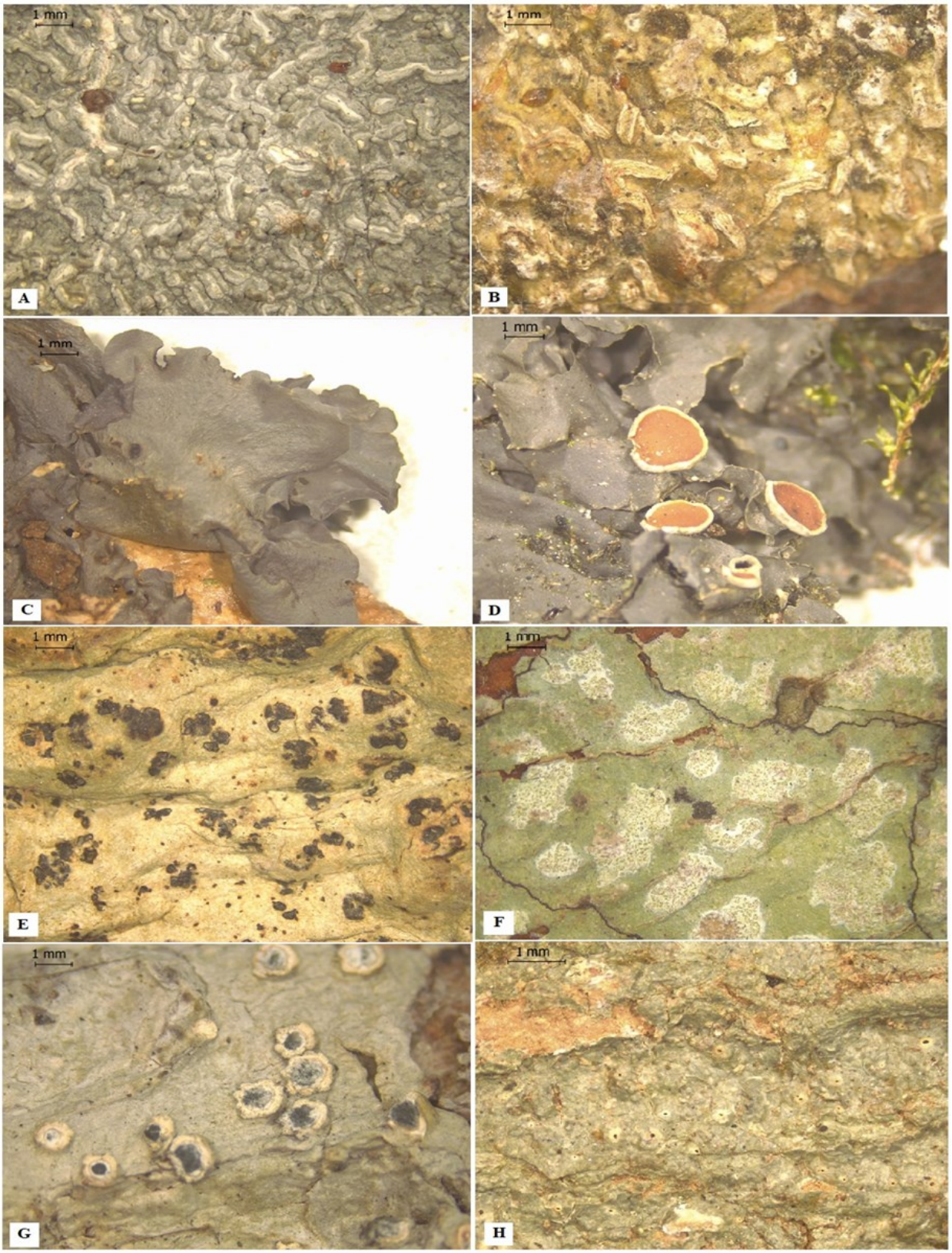

Figure 3. (A-H) Habitus A- *Hemithecium isidiatum,* B- *Hemithecium salacinilabiatum,* C- *Leptogium denticulatum*, D- *Leptogium ulvaceum,* E- *Lithothelium obtectum,* F - *Myriostigma candidum,* G- *Nadvornikia hawaiiensis,* H- *Ocellularia andamanica*

septate, 70–85 x 7–11 µm, I+ violet blue.

Chemistry: Thallus K+ yellow, C-, P+ yellow, UV- with stictic, constictic acid and norstitic acid minor.

Distribution: Australia, Bonnin Island, Indonesia, Japan, Solomon Islands and Thailand, India (Andaman & Nicobar, Arunachal Pradesh, Karnataka, Kerala, Maharashtra).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.034′, E090°18.332′ on the bark of *Syzygium fermosum*, 166m altitude, 04/03/2020, coll. Pungbili Islary.

18. *Hemithecium balaghatense* Adaw. & Makhija, Mycotaxon 92: 388 (2005) (Figure 2H)

Thallus crustose, corticolous, whitish grey to yellowish grey, smooth to verruculose, apothecia lirellate, immersed, simple to irregularly branched, covered by thalline layer, disc open. Exciple entire, brown, hymenium clear, paraphyses simple, ascospores hyaline, transversely 9–11-septate, 27–29 x 5–7 µm.

Chemistry: Thallus K+ yellow, C-, P+ slightly yellowish , UV- with stictic and norstictic acid.

Distribution: India (Madhya Pradesh). Endemic.

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°45′48.31″, E090°17′04.08″ on the bark of *Syzygium fermosum*, 153m altitude, 22/12/2019, coll. Pungbili Islary.

19. *Hemithecium isidiatum* Upreti & U. Dubey, Lichenologist 43(5): 483 (2011) (Figure 3A)

Thallus crustose, corticolous, grey, smooth to verrucose, glossy, with black margin, isidiate, spreading on the thallus, concolorous, simple to coralloid branched, easily detachable, 0.2–0.3 mm diam. and 0.2–1.5 mm high. Apothecia lirellate, grey, emergent, simple and branched, long, disc open and closed. Excipulum pale yellowish brown, hymenium clear, hypothecium pale yellow, epihymenium dark brown. Spores not seen.

Chemistry: Thallus K+ reddish, C-, P+ yellow, UV- with salazinic acid

Distribution: India (Arunachal Pradesh). Endemic.

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.176′, E090°17.371′, on the bark of *Ilex* sp., and *Syzygium fermosum*, 189m altitude, 14/07/2020, coll. Pungbili Islary.

20. *Hemithecium salacinilabiatum* (Patw. & C.R. Kulk.) Chitale & Makhija, Mycotaxon 108: 88 (2009) (Figure 3B)

Basionym: *Graphina salacinilabiata* Patw. & C.R. Kulk., Biovigyanam 5(1): 6 (1979)

Thallus crustose, corticolous, olive green, smooth to verruculose, glossy, photobiont layer and medulla with dense crystals, apothecia lirellate, 2.0–4.0 mm long, simple and branched, covered by thalline layer, disc open, 2–4 striate. Excipulum non-carbonized, hymenium clear, asci 1-spored, ascospores hyaline, muriform, 165–197 x 65–72 µm.

Chemistry: Thallus K+ brownish yellow, C-, P+ slightly yellow, UV- with salazinic acid

Distribution: India (Kerala, Karnataka, Maharashtra). Endemic.

Species examined: INDIA: Assam, Kokrajhar district, Saralpara, N26°51.009′, E090°14.619′, on the bark of *Syzygium fermosum*, 247 m altitude, 05/01/2021, coll. Pungbili Islary.

Family Parmeliaceae

21. *Anzia ornatoides* Yoshim. Biblioth. Lichenol., 58: 459 (1995) (Figure 2A)

Thallus foliose, corticolous, smooth, dorsiventral, lobulate, heteromerous, lower side spongy with reticulate anastomosing thick, corticated only on upper side, medulla white and solid, P-, K-, C-, KC-, isidia simple, 1.0–5.0 mm long, concolorous, spreading on the thallus, apothecia laminal, 1.0–3.0 mm wide, disc brown, widened when maturity, margin pale yellow. Excipulum colourless to pale yellow, epihymenium pale yellow, hypothecium colourless. Asci multi-spored, ascospores hyaline, transversely 6–10-septate, 32–44 x 2–4 µm.

Chemistry: Thallus K+ brownish yellow, C-, P+ slightly yellow, UV- with stictic and lobaric acid.

Distribution: Papua New Guinea, India (Arunachal Pradesh).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.098′, E090°17.098′on the bark of *Mangifera sylvatica*, 196m altitude, 24/11/2020, coll. Pungbili Islary.

Family Pyrenulaceae

22. *Lithothelium obtectum* (Müll. Arg.) Aptroot, Biblioth. Lichenol. 44: 62 (1991) (Figure 3E)

Basionym: *Sagedia obtecta* Müll. Arg., Linnaea 43: 42 (1880)

Thallus crustose, corticolous, greenish grey or to brownish grey, dull to slightly glossy, photobiont layer with dense crystals, perithecia black, erumpent, hemispherical, irregular in shape to shortly elongate, 0.4–1.0 mm diam., solitary and 2–5 fused together with ostioles, ostioles brown and lateral, peridium black carbonized, paraphyses simple. Asci 8-spored, 60–80 x 8–12 µm, ascospores hyaline, fusiform, transversely 3-septate, with subacute ends, distoseptate, locules rounded.10–13 x 4–6 µm.

Chemistry: Thallus K+ brown, C-, P+ slightly yellowish, UV-, no substance detected.

Distribution: Thailand, Vietnam, India (Andaman & Nicobar, Arunachal Pradesh, Karnataka, Maharashtra).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°45′55.74″, E090°17′30.01″ on the bark of *Stereospermum chelonoides*, 161m altitude, 26/02/2020, coll. Pungbili Islary.

23. *Pyrenula maravalensis* Vain., Proc. Amer. Acad. Arts & Sci. 58(3): 132 (1923) (Figure 4E)

Thallus crustose, corticolous, reddish brown with brown to black margin, photobiont layer and medulla with clusters of crystals, perithecia solitary, ostiole mostly apical, peridium carbonized, not spreading laterally, hymenium inspersed, paraphyses simple. Asci 8-spored, ascospores brown, oval, with papillate ends, transversely 3-septate, 18–25 x 7–10 µm.

Chemistry: Thallus K+ reddish, C-, P-, UV-, no substance detected.

Distribution: India (Arunachal Pradesh, Kerala). Endemic.

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46′03.41″, E090°18′33.25″ on bark of *Syzygium fermosum*, 149m altitude, 04/03/2020, coll. Pungbili Islary.

Distribution: North-West England, West Scotland,

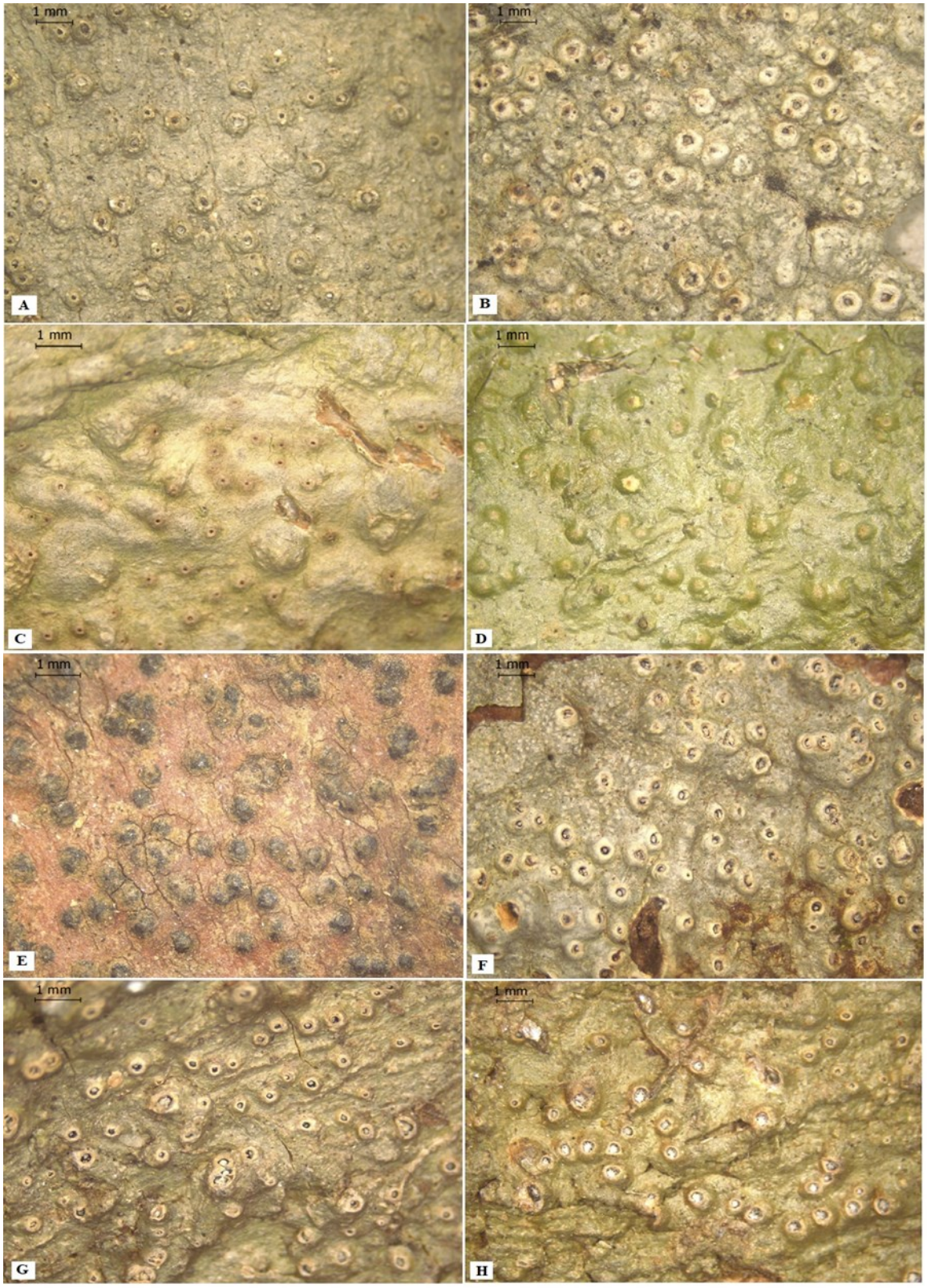

Figure 4. (A-H) Habitus A- *Ocellularia diacida,* B- *Ocellularia terebrata,* C- *Ocellularia violacea,* D- *Porina subcutanea,* E- *Pyrenula maravalensis,* F- *Rhabdodiscus asiaticus,* G- *Rhabdodiscus epitrypus,* H- *Rhabdodiscus marivelensis*

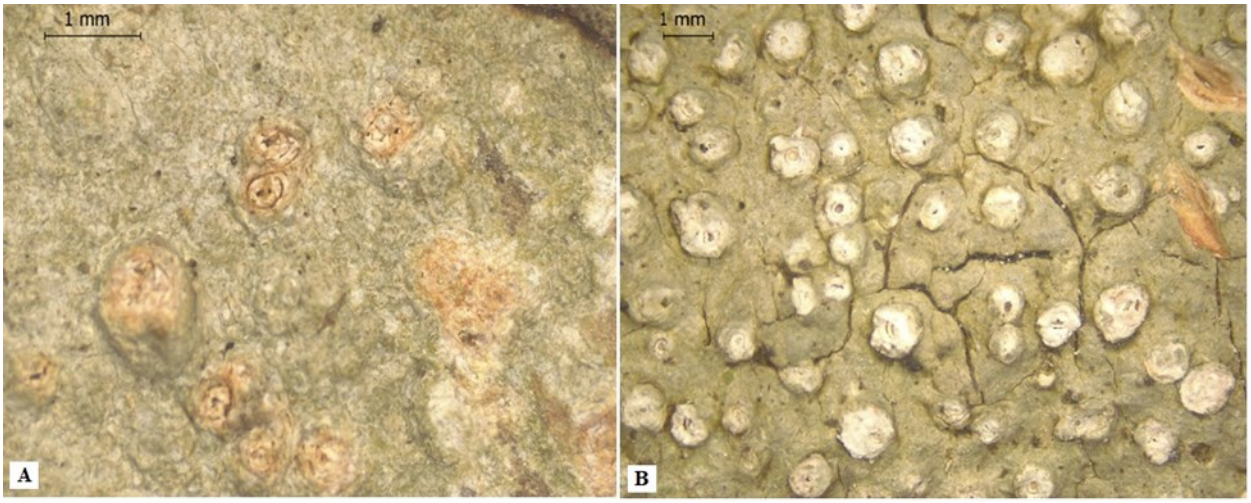

Figure 5. (A-B) Habitus A- *Thelotrema lepadinum,* B- *Thelotrema porinoides*

South West Ireland and North America.

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.054′, E090°17.081′ on the bark of *Ilex* sp., 179m altitude, 24/11/2020, coll. Pungbili Islary.

Family Thelotremataceae

24. *Thelotrema lepadinum* (Ach.) Ach., Methodus, Sectioprior: 132 (1803) (Figure 5A)

Basionym: *Lichen lepadinus* Ach., Lich. Suec. Prodr.: 30 (1799)

Thallus crustose, corticolous, greenish grey to olive green, smooth to uneven, with irregular, compact cortex, thalline margin entire, black to carbonized, photobiont layer with calcium oxalate crystals. Apothecia prominent, rounded, 0.5–1.2 mm diam, disc 0.3–0.5 mm wide pore, pale brown, white-pruinose, proper margin entire, pale brown, undulate, gap in between of double margin. Columella absent, excipulum colourless, Hymenium clear, I+ yellow, periphysoids present, paraphyses simple. Asci 4-spored, ascospores muriform, colorless, 65–83 × 17–27 µm, I+ violet-blue.

Chemistry: Thallus K+ brownish yellow, C-, P-, UV-, no substance detected.

Distribution: Costa-Rica, India (Karnataka, Kerala, Eastern Himalaya, Tamil Nadu).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.042′, E090°17.094′ on bark of *Ilex* sp., 183m altitude, 24/11/2020, coll. Pungbili Islary.

25. *Thelotrema porinoides* Mont. & Bosch, Pl. Jungh. 4: 484 (1856) (Figure 5B)

Thallus crustose, corticolous, greenish grey to olive grey, smooth to uneven, with irregular, compact cortex, thalline margin entire, black to carbonized, photobiont layer with calcium oxalate crystals. Apothecia prominent, rounded, 0.8–2.0 mm diam, disc 0.2–0.5 mm wide pore, white-pruinose, proper margin entire, gap in between of double margin. Columella absent. excipulum colourless, Hymenium clear, I+ yellow, periphysoids present, paraphyses simple. Asci 8-spored, ascospores oblong, colorless, transversely 21–23-septate, with thick septa and locules rounded, 101–150 × 12–17 µm, I+ violet-blue.

Chemistry: Thallus K+ brownish yellow, C-, P+ yellowish, UV- with stictic and constictic acid.

Distribution: Costa Rica, Jawa, India (Andaman & Nicobar, Tamil Nadu).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.087′, E090°17.113′, on the bark of *Lianas* sp., 147m altitude, 24/11/2020, coll. Pungbili Islary.

Family Trichotheliaceae

26. *Porina subcutanea* Ach., Syn. Meth. Lich.: 113 (1814) (Figure 4D)

Thallus crustose, corticolous, corticated, green with black margin, shiny, photobiont layer with dense crystals, perithecia subglobose, 0.3–1.0 mm diam., completely covered with thallus, ostiole black, K–, involucrellum incurving toward the excipulum, black at the top, centrum globose, excipulum pale yellow, paraphyses simple and slightly wavy. Asci 8-spored, ascospores hyaline, oblong to ellipsoid, transversely 6–10-septate, 62–77 x 11–16 µm, I+ reddish.

Chemistry: Thallus K+ yellowish, C-, P-, UV-, no substance detected.

Distribution: India (Andaman & Nicobar, Arunachal Pradesh, Goa, Karnataka, Kerala, Manipur, Sikkim, Tamil Nadu and West Bengal).

Species examined: INDIA: Assam, Kokrajhar district, Ultapani, N26°46.054′, E090°17.081′, on the bark of *Ilex* sp., 142m altitude, 24/11/2020, coll. Pungbili Islary.

DISCUSSION

Addition of 26 species as new records to the lichen biota of Assam within Ultapani Forest Range of Kokrajhar district, Assam clearly indicates the richness in the area with favourable ecological conditions. The area exhibited dominance of crustose lichen (89%) followed by foliose lichen (11%). Of these recorded species *Diploschistaceae* was dominant family with eight species followed by *Graphidaceae* with 6 species and *Collemataceae*, *Pyrenulaceae* and *Thelotremataceae* with two species each. Based on these observations, it is clear that the study area provides suitable condition for the diverse colonization of lichens. Many more regions of the state needs to be explored to contribute more taxa to the lichen biota of Assam. These exploration not only will add more taxa but also will act as a baseline data

for carrying out future survey related to biomonitoring and bioprospecting studies in the field of lichenology. With the addition of 26 new records, the number of lichen species of Assam has reached to 525. However most of the areas under the forest range have been cleared for human settlement which is a threat to lichens of the region. Therefore, it necessitates conservation of the region so as to protect the lichen biota along with other flora and fauna.

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