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Additional lichen records of Graphidaceae for Manipur, Meghalaya and Nagaland, North-East India

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ABSTRACT

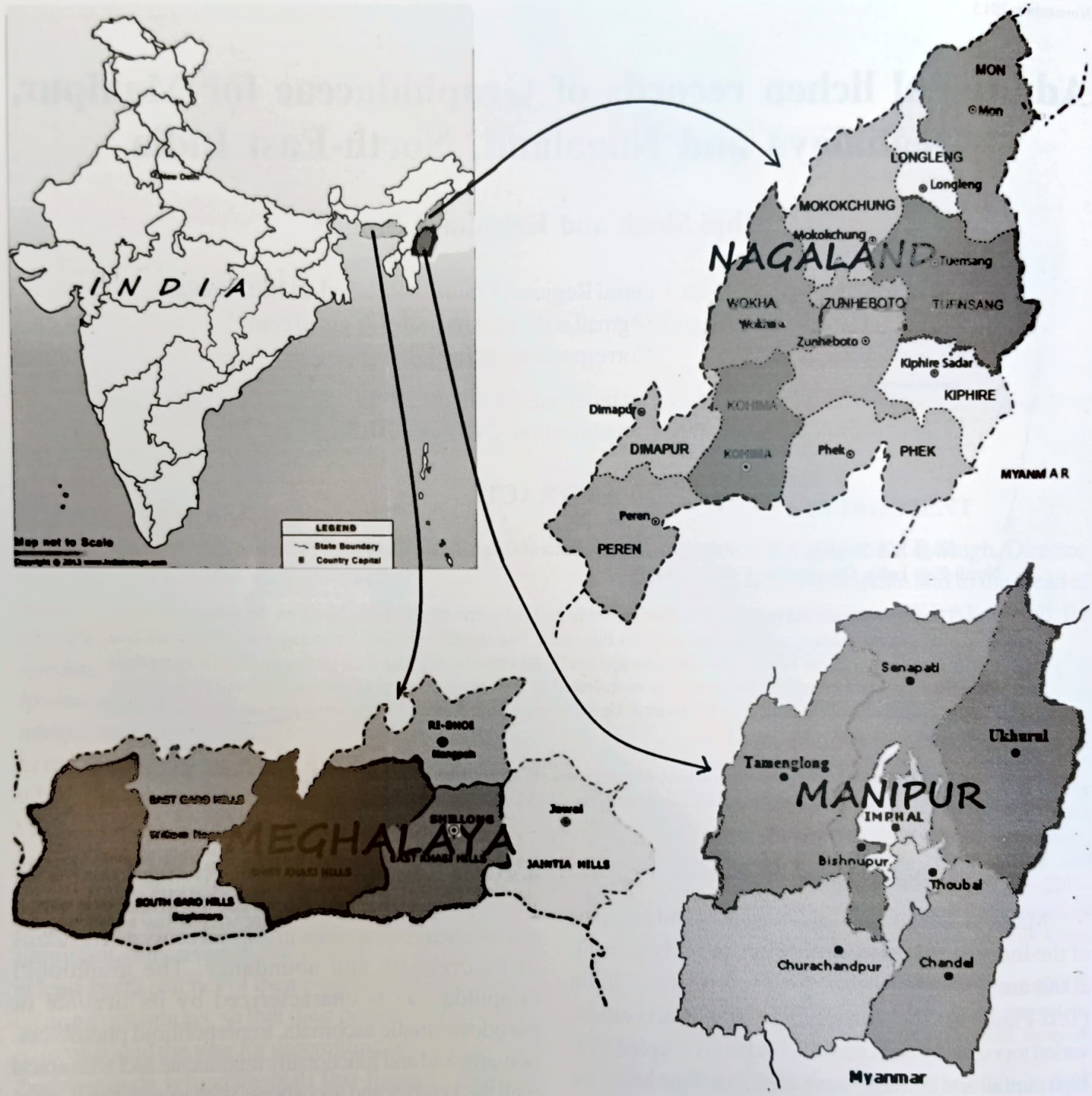
Singh P. & Singh K. P. 2015. Additional lichen records of Graphidaceae for Manipur, Meghalaya and Nagaland, North-East India. Geophytology 45(2): 181-194.

The paper reports thirty-eight new distribution records of graphidoid lichens, based on the collections made from Manipur, Meghalaya and Nagaland in North-East India. Two species, viz. *Graphis crassilabra* and *G. pavoniana* marked by an asterisk are new records for India and briefly described along with their photographs to facilitate their identification while remaining 36 species are enumerated by their distinguishing characters and habit photographs. *Platygramme wattiana* (Müll. Arg.) V. Tewari & Upreti is synonymized with *Platygramme pudica* (Mont. & Bosch) M. Nakan. & Kashiw.

Key-words: *Graphis crassilabra, Graphis pavoniana, Platygramme wattiana, Platygramme pudica*, graphidoid lichens, lichenized fungi, Manipur, Meghalaya and Nagaland, India.

INTRODUCTION

Manipur, Meghalaya and Nagaland and also part of the Indo-Burma biodiversity hotspot (Myers et al. 2000) are situated in the north-eastern region of India (Text-Figure 1). The unique bio-geographical position, varied topography and climatic conditions coupled with high rainfall and humidity have contributed the luxuriant lichen diversity in these states. Though not many, but some important publications already made from these areas include those of Müller Argoviensis (1892), Awasthi and Singh (1977), Awasthi (1980), Singh (1980a, b, c, 1981a, b, 1983), Singh and Singh (1982, 1984), Singh and Sinha (1994), Pinokiyo and Singh (2006), Sanayaima Devi et al. (2013), Singh and Singh (2014), etc. Singh and Sinha (2010) listed 299, 178 and 306 species from Manipur, Meghalaya and Nagaland, respectively. However, a comprehensive account particularly of microlichens remained incomplete. Graphidaceae is the dominant family of microlichen communities in tropical ecosystem in terms of biodiversity and abundance. The graphidoid Graphidaceae is characterized by its lirellate or pseudostromatic ascomata, trentepohlioid photobiont, non-amyloid and functionally unitunicate asci with apical wall thickenings and ascospores with mostly thick, often amyloid septa and lens-shaped lumina. During the course of revisionary studies on graphidoid Graphidaceae materials collected from Manipur, Meghalaya and Nagaland as well as specimens taken on loan from Indian and foreign herbaria have been investigated. As a result, 11 species for Manipur, 14 species for Meghalaya and 24 species for Nagaland have been found as additional distribution records. Two species, viz. *Graphis crassilabra* Müll. Arg. and *G. pavoniana* Fée (marked with an asterisk) are



Text-Figure 1. Showing various districts in Manipur, Meghalaya and Nagaland, north-east India.

discovered as new records for India and are described briefly to facilitate their identification. The remaining 36 species are enumerated with brief notes.

MATERIAL AND METHODS

Material collected from Manipur, Meghalaya and Nagaland, deposited in ASSAM, BSA and CAL

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Plate 1

A–O. Habit. **A.** *Diorygma megasporum*. **B.** *Fissurina cingalina*. **C.** *Glyphis cicatricosa*. **D.** *Graphis cincta*. **E.** *Graphis dendrogramma*. **F.** *Graphis duplicata*. **G.** *Graphis farinulenta*. **H.** *Graphis furcata*. **I.** *Graphis galactoderma*. **J.** *Graphis glauconigra*. **K.** *Graphis handelii*. **L.** *Graphis immersella*. **M.** *Graphis japonica*. **N.** *Graphis librata*. **O.** *Graphis manipurensis*. **Scale Bar:** 1 mm.

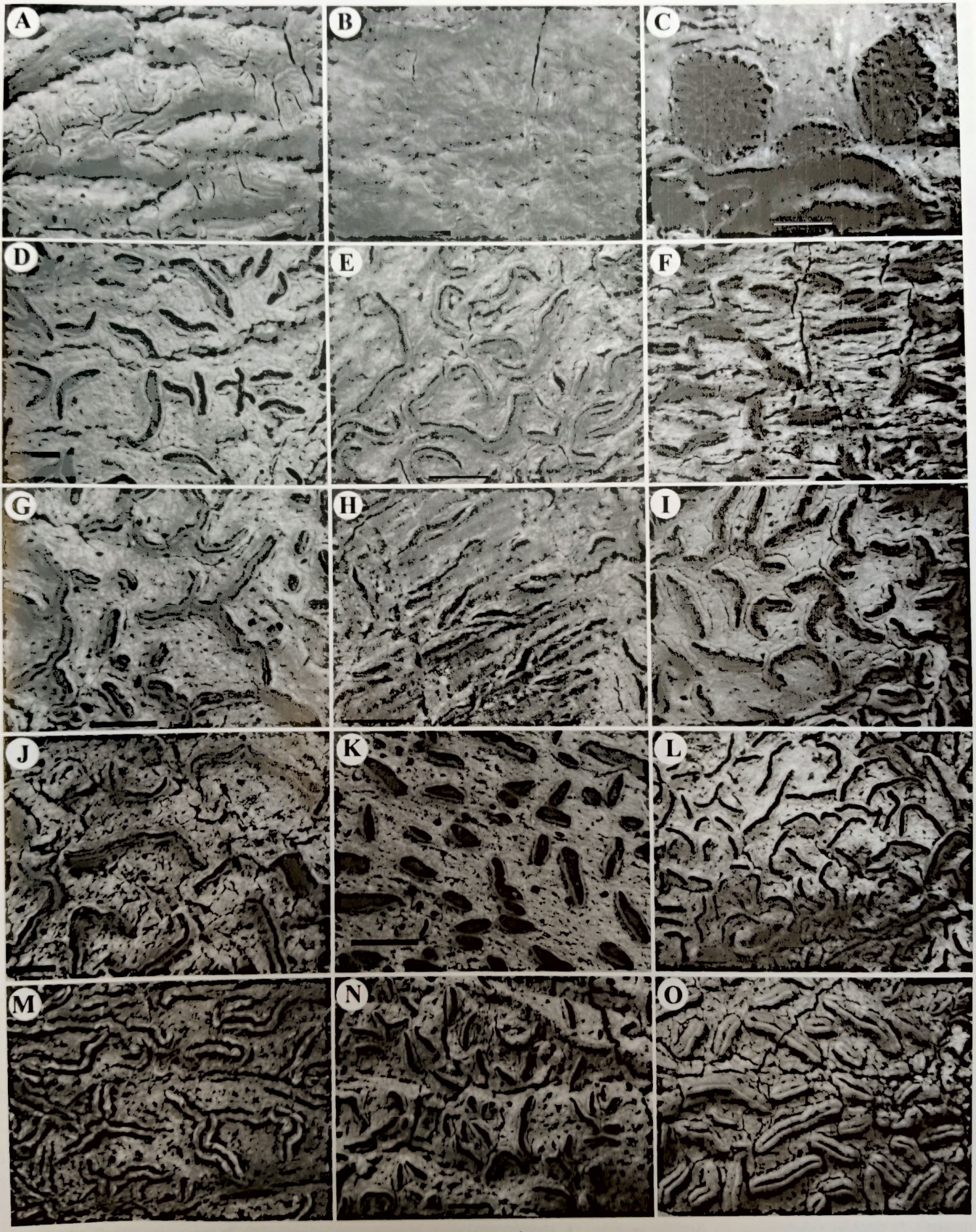

Plate 1

herbaria were examined morphologically, anatomically and chemically. Morphological characters of thallus, reproductive structures, colour, size and shapes were examined under stereomicroscope (NIKON SMZ 1500). Thin hand-cut sections of thalli and ascomata were mounted in water and KOH and examined. All anatomical measurements were made in water mounts and examined under a compound microscope (Nikon Eclipse 50i). Ascospores were stained with Lugol's solution to check the amyloid reaction and measured in water. Secondary metabolites were identified by thin-layer chromatography (TLC) following standard procedures (Orange et al. 2001). All the materials were identified with the help of authenticated specimens available in the herbarium, type specimens taken on loan and published literature (Staiger 2002, Kalb et al. 2004, Lücking et al. 2009, Bárcenas-Peñta et al. 2014).

ENUMERATION OF TAXA

Diorygma megasporum Kalb, Staiger & Elix, Symb. Bot. Upsal. 34(1): 160. 2004.

Plate 1, figure A

Notes: This species is characterized by its erumpent lirellae often with closed disc; uncarbonized exciple; laterally I+ blue hymenium; 2–6-spored asci with muriform, 120–190 × 22–50 µm ascospores and presence of stictic acid complex. It was reported earlier from Manipur, Sikkim, West Bengal and Maharashtra and is a new record for Meghalaya and Nagaland.

Materials examined: Meghalaya, Jaintia hills district, Shillong-Silchar road, alt.1484 m, on *Alnus nepalensis*, K. P Singh and G. Swarnlatha 7637 (BSA). Nagaland, Wokha district, Wokha, near forest colony IB, alt. 1450, K. P. Singh and G. P. Sinha 665, N664B (ASSAM); Paren district, towards Tening, on bark, alt. 1500 m, K. P. Singh and G. P. Sinha N111 (ASSAM).

Diorygma soozanum (Zahlbr.) Nakan. & Kashiw. in Nakanishi, Kashiwadani & Moon, Bull. Natn. Sci. Mus., Tokyo, B 29(2): 86. 2003. *Graphina soozana* Zahlbr., Feddes Repert. 31: 215. 1933.

Notes: This species is characterized by its erumpent lirellae with whitish pruinose disc; uncarbonized exciple; laterally I+ blue hymenium; 1-spored asci with muriform, (90–) 100–130 × 16.7–25 µm ascospores and presence of norstictic acid. Previously it reported from Arunachal Pradesh is a new record for Nagaland.

Material examined: Nagaland, Kohima district, Secha, on Dimapur-Kohima road, alt. 950 m, K. P. Singh and G. P. Sinha 2628 (ASSAM).

Fissurina cingalina (Nyl.) Staiger, Biblioth. Lichenol. 85:128. 2002. *Graphis cingalina* Nyl., Acta Soc. Sci. Fenn. 26(10): 21. 1900.

Plate 1, figure B

Notes: This species is characterized by its 1-3 mm long, *dumastii*-type of lirellae; uncarbonized exciple; clear hymenium; 8-spored asci; colorless, muriform, 7–9-trans-septate and 2–3 vertical septate, 25–35 × 10–18 µm, I-ascospores with halo and absence of lichen substances. It was reported earlier from Kerala, Maharashtra and Tamil Nadu and is a new record for Manipur.

Material examined: Manipur, Senapati district, Mao, alt. 1860 m, on bark, K. P. Singh 550381 (CAL).

Glyphis cicatricosa Ach., Syn. Meth. Lich.: 107. 1814.

Plate 1, figure C

Notes: This species is characterized by its lirellae immersed in stromata; completely carbonized exciple; clear hymenium; colorless, (5–) 6–12-trans-septate, 22–60 × 7–10 µm ascospores and absence of lichen substances. It was reported earlier from Andaman and Nicobar Islands, Arunachal Pradesh, Goa, Karnataka, Kerala, Sikkim, Tamil Nadu and West Bengal-hills. It shows new extended distribution to Manipur, Meghalaya and Nagaland.

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Plate 2

A–O. Habit. **A.** *Graphis parilis*. **B.** *Graphis perstriatula*. **C.** *Graphis pinicola*. **D.** *Graphis pyrrhocheiloides*. **E.** *Graphis sirohiensis*. **F.** *Graphis striatula*. **G.** *Graphis subasahinae*. **H.** *Graphis urandrae*. **I.** *Graphis vittata*. **J.** *Hemithecium aphanes*. **K.** *Pallidogramme chrysenteron*. **L.** *Phaeographis caesioradians*. **M.** *Sarcographa glyphiza*. **N.** *Sarcographa labyrinthica*. **O.** *Thecaria quassiicola*. **Scale Bar:** 1 mm.

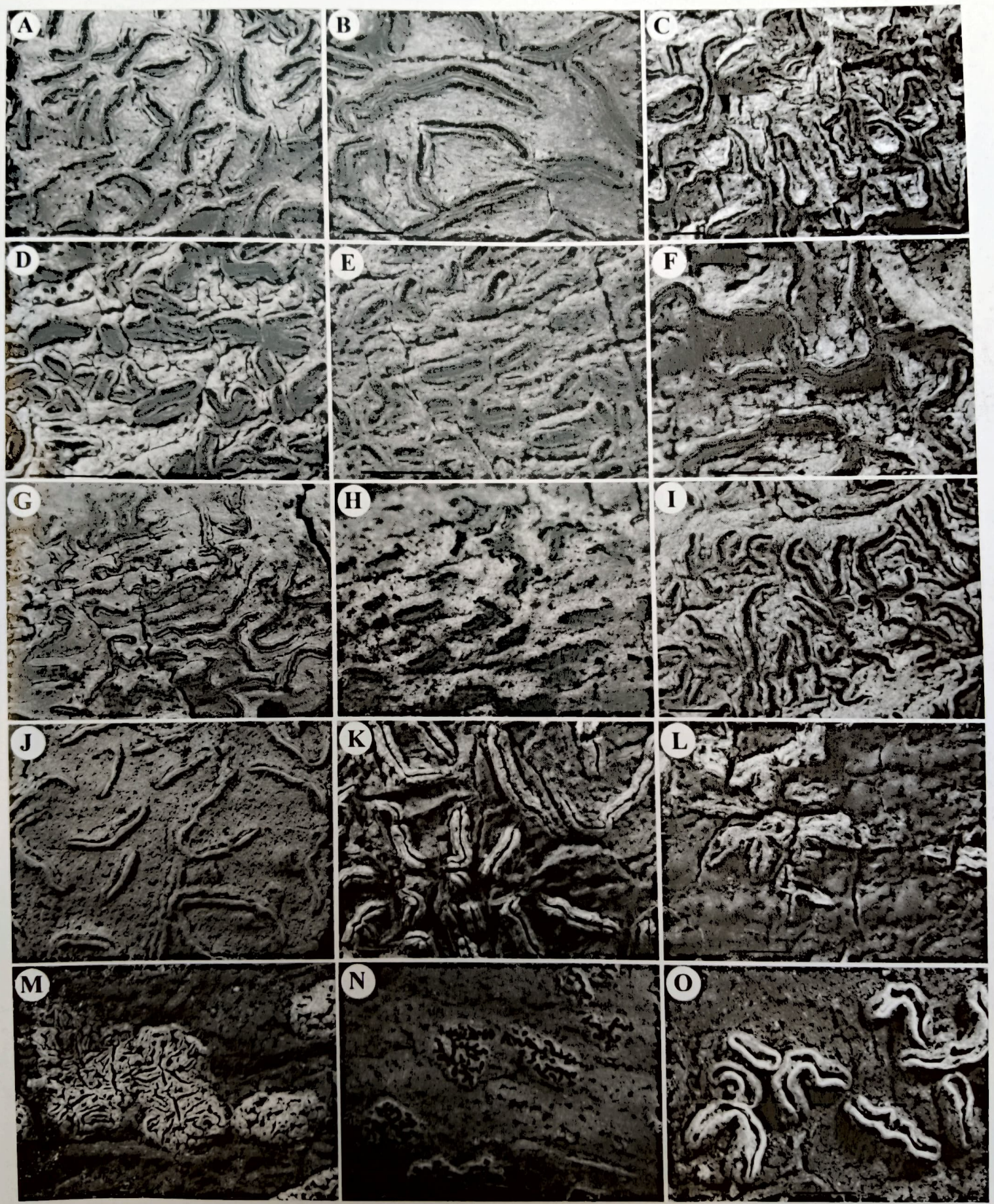

Plate 2

Materials examined: Manipur, Ukhrul district, on way to Siroi hills, alt. 1650 m, on bark, K. P. Singh 54820 (CAL). Meghalaya, East Khasi hills district, Shillong, Botanical Survey of India, campus garden alt. 1463 m, K. P. Singh and G. Swarnlatha 7665B (BSA). Nagaland, Wokha district, near forest colony IB, alt. 1450 m, G. P. Sinha N664A (ASSAM).

Graphis albissima Müll. Arg., Bull. Herb. Boissier 3: 319. 1895.

Notes: This species is characterized by its erumpent, elongate to irregularly branched lirellae, covered by lateral thalline margin; entire labia with laterally carbonized exciple; clear hymenium with transversely 9–11-septate, 30–40 × 6–8 µm ascospores and absence of lichen substances. It was reported earlier from Andaman and Nicobar Islands and is now a new record for Meghalaya.

Material examined: Meghalaya, Jaintia hills district, near Jowai, Shillong-Silchar road, alt. 1320 m, K. P. Singh and G. Swarnlatha 7647B (BSA).

Graphis cincta (Pers.) Aptroot in A.W. Archer, Fl. Australia 57: 651. 2009. *Opegrapha cincta* Pers., Ann. Wetter. Ges. 2: 15, tab. 10, f. 4. 1811.

Plate 1, figure D

Notes: This species is characterized by its elongate, slender c. 0.2 mm broad lirellae with closed disc and entire labia; laterally carbonized exciple with basal thalline margin; inspersed hymenium with transversely 7–11-septate, 22–40 µm long ascospores and presence of norstictic acid. It reported previously from Arunachal Pradesh, Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu is a new record for Manipur, Meghalaya and Nagaland.

Materials examined: Manipur, Chandel district, Tegnoupal, 1500 m, on bark, K. P. Singh 550891 (CAL); above Hiphi, alt.1650 m, K. P. Singh 550147 (CAL); Moreh, 900-1200 m, K. P. Singh 550756 (CAL). Meghalaya, East Khasi hills district, Shillong, Botanical Survey of India, campus garden, alt 1435 m, Pushpi Singh 6814 (BSA); K. P. Singh and G. Swarnlatha 7670 and 7662 (BSA); Jaintia hills district, near Jowai, Shillong-Silchar road, alt.1484 m, K. P. Singh and G. Swarnlatha 7649 and 7651 (BSA). Nagaland, Kohima district, Bosta, on Kohima-Wokha road, alt. 1450 m, K. P. Singh and G. P. Sinha 2477 and 2475 (ASSAM).

****Graphis crassilabra*** Müll. Arg., Flora, Regensburg 65: 502. 1882.

Plate 3. Figure A-C

Description: Thallus corticolous, epiphloeodal, 3–6 cm across, grayish green, continuous, smooth, glossy; cortex 13–16 µm thick; algal layer 60–80 µm thick, below the algal layer numerous patches of large crystals present; prothallus pale brown; photobiont a species of *Trentepohlia*. Apothecia lirelliform, immersed, elongate to irregularly branched, covered with abruptly sloping lateral thalline margin, 1–2 mm long, 0.12–0.18 mm wide; *disc* concealed; *labia* entire, epruinose; exciple laterally carbonized, 45–60 µm thick, covered by 30–50 µm thick thalline margin; epihymenium pale brown, 8–10 µm high; *hymenium* hyaline, clear, 90–115 µm high; paraphyses simple, c. 1.5 µm thick; asci cylindrical, 8-spored, 75–100 × 18–25 µm; ascospores colorless, fusiform, transversely 14–15-septate, 44–65 (–69) × 10–12 µm, I+ blue.

Chemistry: Thallus K+ yellow, C-, P-, UV-. TLC: Stictic acid (major) and hypostictic acid (trace).

Notes: This species is easily characterized by its immersed lirellae with entire labia; laterally carbonized exciple; clear hymenium; transversely 14–17-septate, 44–69 µm long ascospores and presence of stictic acid (major). Anatomically and chemically, it closely resembles *Graphis leptogramma* Nyl., which has flexuose and very narrow lirellae with gently sloping lateral thalline margin. This species grows in moist and dry places and reported earlier from Australia and Philippines. It is a new record for India.

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Plate 3

A-C. *Graphis crassilabra*. **A.** Habit. **B.** Cross section of apothecium. **C.** Ascospores. **D-F.** *Graphis pavoniana*. **D.** Habit. **E.** Cross section of apothecium. **F.** Ascospores. **G–I.** *Platygramme pudica* (Lectotype BM!). **G.** Habit. **H.** Cross section of apothecium. **I.** Ascospore. **Scale Bar:** A, D, G= 1 mm; B, E, H = 100 µm; D = 25 µm; F, I = 20 µm.

Material examined: Meghalaya, West Garo hills district, Balpakgram forest, on bark, K. P. Singh 6852 (ASSAM).

Graphis dendrogramma Nyl. in Cromb., J. Linn. Soc., Bot. 16: 226. 1878.

Plate 1, figure E

Notes: This species is characterized by its irregularly branched lirellae with concealed disc and entire, pruinose labia; laterally carbonized exciple; clear hymenium with 8-spored asci; transversely 5–9-septate, 20–40 × 5–7 µm ascospores and presence of stictic and constictic acids. Earlier it reported from West Bengal is a new record for Nagaland.

Materials examined: Nagaland, Tuensang district, Noklak-Pangsha road, 1-10 km range, alt. 1200-1400 m, K. P. Singh and G. P. Sinha 3344 (ASSAM)

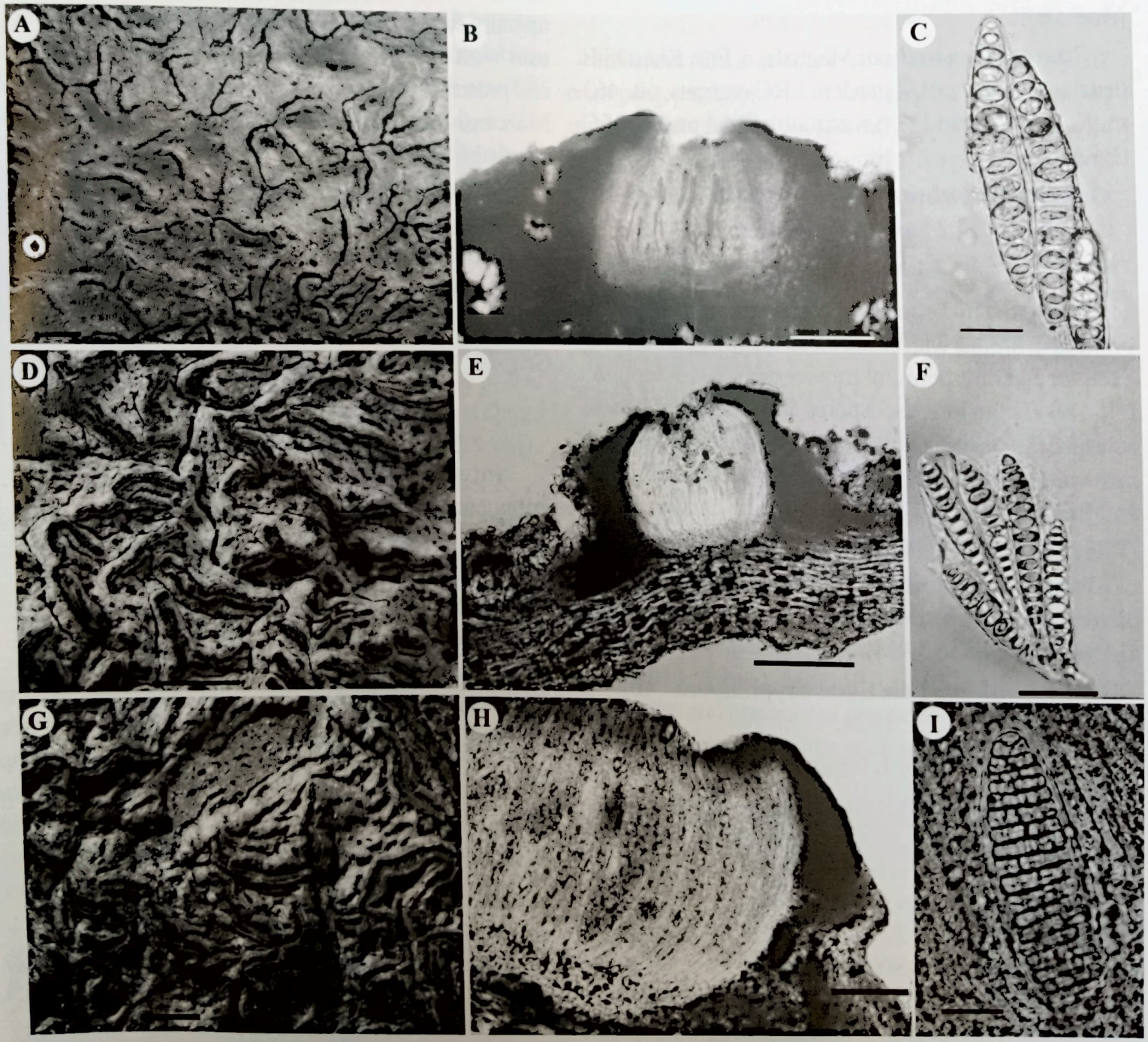

Plate 3

Graphis duplicata Ach., Syn. Meth. Lich.: 81. 1814.

Plate 1, figure F

Notes: This species is characterized by its erumpent to prominent lirellae lacking thalline margin; striate labia with laterally carbonized exciple; 8-spored asci with transversely 10–15-septate, 32–45 × 7–9 µm, ascospores and absence of lichen substances. Previously it reported from Arunachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Nagaland, Tamil Nadu and Uttarakhand is a new record for Meghalaya.

Materials examined: Meghalaya, East Khasi hills district, Shillong, BSI garden, ERC campus, alt. 463 m, K. P. Singh and G. Swarnlatha 7664 and 7665C (BSA).

Graphis farinulenta Müll. Arg., Bull. Soc. Roy. Bot. Belg. 30: 80. 1891.

Plate 1, figure G

Notes: This species is characterized by its prominent lirellae with entire labia; laterally carbonized exciple; clear hymenium; transversely 8–13-septate, (50–) 60–71 µm long ascospores and absence of lichen substances. Anatomically, it closely resembles *Graphis pavoniana* which has erumpent lirellae and slightly smaller ascospores. It was reported earlier from Arunachal Pradesh and is a new record for Nagaland.

Material examined: Nagaland, Mokokchung district, Mekong forest, alt. 1325 m, K. P. Singh and G. P. Sinha 867 (ASSAM).

Graphis furcata Fée, Essai Crypt. Ecorc.: 40. 1824.

Plate 1, figure H

Notes: This species is characterized by its slender, erumpent to prominent, simple to furcated lirellae with entire labia; laterally carbonized exciple with lateral thalline margin; 6–8-spored asci with transversely 6–10 (–12)-septate, (22–) 32–38 × 6.5–10 µm ascospores and absence of lichen substances. Previously, it was reported from Andaman and Nicobar Islands. The present record is therefore a new report for Meghalaya.

Material examined: Meghalaya, East Khasi hills district, Shillong, Botanical Survey of India, campus garden, on bark, Pushpi Singh 6868A (BSA)

Graphis galactoderma (Zahlbr.) Lücking in Lücking, Archer & Aptroot, Lichenologist 41(4): 436. 2009. *Graphina galactoderma* Zahlbr., in Handel-Mazzetti, Symb. Sinic. 3: 54. 1930.

Plate 1, figure I

Notes: This species is characterized by its erumpent to prominent, short and sparsely branched lirellae with lateral thalline margin; striate labia with apically carbonized exciple; clear hymenium; 8-spored asci with muriform, 35–40 × 12–13 µm ascospores and presence of stictic acid. It was reported earlier from Maharashtra and is now a new record for Manipur and Meghalaya.

Materials examined: Manipur, Senapati district, near Kala Pahar, on the way of Hiphi, alt.4500 m, on bark, K. P. Singh 55023 (CAL). Nagaland, Phek district, Meluri, towards three kheel village, alt. 1350 m, K. P. Singh and G. P. Sinha 549B (ASSAM).

Graphis glauconigra Vain., Ann. Acad. Sci. Fenn., ser. A, 15(6): 242. 1921.

Plate 1, figure J

Notes: This species is characterized by its prominent, elongate to irregularly branched lirellae with concealed disc and striate labia; completely carbonized exciple; clear hymenium with 8-spored asci; transversely 9–12-septate, 40–50 (–60) × 8–11 µm ascospores and absence of lichen substances. Previously it reported from Kerala, Sikkim, Tamil Nadu and West Bengal-hills is a new report for Nagaland.

Material examined: Nagaland, Tuensang district, Kiphire, towards Kohima, alt. 1100 m, G. P. Sinha 1111 (ASSAM).

Graphis handelii Zahlbr. in Hand.-Mazz., Symb. Sin. 3: 39, 40. 1930.

Plate 1, figure K

Notes: This species is characterized by its erumpent to prominent, simple to sparsely branched lirellae with exposed epruinose disc; entire labia; laterally carbonized exciple with basal thalline margin; inspersed

hymenium with transversely 7–10-septate, 30–45 × 6–10 µm ascospores and presence of norstictic acid. Previously it reported from Arunachal Pradesh and West Bengal-plains, is a new record for Meghalaya.

Material examined: Meghalaya, East Khasi hills district, Shillong, Botanical Survey of India, campus garden, alt. 1463 m, K. P. Singh and G. Swarnlatha 7661 (BSA).

Graphis immersella Müll. Arg., Bull. Herb. Boissier 3: 319. 1895.

Plate 1, figure L

Notes: This species is characterized by its immersed to erumpent lirellae with entire epruinose labia, laterally carbonized exciple; clear hymenium; 8-spored asci with transversely 7–9-septate, 35–45 × 6–8 µm ascospores and presence of stictic acid. Previously it reported from Andaman and Nicobar Islands, is a new record for Meghalaya and Nagaland.

Materials examined: Meghalaya, Jaintia hills district, near Jowai, Silchar road, alt.1320 m, K. P. Singh and G. Swarnlatha 7639 (BSA). Nagaland, Phek district, Meluri, towards Three Kheel village, Kohima road alt.1350 m, K. P. Singh and G. P. Sinha 549A (ASSAM); Tuensang district, Tuensang-forest Dept. compound, alt. 1400 m, G. P. Sinha N1001 (ASSAM).

Graphis japonica (Müll. Arg.) A. W. Archer & Lücking, in Lücking, R., Archer A. W. & Aptroot A., lichenologist 41 (4): 437. 2009. *Graphina japonica* Müll. Arg., Flora 74: 113. 1891.

Plate 1, figure M

Notes: This species is characterized by its erumpent to prominent, simple to branched lirellae covered by complete thalline margin; apically to laterally carbonized exciple with entire labia; 2–4 spored asci; muriform, 50–80 × 16–25 µm ascospores and presence of stictic, constictic (major) and hypostictic acids (trace). Previously it reported for Arunachal Pradesh is a new record for Nagaland.

Materials examined: Nagaland, Tuensang district, Hakcheng village forest, alt. 800-1000 m, K. P. Singh and G. P. Sinha 3930 (ASSAM).

Graphis leptoclada Müll. Arg., Flora 65: 335. 1882.

Notes: This species is characterized by its erumpent lirellae with entire labia; laterally carbonized exciple, with lateral thalline margin; 8-spored asci with transversely 13–15-septate, 58–70 µm long ascospores and absence of lichen substances. Previously it reported from Tamil Nadu is a new record for Nagaland.

Material examined: Nagaland, Tuensang district, Noklak, near rest house, alt. 1400 m, K. P. Singh and G. P. Sinha 3401 (ASSAM).

Graphis librata C. Knight, Trans. New Zealand Inst. 16: 404. 1884.

Plate 1, figure N

Notes: This species is characterized by its erumpent, partly branched lirellae with lateral thalline margin and entire labia; laterally carbonized exciple covered by basal thalline margin; 8-spored asci with fusiform, transversely (5–) 6–8-septate, (18–) 24–28 µm long ascospores and presence of norstictic and connorstictic acids. Previously it reported from Maharashtra is a new record for Nagaland.

Material examined: Nagaland, Mon district, Champang Guest House area, alt. 525 m, K. P. Singh and G. P. Sinha N3950 (ASSAM).

Graphis manipurensis Pushpi Singh & Kr. P. Singh, Mycosphere 5: 504. 2014.

Plate 1, figure O

Notes: The species is characterized by its very short and unbranched lirellae with completely covered by thick thalline margin; laterally carbonized exciple with entire labia; inspersed hymenium; 1-spored asci with muriform, (95–) 100–130 × (22–) 28–45 µm ascospores and presence of norstictic acid. It was earlier reported from Manipur and is a new record for Meghalaya.

Material examined: Meghalaya, West Garo hills district, Tura, DFO residence campus, K. P. Singh 6733 (ASSAM).

Graphis parilis Kremp., Flora 59: 422, 445. 1876.

Plate 2, figure A

Notes: This species is characterized by its erumpent to prominent, simple to sparsely branched lirellae with concealed disc; striate labia with apically

carbonized exciple covered by lateral thalline margin; muriform, 50–70 µm long ascospores and presence of stictic, constictic and hypostictic acids. It was reported earlier from Tamil Nadu and Uttarakhand and is a new record for Manipur.

Materials examined: Manipur, Senapati district, Toribari village, alt. 1050-1200 m, on bark, K. P. Singh 550051, 550043, 550025 (CAL).

Graphis pavoniana Fée, Essai Crypt. Ecorc. 40. 1825.

Plate 3. figure D-F

Description: Thallus corticolous, crustose, epiphloeodal, 4–6 cm across, white-gray, continuous, uneven, ecorticate; algal layer 60–90 µm thick encrusted by numerous small crystals; prothallus indistinct; photobiont a species of *Trentepholia*. Apothecia lirellate erumpent, elongate to sparsely branched covered by lateral thalline margin, 1–4 mm long, 0.20–0.24 mm wide; disc concealed; labia entire, white pruinose; exciple laterally carbonized, 30–54 µm thick, covered by 30–40 µm thick lateral thalline margin; hymenium hyaline, not inspersed, 80–105 µm high; paraphyses simple, 1–1.5 µm thick; hypothecium hyaline, 10–15 µm thick; asci cylindrical, 6–8-spored, 75–90 × 15–20 µm; ascospores colorless, fusiform, transversely 10–15-septate, 35–60 × 8–12 µm, I+ blue.

Chemistry: Thallus K–, C–, P–, UV–. TLC: no lichen substances present.

Notes: This species is characterized by its erumpent lirellae; concealed disc with entire white pruinose labia; laterally carbonized exciple; clear hymenium with transversely 10–15-septate 35–60 µm ascospores and absence of lichen substances. This species reported earlier from South America (Lucking et al. 2009). It is a new record for India.

Specimen examined: Nagaland, Mokokchung district, Mokokchung-Mekong forest, alt. c. 1325 m, K. P. Singh & G. P. Sinha 867 (ASSAM).

Graphis perstriatula Nyl., Bull. Soc. Linn. Normandie, ser. 2, 7: 176. 1873.

Plate 2, figure B

Notes: This species is characterized by its erumpent, elongate, irregularly branched lirellae with lateral thalline margin; striate labia; apically carbonized exciple with clear hymenium; 8-spored asci with muriform 25–42 × 11–15 µm ascospores and presence of norstictic acid. This species, previously reported from Andaman and Nicobar Islands, is a new record for Nagaland.

Material examined: Nagaland, Peren district, towards Tening, on bark, alt. 1500 m, K. P. Singh and G. P. Sinha N112A (ASSAM).

Graphis pinicola Zahlbr., in Hand.-Mazz., Symb. Sin. 3: 40, 43. 1930.

Plate 2, figure C

Notes: *Graphis pinicola* is characterized by its erumpent to prominent lirellae with entire labia; laterally carbonized exciple; 8-spored asci with transversely 8–11-septate, 29–35 µm long ascospores and absence of lichen substances. It was previously known from Tamil Nadu and is a new record for Nagaland.

Materials examined: Nagaland, Zunheboto district, town-Agunats road, 2 km, alt.1700 m, K. P. Singh and G. P. Sinha 1242 (ASSAM); Peren district, towards Tening, alt.1500 m, K. P. Singh and G. P. Sinha 109 (ASSAM); Phek district, Meluri, towards three Kheel village side road, alt. 1350 m, G. P. Sinha N545 (ASSAM); Wokha district, Wokha Mt. Tiyei forest, alt.1450 m, G. P. Sinha N655 (ASSAM).

Graphis proserpens Vain., Bot. Tidsskr. 29(2): 132. 1909.

Notes: This species is characterized by its prominent lirellae with basal thalline margin; striate labia with apically carbonized exciple; 8-spored asci with transversely 8–14-septate ascospores and absence of lichen substances. It was previously known from Arunachal Pradesh, Kerala, Madhya Pradesh, Manipur, Sikkim and Tamil Nadu. It is a new record for Nagaland.

Materials examined: Nagaland, Tuensang district, Solomi village forest alt. 2200 m, K. P. Singh and G. P. Sinha 1766 (ASSAM); Kohima district, Kohima-Jakhama road, 16 km from Kohima alt. 1700 m, G. P. Sinha 1524A (ASSAM).

Graphis pyrrhocheiloides Zahlbr., Cat. Lich. Univ. 2: 321. 1923.

Plate 2, figure D

Notes: This species is characterized by its erumpent, simple to irregularly branched lirellae covered by lateral thalline margin; disc exposed, slightly ashy grey prurinose; entire labia with laterally carbonized exciple; clear hymenium; 8-spored asci with transversely 6–9-septate, 20–38 × 6–9 µm ascospores and presence of norstictic, connorstictic and hypostictic acids. Previously it reported from Karnataka, Maharashtra and West Bengal-hills is a new report for Manipur.

Material examined: Manipur, Senapati district, Toribari, alt. 900-1200 m, on bark, K. P. Singh 550023 (CAL).

Graphis sirohiensis Pushpi Singh & Kr. P. Singh, Mycosphere 5(4): 507. 2014.

Plate 2, figure E

Notes: This species is characterized by its prominent lirellae with laterally thick thalline margin; partly exposed disc; laterally to completely carbonized exciple with entire labia; heavily inspersed hymenium; small, clavate, submuriform to muriform, 35–50 × 10–12 µm ascospores and presence of norstictic acid, sometimes additionally stictic acid. It is a new record for Nagaland and known earlier from Manipur.

Materials examined: Nagaland, Peren district, towards Tening, on bark, alt. 1500 m, K. P. Singh and G. P. Sinha 116 (ASSAM); Wokha district, Wokha, 10-12 m, on Kohima road alt. 1300 m, K. P. Singh and G. P. Sinha N2507 (ASSAM); Mokokchung district, Mekong forest, alt. 1325 m, G. P. Sinha N804 (ASSAM); Tuensang district, Shamatore PWD rest house, surrounding area, alt. 1760 m, K. P. Singh and G. P. Sinha 3258 (ASSAM).

Graphis striatula (Ach.) Spren., Syst. Veg. Lich. 4: 250. 1827. *Opegrapha striatula* Ach., Syn. Meth. Lich.: 74. 1814.

Plate 2, figure F

Notes: This species is characterized by its conspicuous, prominent lirellae; striate labia with laterally carbonized exciple; clear hymenium; 8-spored asci with transversely 9–13-septate, 40–60 × 8–12 µm ascospores and absence of lichen substances. It is a new record for Manipur and Nagaland and was reported earlier from Arunachal Pradesh and Meghalaya.

Materials examined: Manipur, Chandel district, Tengnopal, 1500 m., K. P. Singh 550913 (CAL). Nagaland, Mon district Chenloisho forest, 7th km towards Burma, alt. 1600-2000 m, K. P. Singh and G. P. Sinha 4205 (ASSAM); Mokokchung district, Mekong forest alt. 1325 m, K. P. Singh and G. P. Sinha 797 (ASSAM); Wokha district, Wokha, near forest colony IB, alt. 1450 m, K. P. Singh and G. P. Sinha N662 (ASSAM).

Graphis subasahinae Nagarkar & Patw., Biovigyanam 8: 130. 1982.

Plate 2, figure G

Notes: This species is characterized by its sparsely to irregularly branched lirellae with entire labia; clear hymenium; 8-spored asci with transversely 6–8-septate, 22–33 × 7–9 µm ascospores and additional stictic acid along with norstictic and salazinic acids. Previously it was reported from Arunachal Pradesh and Assam and is a new record for Manipur and Nagaland.

Materials examined: Manipur, Ukhrul district, Saraikhonglitan, alt. 3000 ft., K. P. Singh 54745 (CAL). Nagaland, Kohima district, Kiphruma-Kigwema, near Jekhama, on way to Japho peak, alt. 1600-2000 m, K. P. Singh and G. P. Sinha N2571 (ASSAM).

Graphis urandrae Vain., Ann. Acad. Sci. Fenn., ser. A, 15(6): 255. 1921.

Plate 2, figure H

Notes: This species is characterized by its sessile, short and unbranched lirellae with basal thalline margin; disc concealed with entire labia; laterally carbonized exciple with clear hymenium; 8-spored asci with transversely 5-7 (-9)-septate, 15–25 × 4.5–5.5 µm ascospores and absence of lichen substances. It was reported previously from Andaman and Nicobar Islands and Sikkim and is a new record for Nagaland.

Material examined: Nagaland, Dimapur district, Rangapahar, coffee and rubber plantation garden, alt. 400 m, G. P. Sinha N. 25 (ASSAM).

Graphis vittata Müll. Arg., Flora 65: 335. 1882.

Plate 2, figure I

Notes: This species is characterized by its erumpent lirellae with lateral thalline margin; striate labia with apically carbonized exciple; clear hymenium; 8-spored asci with transversely (7–) 10–12 (–15)-septate, 25–55 (–60) µm long ascospores and presence of stictic, constictic and hypostictic acids. It is a new record for Nagaland and was reported earlier from Arunachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra and Sikkim.

Materials examined: Nagaland, Mokokchung district, Mokokchung-Tuensang road, near Ungma village, alt. 1300 m, G. P. Sinha 899 (ASSAM); Tuensang district, Solomi village forest, alt. 2200 m, K. P. Singh and G. P. Sinha 1761 (ASSAM).

Hemithecium aphanes (Mont. & Bosch) M. Nakan. & Kashiw., Bull. Natl. Sci. Mus. Tokyo, B, 29(2): 88. 2003. *Graphis aphanes* Mont. & Bosch in Jungh., Pl. Jungh. 4: 474. 1855.

Plate 2, figure J

Notes: This species is characterized by its erumpent to prominent lirellae with closed to narrowly open epruinose disc with entire to striate labia; transversely 11–24 septate, 45–95 (–110) µm long ascospores and presence of constictic, stictic, norstictic and hypostictic acids. It was reported from Andaman and Nicobar Islands, Arunachal Pradesh, Karnataka, Kerala and Maharashtra and is a new record for Nagaland.

Material examined: Nagaland, Peren district, towards new colony valley side, on bark, alt.1400 m, K. P. Singh and G. P. Sinha 198 (ASSAM).

Pallidogramme chlorocarpoides (Nyl.) Staiger, Kalb & Lücking, Fieldiana, Bot. 46: 9. 2008. *Graphis chlorocarpoides* Nyl., Flora 49: 133. 1866.

Notes: This species is characterized by its prominent to sessile lirellae; striate labia with uncarbonized exciple; inspersed hymenium; 1–2 (–4)-spored asci with muriform, 112–156 µm long ascospores and presence of stictic and constictic acids. It was reported earlier from Assam, Meghalaya, West Bengal-hills and Sikkim and is a new record for Manipur.

Materials examined: Manipur, Senapati district, Mao, on bark, alt. 1950 m, K. P. Singh 550403 (CAL).

Pallidogramme chrysenteron (Mont.) Staiger, Kalb & Lücking, Fieldiana, Bot. 46: 9. 2008. *Graphis chrysenteron* Mont., Ann. Sci. Nat., Bot., ser. 2, 18: 268. 1842b.

Plate 2, figure K

Notes: This species is characterized by its prominent to sessile lirellae with striate labia; uncarbonized exciple; 6–8 spored asci with muriform, 48–64 µm long ascospores and presence of stictic and constictic acids. It was reported earlier from Arunachal Pradesh, Manipur and Sikkim and is a new record for Meghalaya and Nagaland.

Materials examined: Meghalaya, Jaintia hills district, near Jowai, Silchar road, alt. 1320 m, K. P. Singh and G. Swarnlatha 7658A (BSA). Nagaland, Kohima district, Jakhama,16 km from Kohima on Imphal road, alt. 1700 m, K. P. Singh and G. P. Sinha 1533 (ASSAM); Tuensang district, Noklak, near rest house, alt. 1400 m, K. P. Singh and G. P. Sinha 3399 (ASSAM).

Phaeographis caesioradians (Leight.) A.W. Archer, Telopea 11: 75. 2005. *Graphis caesioradians* Leight., Trans. Linn. Soc. London 27: 176. 1869.

Plate 2, figure L

Notes: This species is characterized by its erumpent to prominent lirellae with convergent entire labia covered with white pruinosity; uncarbonized exciple with inspersed hymenium; 8-spored asci with brown, muriform, 48–50 µm long ascospores and absence of lichen substances. It was reported earlier from Andaman and Nicobar Islands, Assam, Kerala, Nagaland and is a new record for Manipur.

Material examined: Manipur, Chandel district, Moreh, on bark, K. P. Singh 550860 (CAL).

Platygramme pudica (Mont. & Bosch) M. Nakan. & Kashiw, Bull. Natn. Sci. Mus., Tokyo, Ser. B, 29: 89. 2003.

Graphis pudica Mont. & Bosch, in Junghuhn, Plantae Junghuhnianae, 4: 474. 1855. Type: Java (L!).

Syn. nov. *Phaeographina wattiana* Müll. Arg., J. Linn. Soc., Bot. 29: 227. 1892.

Platygramme wattiana (Müll. Arg.) V. Tewari & Upreti, Indian J. Forest. 31(3): 458. 2008. Type: India, Manipur, G. Watt 6964 (Lectotype: BM!).

Plate 3. figures G–I

Notes: This species is characterized by its conspicuous sessile lirellae, laterally carbonized exciple with thick closed to slightly open labia; strongly inspersed hymenium; 1-spored asci with colorless to pale brown, elongate ellipsoid, muriform, 100–180 × 25–40 µm, non-amyloid ascospores and the presence of echinocarpic acid as major secondary metabolite. Tewari and Upreti (2008) made *Platygramme wattiana* (Müll. Arg.) V. Tewari & Upreti a new combination for *Pheaographina wattiana* Müll. Arg., reported from Manipur (India) by Müller Argoviensis (1892). We have examined the type materials of both *Platygramme wattiana* (BM!) and *P. pudica* (Mont. & Bosch) M. Nakan. & Kashiw. (L!), and confirmed that both the species possess same anatomy, chemistry and similar ascospores and differ only in the degree to which the lirellae are slightly open. Both species also contain echinocarpic acid as major lichen compound. Therefore, *P. wattiana* is considered here synonymous with *P. pudica,* a species originally described from Java and also reported from Australia, China and Japan (Jia & Kalb 2013). In India, this species is widely distributed in north-eastern states and recorded new to Meghalaya and Nagaland.

Materials examined: Meghalaya, East Khasi Hills district, near Laitlyngkot, K. P. Singh 145 (ASSAM). Nagaland, Mon district, Naginimora, Kongan village forest, alt. 650-700 m, K. P. Singh and G. P. Sinha 4266 (ASSAM).

Sarcographa glyphiza (Nyl.) Kr. P. Singh & G. P. Sinha, Indian Lichens: an annotated Checklist: 404. 2010. *Graphis glyphiza* Nyl., Ann. Sci. Nat., Bot. 4(14): 374. 1863.

Plate 2, figure M

Notes: This species is characterized by its lirellae immersed in the stromata; densely white pruinose disc; completely carbonized exciple with ±convergent entire labia; inspersed hymenium; 8-spored asci with brown sub-muriform, 6–7 × 1–3 locular, 16–38 × 10–15 µm ascospores and presence of stictic, norstictic and hypostictic acids. It was reported earlier from Assam, Kerala and Nagaland and is a new record for Meghalaya.

Material examined: Meghalaya, West Garo hills district, Baghmara, K. P. Singh 6819 (ASSAM).

Sarcographa labyrinthica (Ach.) Müll. Arg., Mem. Soc. Phys. Genève 29(8): 62. 1887. *Glyphis labyrinthica* Ach., Syn. Meth. Lich.: 107. 1814.

Plate 2, figure N

Notes: This species is characterized by the thin irregularly spreading stromata, stellate discrete lirellae with completely carbonized exciple; inspersed hymenium; 8-spored asci with 3–5-septate, 14–18 × 6–9 µm ascospores and presence of stictic, constictic and hypostictic acids. It was reported earlier from Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Karnataka and Kerala and is a new record for Manipur.

Material examined: Manipur, Ukhrul district, Saraikonglitan, alt.1080 m, on bark, K. P. Singh 54820 (CAL).

Thecaria quassiicola Fée, Meth. Lichenogr. Gen.: 92, tab. 1, fig. 16. 1824.

Plate 2, figure O

Notes: This species is easily characterized by its sessile, simple to sparsely branched lirellae having ashy-white pruinose open disc; completely carbonized exciple; inspersed hymenium; 4–6-spored asci with pale brown, muriform (48–) 67–118 (–120) × 16–25 (–29) µm ascospores and absence of lichen substances. It was reported earlier from Arunachal Pradesh, Assam, Karnataka, Kerala and West Bengal and is a new record for Meghalaya.

Material examined: Meghalaya, East Garo hills district, Williamnagar road, 2 km on Baghmara road, K. P. Singh 6771 (ASSAM).

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