

Record of graphidoid Graphidaceae (lichenized Ascomycota) from the Andaman and Nicobar Islands, India

Pushpi Singh¹, T.A.M. Jagadeesh Ram² and K.P. Singh^{1*}

¹Botanical Survey of India, Central Regional Centre, 10- Chatham Lines, Allahabad–211 002, India.

²Botanical Survey of India, Andaman and Nicobar Regional Centre, Port Blair–744 102, India.

*Corresponding author's e-mail: krishna.p.singh@gmail.com

Manuscript received: 27 July 2016

Accepted for publication: 12 April 2017

ABSTRACT

Graphidoid lichens are known from different parts of India. In the present contribution, we report fifteen additional species of lichens belonging to family Graphidaceae (lichenized Ascomycota) from the Andaman and Nicobar Islands, India. Here, we also provide distinguishing characters of the recorded species for detailed comparisons with closely comparable taxa.

Key-words: Lichenized fungi, Ascomycota, Taxonomy, Andaman and Nicobar Islands.

INTRODUCTION

The Andaman and Nicobar Islands (Text Figure 1), cover a geographical area of about 8293 sq. km (06°45'–13°40' N and 92°12'–93°57' E) and comprise of about 572 islands and islets (Rao and Sinha, 1999). This festoon of islands harbors luxuriant lichen diversity (Singh and Sinha, 2010; Jagadeesh Ram, 2013, 2014a, b, 2015a, b, 2016; Jagadeesh Ram and Singh, 2014). These records also suggest that Graphidaceae (including thelotremoids), a dominant family found in these islands is represented by at least 114 species. Recently, we collected lichens belonging to family Graphidaceae and recognized fifteen additional species from these islands. In the present article, we provide distinguishing taxonomical characters of the recorded species for detailed comparisons with closely comparable taxa.

MATERIAL AND METHODS

Specimens collected from Andaman and Nicobar Islands (Text Figure 1) are deposited in the herbaria of

Botanical Survey of India, Port Blair, Andaman and Nicobar Islands, India. The collected specimens 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 under a compound microscope (NIKON Eclipse 50i). All the measurements were made in water mounts. Ascospores were stained with Lugol's solution to check the amyloid reaction. Secondary metabolites were identified by Thin-Layer Chromatography (TLC) following standard procedures (Orange et al. 2001).

SYSTEMATIC DESCRIPTION

Diorygma pachygraphum (Nyl.) Kalb, Staiger & Elix 2004.

Graphis pachygrapha Nyl. 1863

Plate 2, figure A

Comparisons and remarks: The species is characterized by its prominently raised lirellae, single-spored asci, large muriform ascospores. Presence of norstictic acid in this species is also a characteristic feature. It also closely resembles *D. macgregorii* (Vain.) Kalb *et al.*, in having exposed whitish pruinose discs (Kalb *et al.* 2004). Recently, this species has been recorded from Arunachal Pradesh (Singh *et al.* 2015).

Specimens examined: Andaman and Nicobar Islands, North Andaman, Saddle Peak National Park, alt. c. 600 m, *T.A.M. Jagadeesh Ram* 153, 1467, 1505 (Port Blair).

Graphis analoga Nyl. 1859

Plate 1, figure B

Comparisons and remarks: This species is characterized by its short to elongate, prominent lirellae with basal thalline margin, entire labia with laterally carbonized excipulum; clear hymenium; 8 spored asci with muriform, ascospores measuring 20–30 × 8–11 µm. Norstictic acid is present. Morphologically and anatomically it also resembles *Graphis consimilis* Vain., which lacks lichen substances (Lücking *et al.* 2009). The species was previously reported from the state of Uttarakhand.

Specimens examined: Andaman and Nicobar Islands: Middle Andaman, Sound Island, alt. 5 m, *T.A.M. Jagadeesh Ram* 932 (PBL); Long island Seashore, alt. 10 m; on the bark of *Heritiera littoralis*, *T.A.M. Jagadeesh Ram* 1175, 1173 (PBL). South Andaman, Hentry Lawrence Island, *T.A.M. Jagadeesh Ram* 1910 (PBL).

Graphis crassilabra Müll. 1882

Plate 2, figure C

Comparisons and remarks: This species is characterized by immersed lirellae; entire labia with laterally carbonized exciple; clear hymenium; 8 spored asci with 14–17 transverse septa, 45–70 µm long ascospores and presence of stictic acid. Anatomically and chemically, it also resembles *Graphis leptogramma* Nyl., which has flexuose and very narrow lirellae with gently sloping lateral thalline margin (Lücking *et al.* 2009). The species was previously known from Meghalaya.

Specimen examined: Andaman and Nicobar Islands, Middle Andaman, Panchwati seashore, alt. 10 m, on the bark of *Calophyllum* sp., *T.A.M. Jagadeesh Ram* 1097 (PBL).

Graphis crebra Vain. 1899

Plate 2, figure D

Comparisons and remarks: The species is characterized by its erumpent, short to elongate, sparsely to irregularly branched lirellae with lateral thalline margin and exposed pruinose disc; entire labia with laterally carbonized exciple; inspersion of hymenium; 8 spored asci with 7–10 septa, 25–40 µm long ascospores and presence of norstictic acid. Anatomically and chemically, it resembles *Graphis handelii* Zahlbr., which has epruinose disc (Lücking *et al.* 2009). The species was known from West Bengal.

Specimen examined: Andaman and Nicobar Islands, South Andaman, Chidiyatapu forest, alt. 5 m, *T.A.M. Jagadeesh Ram* 9 (PBL).

Graphis dendrogramma Nyl. 1878

Plate 2, figure E

Comparisons and remarks: This species is characterized by its immersed, radiately branched lirellae; concealed disc with pruinose labia; clear hymenium laterally carbonized exciple; 8 spored asci with 5–9 septa, 20–45 µm long ascospores and presence of stictic and constictic acids. Anatomically, it closely resembles *Graphis sundarbanensis* Jagadeesh Ram & G. P. Sinha, but latter species differs in having widely exposed whitish pruinose disc (Lücking *et al.* 2009). The species was previously known from Arunachal Pradesh, Kerala, Sikkim and West Bengal.

Specimens examined: Andaman and Nicobar Islands: North Andaman, Reef Island Wildlife Sanctuary, alt. 20 m, *T.A.M. Jagadeesh Ram* 1210, 1231, 1217 (PBL); Middle Andaman, Long Island seashore, alt. 10 m, on the bark of *Heritiera littoralis*, *T.A.M. Jagadeesh Ram* 1174 (PBL). Middle Andaman, Rampur Beach, alt. 12 m, *T.A.M. Jagadeesh Ram* 694, 739 (PBL); Long Island, seashore forest, alt. 10 m, *T.A.M. Jagadeesh Ram* 2474 (PBL). South Andaman, Outran Island, *T.A.M. Jagadeesh Ram* 1838 (PBL). South Andaman, Havelock Island, Radhanagar Beach forest, alt. 6 m, *T.A.M. Jagadeesh Ram* 3113 (PBL).

Graphis duplicata Ach. 1814

Plate 2, figure F

Comparisons and remarks: This species is characterized by its elongate and irregularly branched, erumpent to prominent lirellae without thalline margin; striate labia with laterally carbonized exciple; 8 spored asci with 10–15 septa, ascospores 32–45 × 7–9 µm, lichen substances absent. Morphologically, it closely resembles *Graphis striatula* (Ach.) Spreng., which has larger ascospores (Lücking et al. 2009). This species was previously known from Arunachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Tamil Nadu and Uttarakhand.

Specimens examined: Andaman and Nicobar Islands, South Andaman, Mount-Harriet National Park near watch tower, T.A.M. Jagadeesh Ram 2814 (PBL). Great Nicobar Island, North South road, Gandhi Nagar, alt. 5 m, T.A.M. Jagadeesh Ram 2947 (PBL).

Graphis insulana (Müll. Arg.) Lücking & Sipman 2008

Plate 2, figure G

Comparisons and remarks: This species is characterized by its elongate erumpent lirellae with thick lateral thalline margin; concealed disc; entire labia with laterally carbonized exciple; interspersed hymenium; 8 spored asci with muriform 50–80 µm long ascospores and presence of norstictic acid. Morphologically, it closely resembles *Graphis diplocheila* Vain., which has 1 to 2 spored asci and contains stictic acid (Lücking et al. 2009). The species was previously known from Karnataka and Maharashtra.

Specimens examined: Andaman and Nicobar Islands: Nicobar - Kondul Island, alt. 5 m, K. P. Singh & T.A.M. Jagadeesh Ram 3042 (PBL); Little Nicobar Island, Publobatia, alt. 5 m, on *Gnetum gnemon*, K. P. Singh & T.A.M. Jagadeesh Ram 3036 (PBL).

Graphis lineola Ach. 1810

Plate 2, figure H

Comparisons and remarks: This species is characterized by its erumpent lirellae with lateral thalline margin; entire labia with laterally carbonized exciple; interspersed hymenium with transversely 8–11 septa,

ascospores 35–40 × 6–8 µm, lichen substances absent. Morphologically, it closely resembles *Graphis polyclades* Kremp., which has muriform ascospores (Lücking et al. 2009). The species was previously known from Arunachal Pradesh, Karnataka, Tamil Nadu, Uttarakhand and West Bengal hills.

Specimen examined: Andaman and Nicobar Islands, South Andaman, Manjeri, on fallen trunk, alt. 10 m, T.A.M. Jagadeesh Ram 682 (PBL).

Graphis pinicola Zahlbr. 1930

Plate 2, figure A

Comparisons and remarks: *Graphis pinicola* is characterized by the short and sparsely branched lirellae; labia with laterally carbonized exciple; clear hymenium; 8 spored asci; 7–10 septa, 29–35 µm long ascospores and lacking lichen substances. Anatomically and in ascospore characters, it resembles *G. albissima* Müll. Arg., which has very long and irregularly to radiately branched lirellae (Lücking et al. 2009). The species was previously known from Arunachal Pradesh and Tamil Nadu.

Specimen examined: Andaman and Nicobar Islands, Great Nicobar Island, Govind Nagar, alt. 6 m, K.P. Singh & T.A.M. Jagadeesh Ram 2902 (PBL).

Graphis subserpentina Nyl. 1863

Plate 2, figure B

Comparisons and remarks: This species is characterized by its erumpent elongate and irregularly branched lirellae with lateral thalline margin; entire labia with laterally carbonized exciple; clear hymenium; 1 spored asci with large muriform 130–150 µm long ascospores and presence of norstictic acid. Morphologically, it resembles *Graphis streblocarpa* (Bél.) Nyl., which has stictic acid (Lücking et al. 2009). The species was previously known from Arunachal Pradesh, Karnataka, Kerala, Maharashtra and West Bengal.

Specimens examined: Andaman and Nicobar Islands: North Andaman, Ramnagar sea shore forest, alt. 10 m, T.A.M. Jagadeesh Ram 378 (PBL). Middle Andaman, Long Island sea shore, alt. 7 m, T.A.M. Jagadeesh Ram 1156 (PBL).

Graphis sundarbanensis Jagadeesh & Sinha 2007

Plate 2, figure C

Comparisons and remarks: This species is characterized by the immersed lirellae with exposed whitish pruinose disc; entire labia with laterally carbonized exciple; clear hymenium; 7–8 septa, 20–30 µm long ascospores and presence of stictic acid as a major secondary compound. It closely resembles *Graphis pyrrocheiloides* Zahlbr., which contains norstictic acid. The species was previously known from West Bengal.

Specimens examined: Andaman and Nicobar Islands: North Andaman, Ramnagar seashore forest, alt. 10 m, *T.A.M. Jagadeesh Ram* 381, 386 (PBL). Middle Andaman, Rampur Beach, alt. 6 m, *T.A.M. Jagadeesh Ram* 699 (PBL). South Andaman, Henry Lawrence Island, alt. 8 m, *T.A.M. Jagadeesh Ram* 1931 (PBL).

Graphis supracola Archer, 2001

Plate 2, figure D

Comparisons and remarks: This species is characterized by the erumpent, short to elongate and irregularly branched lirellae with concealed disc, entire whitish pruinose labia; clear hymenium with laterally carbonized excipulum; transversely 5 septa, 23–29 × 5–7 µm ascospores and presence of protocetraric acid. Anatomically it closely resembles *Graphis distincta* Makhija & Adaw., which has exposed whitish pruinose disc (Lücking et al. 2009). The species was previously known from Tripura.

Specimen examined: Andaman and Nicobar Islands, Little Andaman, Butler Bay Beach forest, alt. 10 m, *T.A.M. Jagadeesh Ram* 1603 (PBL).

Pallidogramme chrysenteron (Mont.) Staiger & Al. 2008

Plate 2, figure E

Comparisons and remarks: This species is characterized by the creamish, prominent simple to branched, striate lirellae with narrow disc; uncarbonized convergent exciple with lateral thalline margin; inspersion of hymenium; 6–8 spored asci with muriform, 48–64 µm long ascospores and presence of stictic and constictic

acids. Morphologically, anatomically and in chemical composition it resembles *Pallidogramme chlorocarpoides* (Nyl.) Staiger & Al. which has 2–4 spored asci and 65–110 µm long ascospores (Staiger 2002). The species was previously known from Manipur, Meghalaya, Nagaland and Sikkim.

Specimens examined: Andaman and Nicobar Islands: South Andaman, Nayashahar, Motor Vhanji forest, E, alt. 19 m, *K.P. Singh* 9379 (BSA); Great Nicobar island, Govind Nagar, alt. 6 m, *K.P. Singh & T.A.M. Jagadeesh Ram* 2894 (PBL).

Platygramme platyloma (Müll. Arg.) Nakan. & Kashiw., 2003

Plate 2, figure F

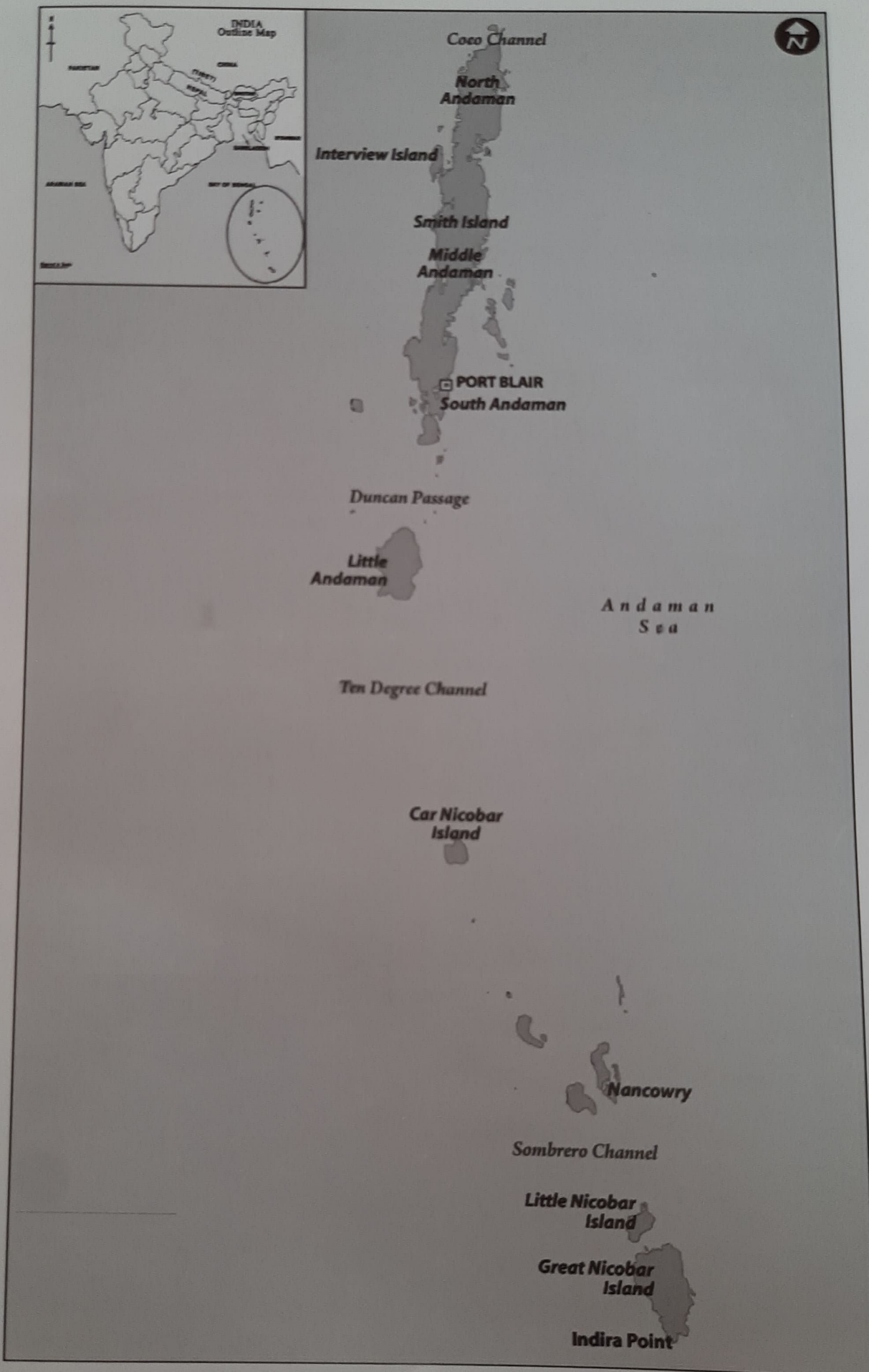
Comparisons and remarks: This species is characterized by the conspicuous lirellae with narrow disc; laterally carbonized wedge-shaped exciple with thick labia; inspersion of hymenium; 1 spored asci with large muriform, 120–150 × 25–35 µm ascospores and lack of lichen substances. It closely resembles *Platygramme muelleri* (A. W. Archer) Staiger, which has apically carbonized lirellae with opened disc (Staiger 2002). The species was previously known from Karnataka and Orissa.

Specimens examined: Andaman and Nicobar Islands: South Andaman, Nayashahar, Motor Vhanji forest, 11°33'93.2" N and 92°40'58.8" E, alt. c. 19 m, *K.P. Singh* 9378 (BSA). Great Nicobar Island, Govind Nagar, on *Areca catechu*, alt. 6 m, *K. P. Singh & T.A.M. Jagadeesh Ram* 2892 (PBL).

Sarcographa tricola (Ach.) Müll. Arg., 1887

Plate 2, figure G

Comparisons and remarks: This species is characterized by the stellate lirellae immersed in conspicuous raised stromata; completely carbonized exciple; inspersion of hymenium and constantly 3 septate ascospores and absence of lichen substances. Morphologically and anatomically, it resembles *Sarcographa medusulina* (Nyl.) Müll. Arg., which has carbonized exciple spreading to adjacent regions of stromata. The species was previously known from Arunachal Pradesh and West Bengal plains.



Text Figure 1. Map showing the Andaman and Nicobar Islands, India (not to scale)

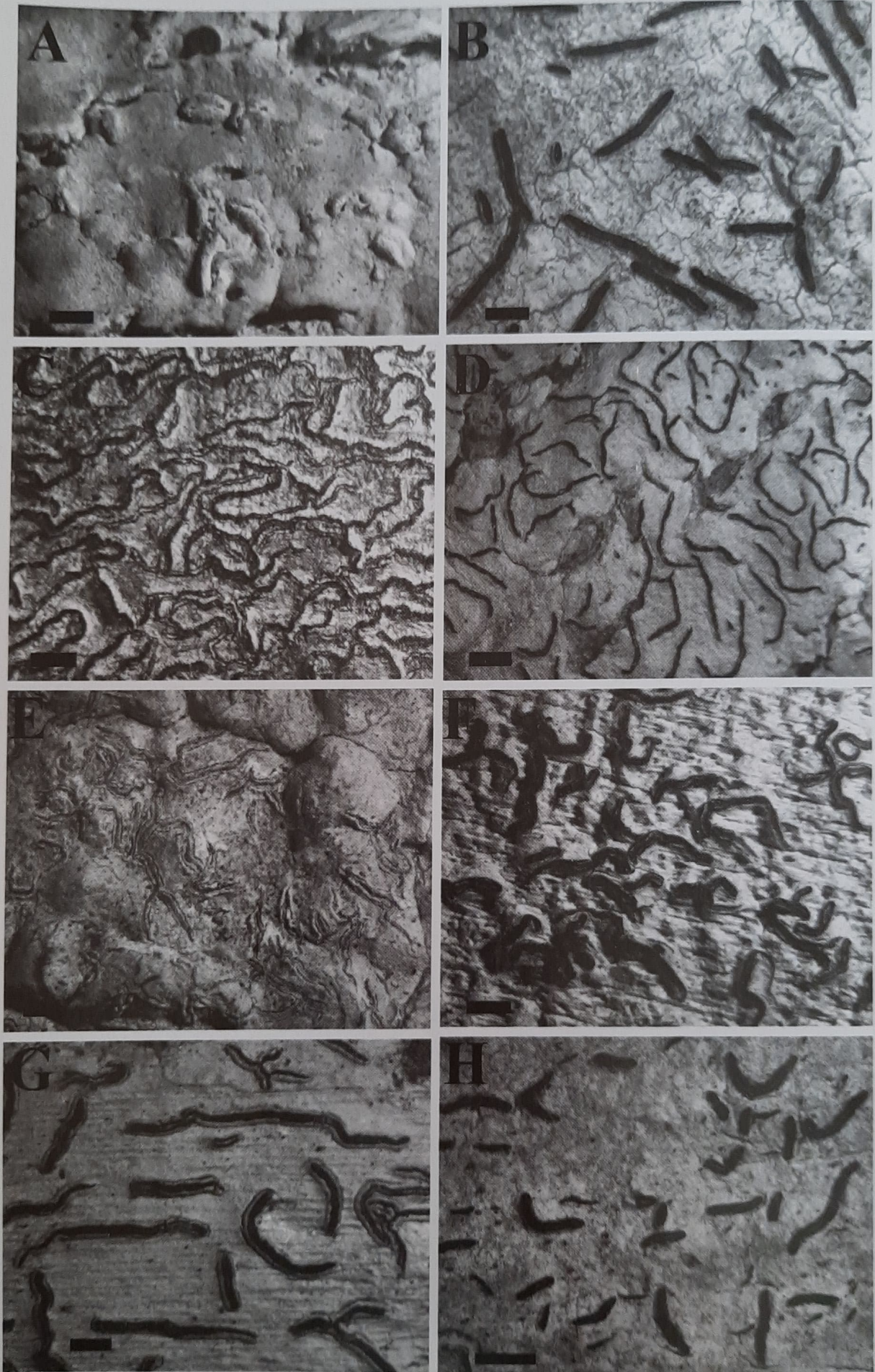


Plate 1

A. *Diorygma pachygraphum*. B. *Graphis analoga*. C. *Graphis crassilabra*. D. *Graphis crebra*. E. *Graphis dendrogramma*. F. *Graphis duplicate*. G. *Graphis insulana*. H. *Graphis lineola* (Scale Bar = 1mm).

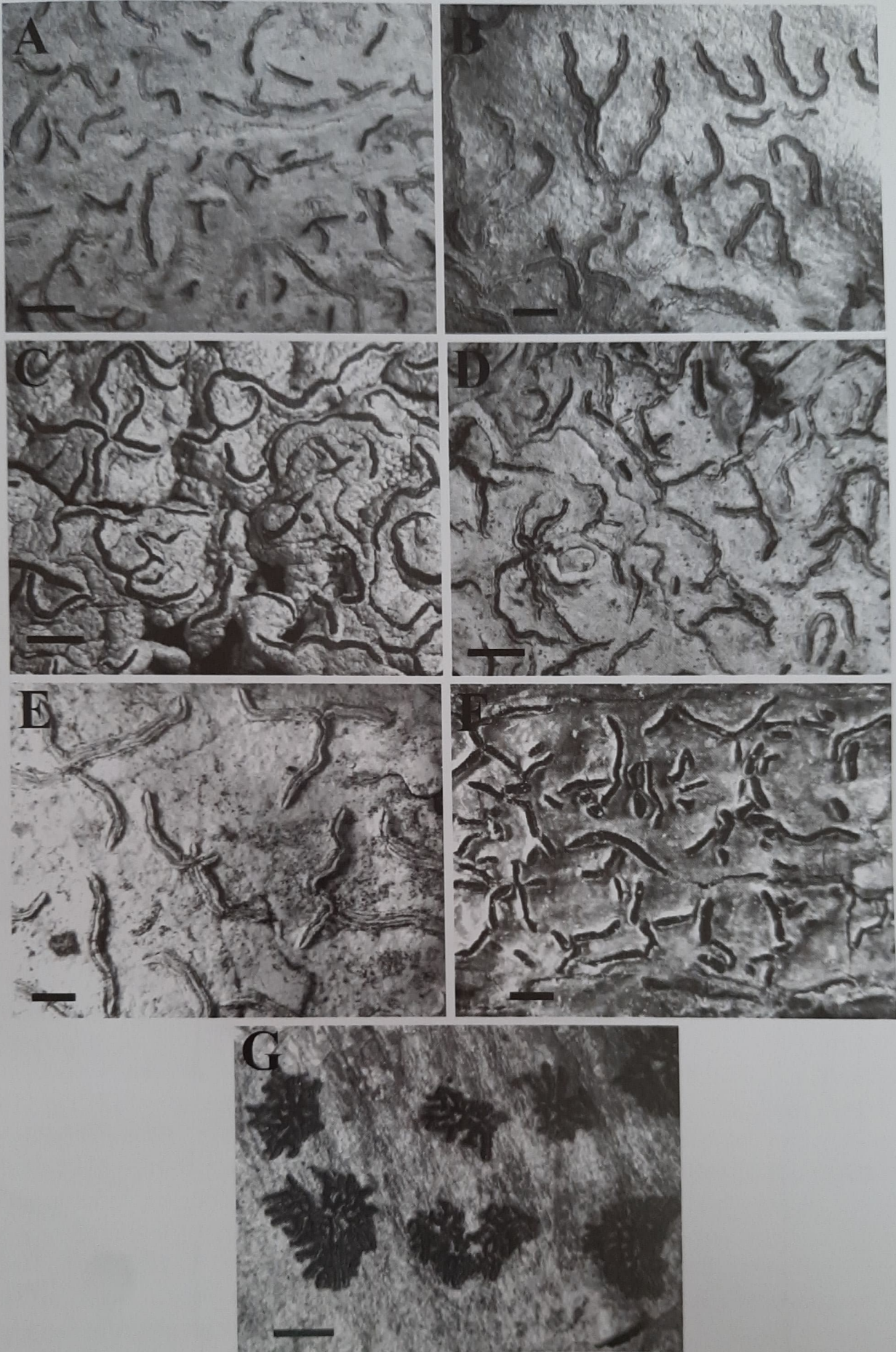


Plate 2

A. *Graphis pinicola*. B. *Graphis subserpentina*. C. *Graphis sundarbanensis*. D. *Graphis supracola*. E. *Pallidogramme chrysenteron*. F. *Platygramme platyloma*. G. *Sarcographa tricosa* (Scale Bar = 1 mm).

Specimen examined: Andaman and Nicobar Islands, Great Nicobar Island, Laful, alt. 3 m, *K.P. Singh & T.A.M. Jagadeesh Ram* 3049 (PBL).

ACKNOWLEDGEMENTS

The authors are thankful to Director, Botanical Survey of India, Kolkata for encouragement. The authors also thank the authorities of Botanical Survey of India in Central Regional Centre, Allahabad and Andaman and Nicobar Regional Centre, Port Blair for providing necessary facilities. One of the authors (PS) is thankful to the authorities of the Botanical Survey of India, for financial assistance under the 'Flora of India Project'.

REFERENCES

- Jagadeesh Ram, T.A.M. & Singh K.P. 2014. *Dictyonema irrigatum* (Berk. & M.A. Curtis) Lücking, an interesting Basidiolichen from Great Nicobar Island, India. *Indian J. Forest.* 37(3): 361–363.
- Jagadeesh Ram, T.A.M. 2013. The lichen genus *Cresponea* (Roccellaceae) in the Andaman Islands. *Indian J. Forest.* 36: 393–400.
- Jagadeesh Ram, T.A.M. 2014a. The genus *Herpothallon* (Arthoniaceae) in the Andaman Islands, India. *Lichenologist.* 46(1): 39–49.
- Jagadeesh Ram, T.A.M. 2014b. New species and new records in Roccellaceae (Arthoniales) from the Andaman Islands, India. *Phytotaxa.* 177 (3): 155–162.
- Jagadeesh Ram, T.A.M. 2015a. Additional lichen records from the Andaman and Nicobar Islands – 1. *Indian J. Forest.* 38: 63–69.
- Jagadeesh Ram, T.A.M. 2015b. Additional lichen records from the Andaman and Nicobar Islands – 2. *Indian J. Forest.* 38: 165–170.
- Jagadeesh Ram, T.A.M. 2016. Additional new species in Roccellaceae s.l. from the Andaman and Nicobar Islands, India. *Phytotaxa.* 246 (4): 281–286.
- Kalb K., Staiger B. & Elix J.A. 2004. A monograph of the lichen Lücking, R., Archer, A.W. & Aptroot, A. 2009. A world-wide key to the genus *Graphis* (Ostropales: Graphidaceae). *Lichenologist*, 41: 363–452.
- Orange, A., James, P.W. & White, F.J. 2001. Microchemical methods for the identification of lichens. British Lichen Society, UK, pp 1–101.
- Sharma, B.O., Khadilkar, P. & Makhija, U. 2012. New species and new combinations in the lichen genera *Fissurina* and *Hemithecium* from India. *Lichenologist*, 44(3): 339–362.
- Singh, K.P. & Sinha, G.P. 2010. Indian Lichens: An Annotated Checklist. Botanical Survey of India. Kolkata. pp 1–571.
- Singh, P. Singh K.P. & Bhatt A.B. 2015. Diversity and distribution of microlichens in a state of Arunachal Pradesh, Eastern Himalaya, India. *Check List*, 11 (6): 1–20.
- Staiger, B. 2002. Die Flechtenfamilie *Graphidaceae*: Studien in Richtung einer natürlicheren Gliederung. *Biblioth. Lichenologist*, 85: 1–526.