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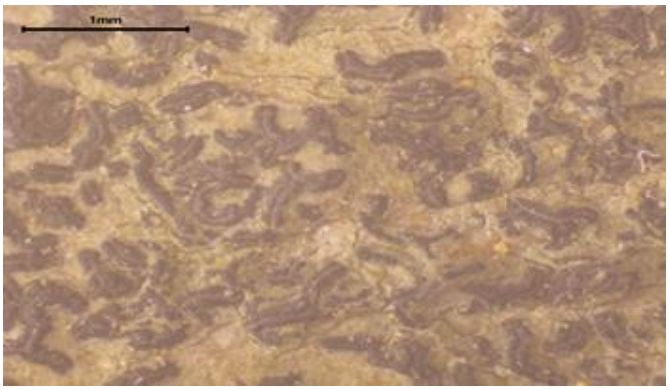
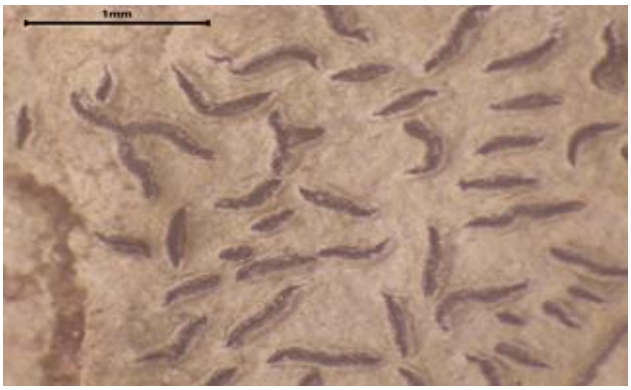
PHOTO PLATES

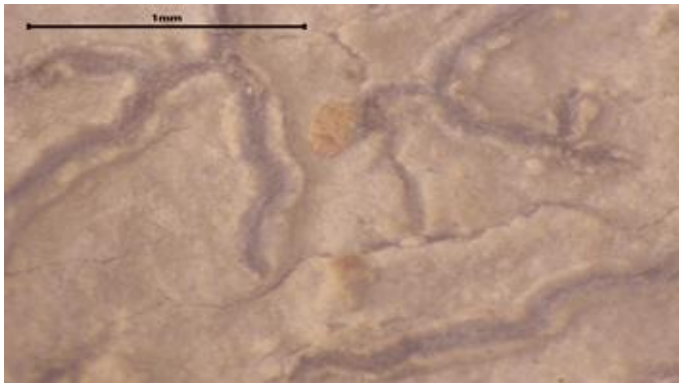
PLATE 1



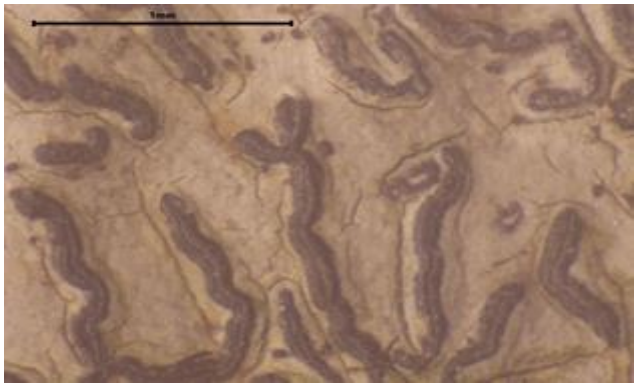
(a) *Allographa fujianensis* (scale bar 1mm)



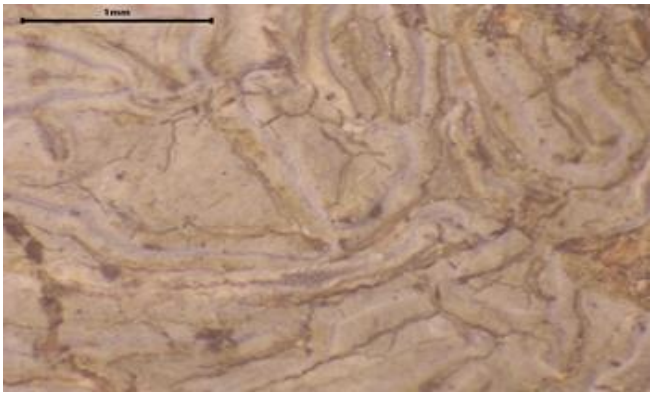
(b) *Allographa hossei* (scale bar 1mm)



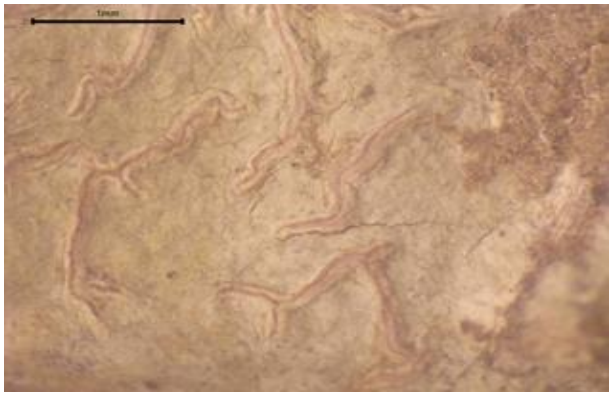
(c) *Allographa malacodes* (scale bar 1mm)



(d) *Allographa rhizicola* (scale bar 1mm)

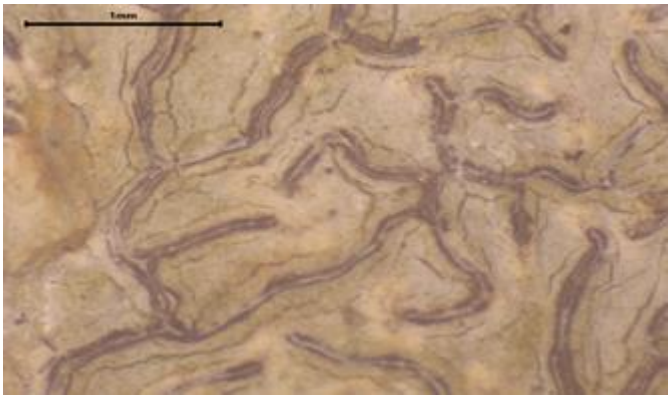


(e) *Allographa sayeri* (scale bar 1mm)

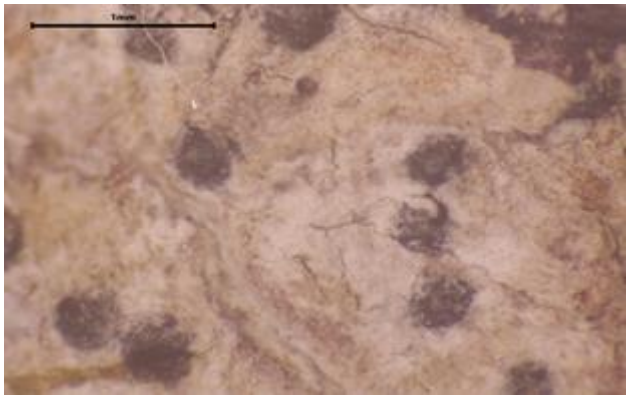


(f) *Allographa stictilabiata* (scale bar 1mm)

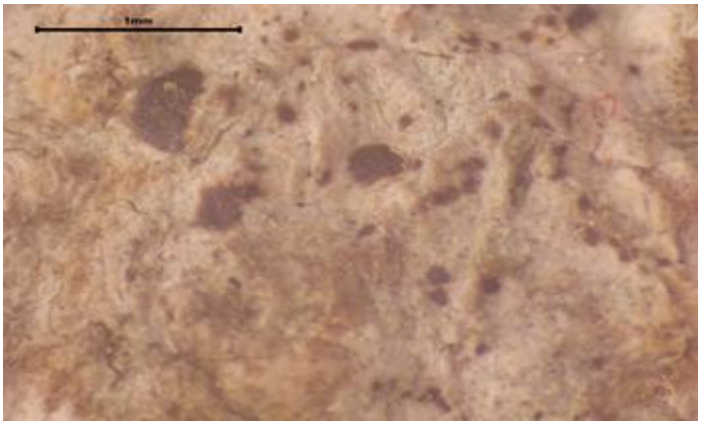
PLATE 2



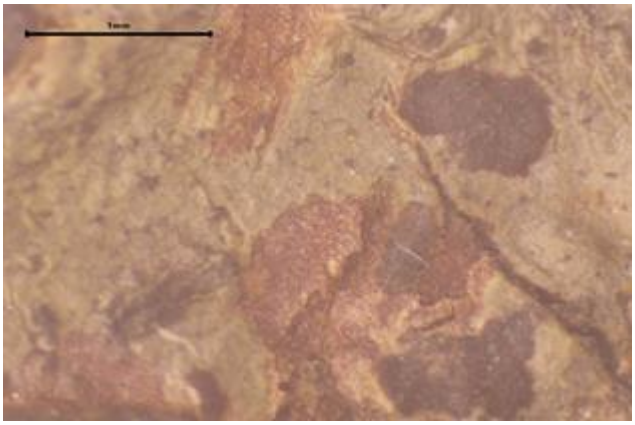
(a) ***Allographa xanthospora*** **(scale bar 1mm)**



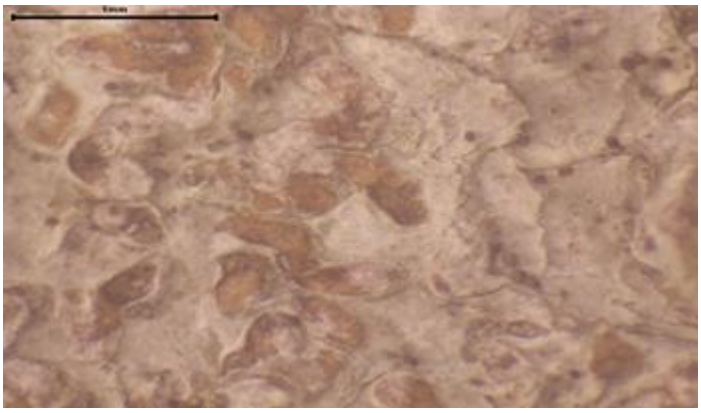
(b) ***Arthopyrenia subvelata*** **(scale bar 1mm)**



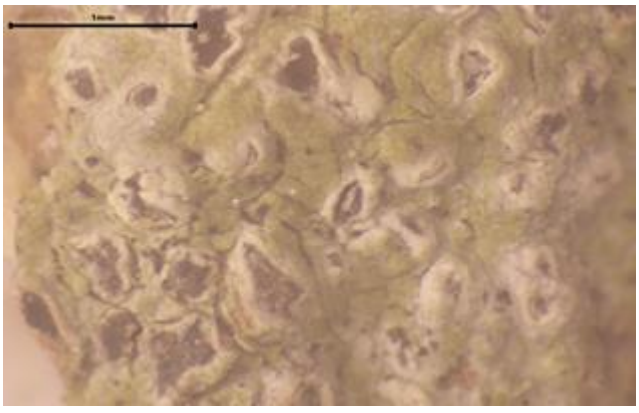
(c) ***Arthonia collectiva*** **(scale bar 1mm)**



(d) ***Arthonia dispersula*** **(scale bar 1mm)**

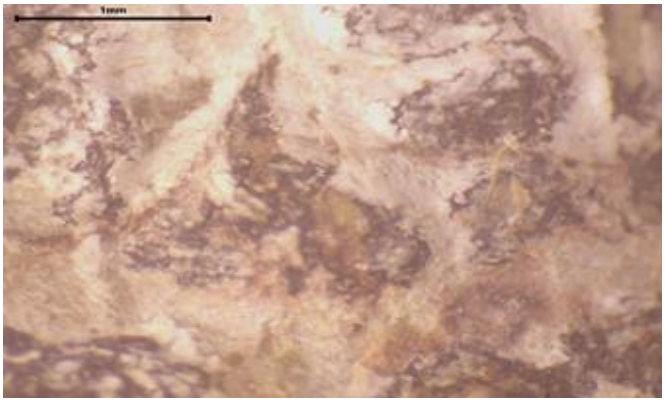


(e) ***Arthonia fissurinella*** **(scale bar 1mm)**

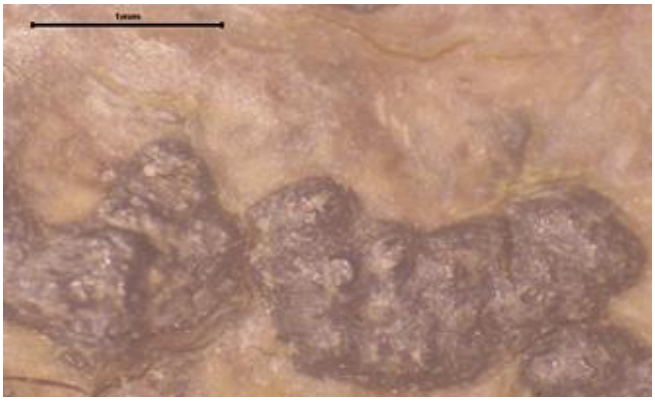


(f) ***Arthonia recedens*** **(scale bar 1mm)**

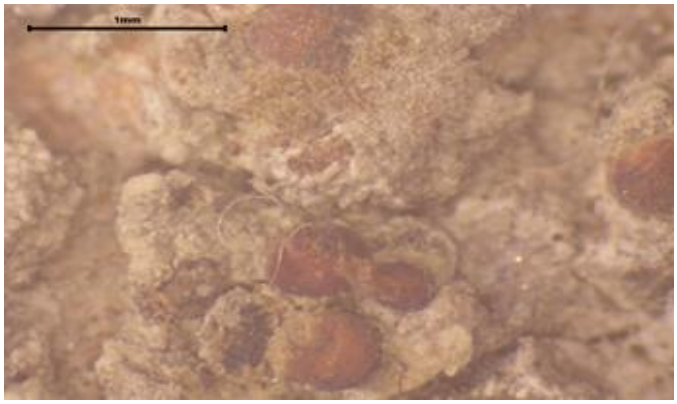
PLATE 3



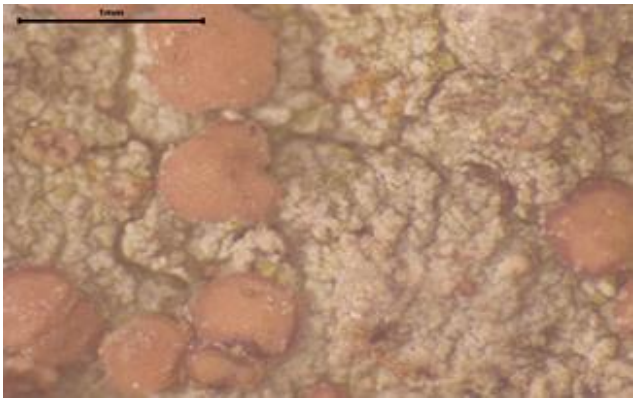
(a) *Arthothelium confertum* (scale bar 1mm)



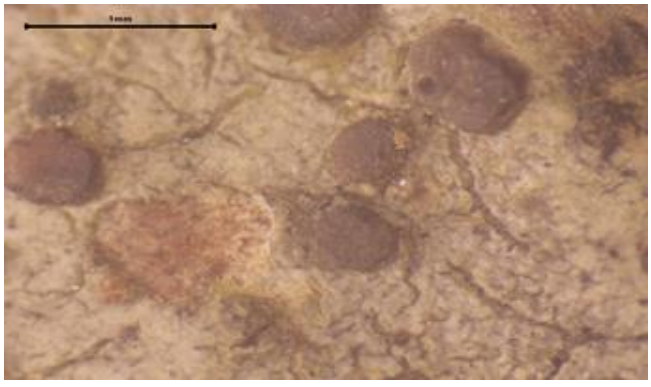
(b) *Astrothelium pupula* (scale bar 1mm)



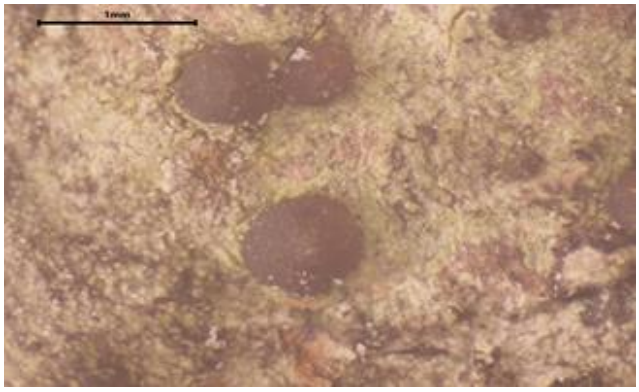
(c) *Bacidia alutacea* (scale bar 1mm)



(d) *Bacidia convexula* (scale bar 1mm)

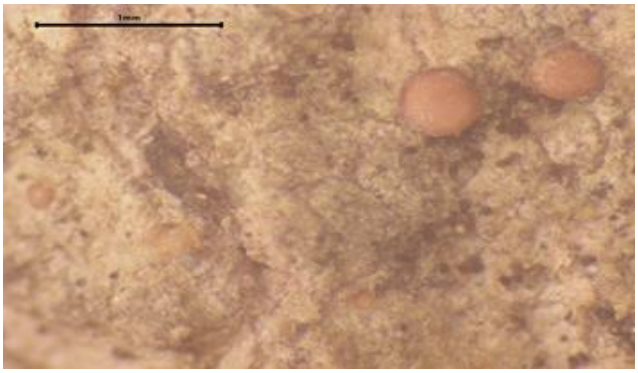


(e) *Bacidia millegrana* (scale bar 1mm)

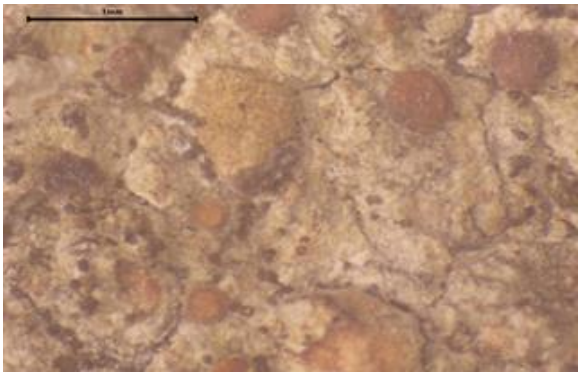


(f) *Bacidia personata* (scale bar 1mm)

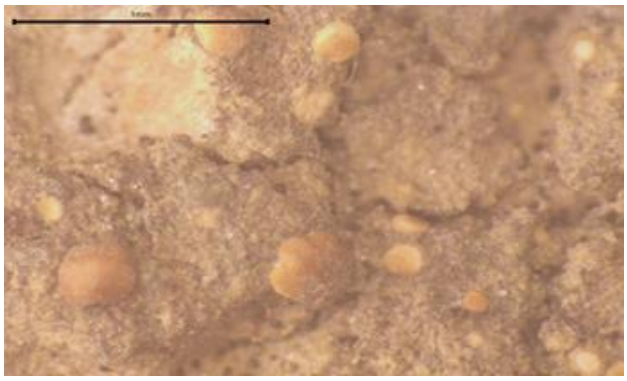
PLATE 4



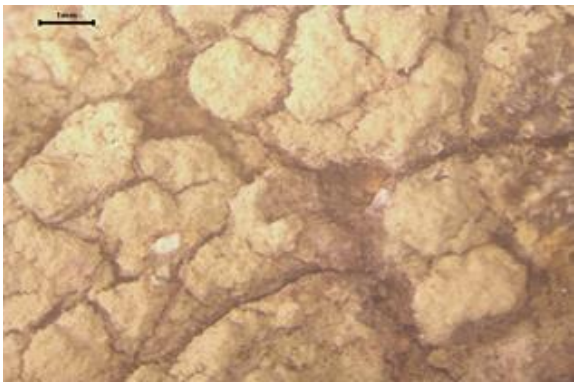
(a) *Bacidia rubella* (scale bar 1mm)



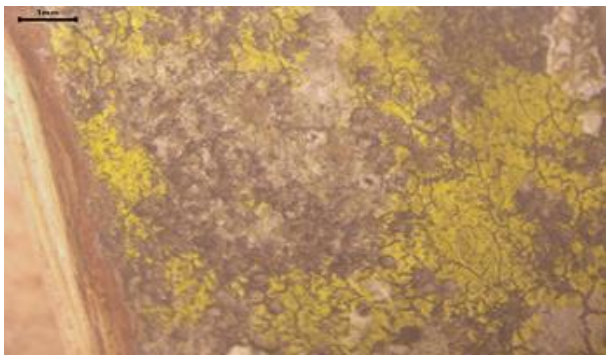
(b) *Bacidia submedialis* (scale bar 1mm)



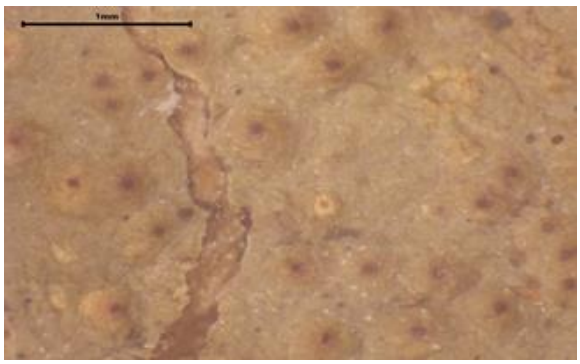
(c) *Bacidina medialis* (scale bar 1mm)



(d) *Chrysothrix candelaris* (scale bar 1mm)

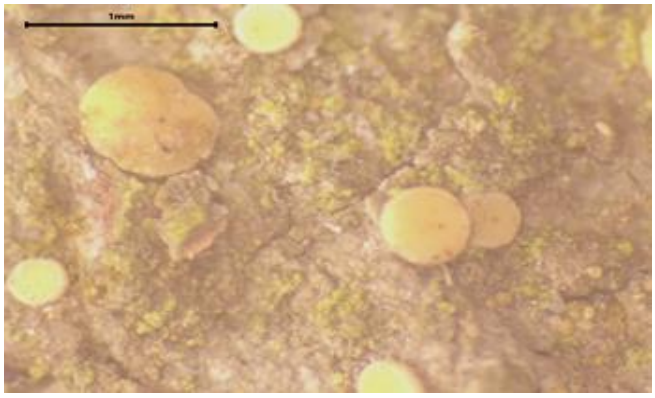


(e) *Chrysothrix chlorina* (scale bar 1mm)

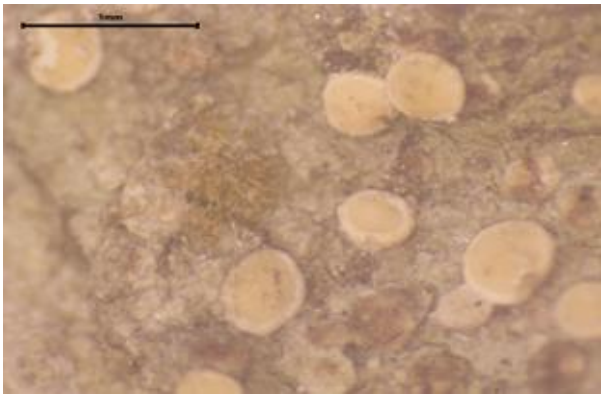


(f) *Clathroporina mastoidea* (scale bar 1mm)

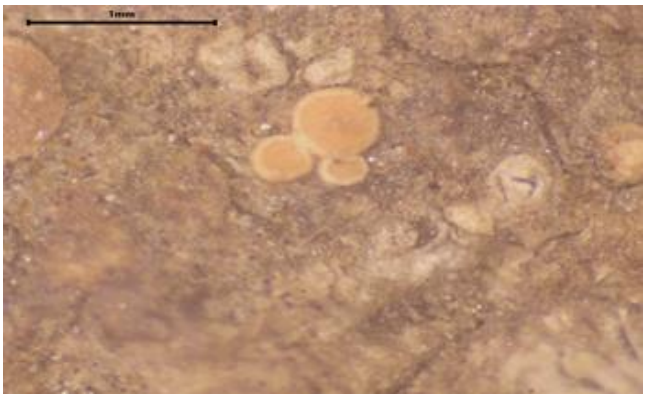
PLATE 5



(a) *Coenogonium bacilliferum* (scale bar 1mm)



(b) *Coenogonium pineti* (scale bar 1mm)



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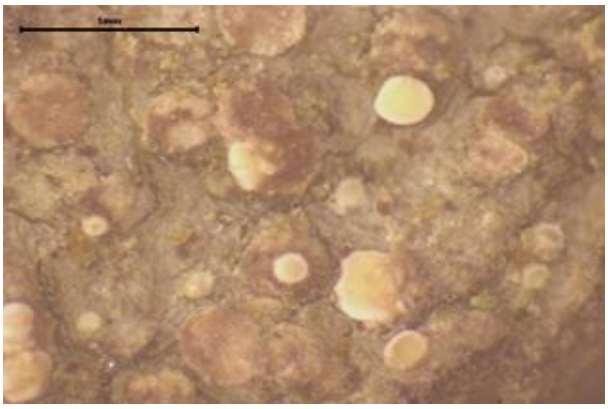
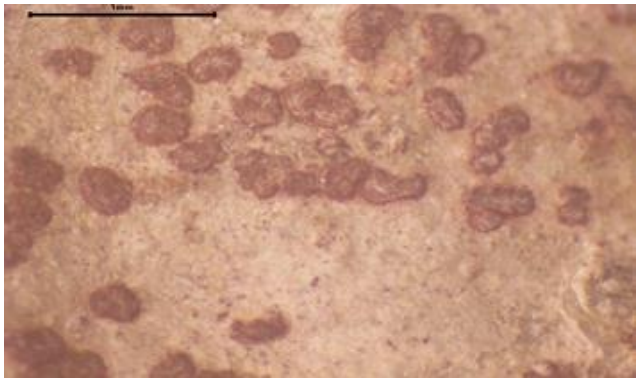
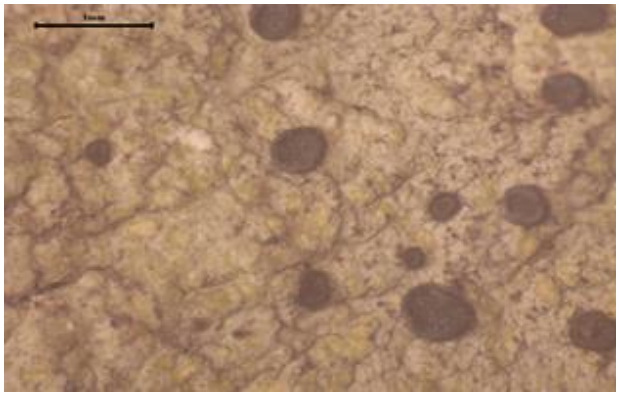


(d) *Coenogonium wrightii* (scale bar 1mm)



(e) *Coniocarpon cinnabarinum* (scale bar 1mm)

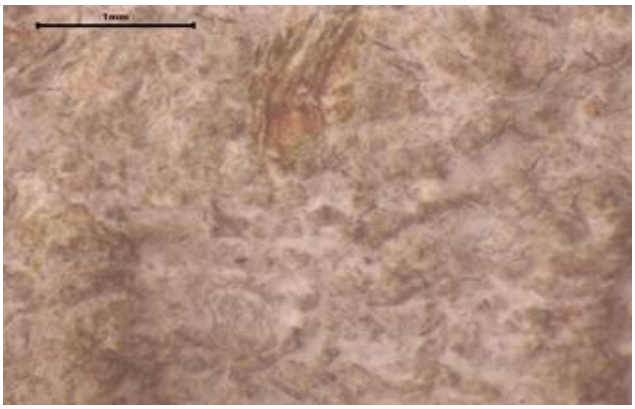


(f) *Cratiria lauricassiae* (scale bar 1mm)

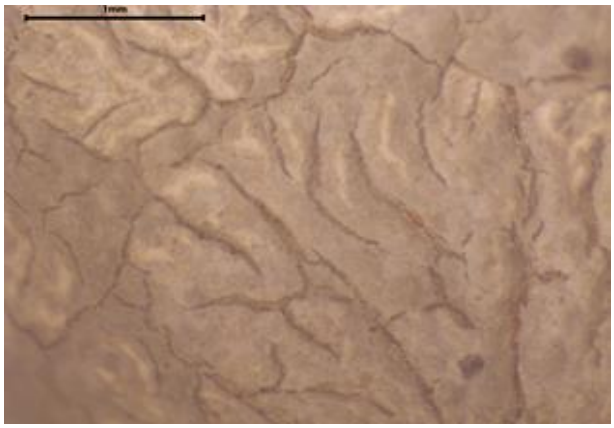
PLATE 6

(a) *Cryptothecia lunulata* (scale bar 1mm)

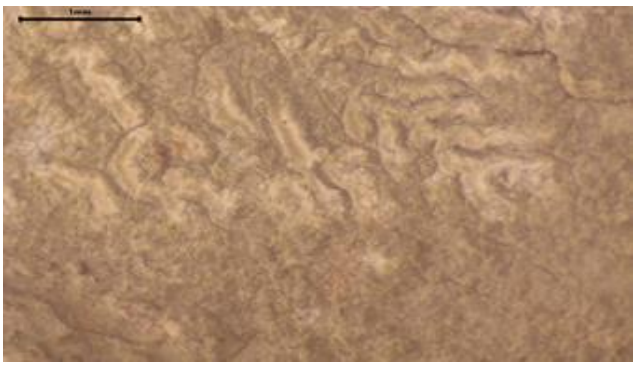
(b) *Cryptothecia subtecta* (scale bar 1mm)



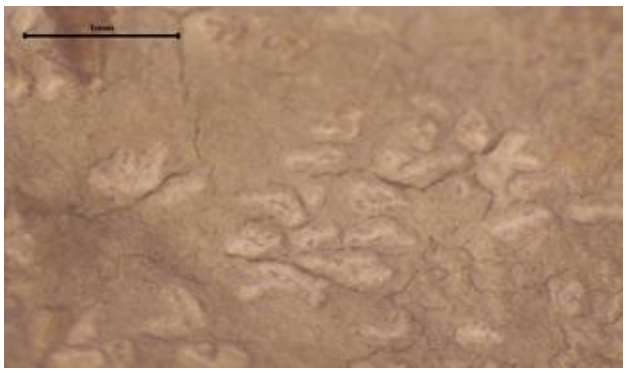
(c) *Cryptothecia verruculifera* (scale bar 1mm)



(d) *Diorygma hieroglyphicum* (scale bar 1mm)

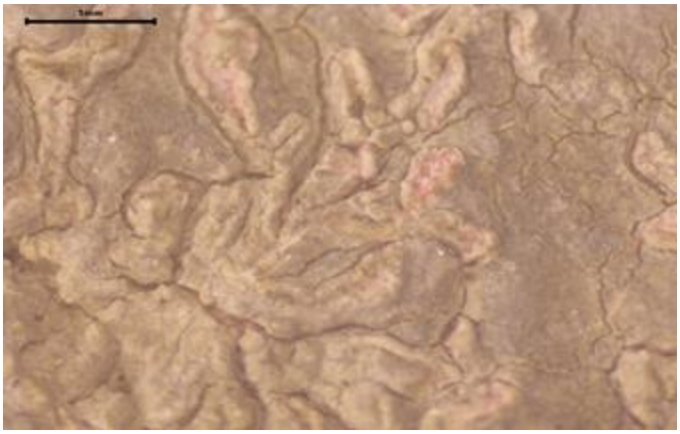


(e) *Diorygma junghuhnii* (scale bar 1mm)

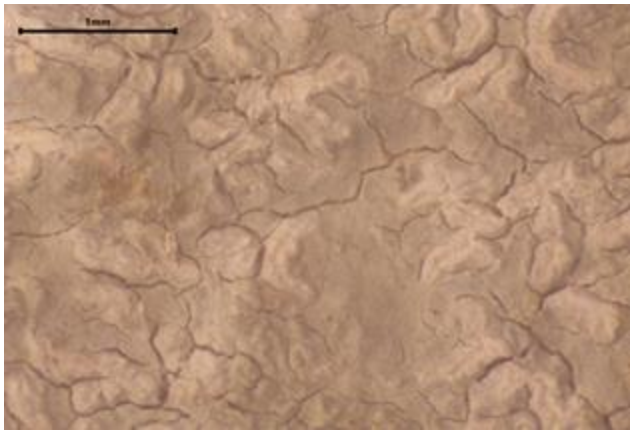


(f) *Diorygma reniforme* (scale bar 1mm)

PLATE 7



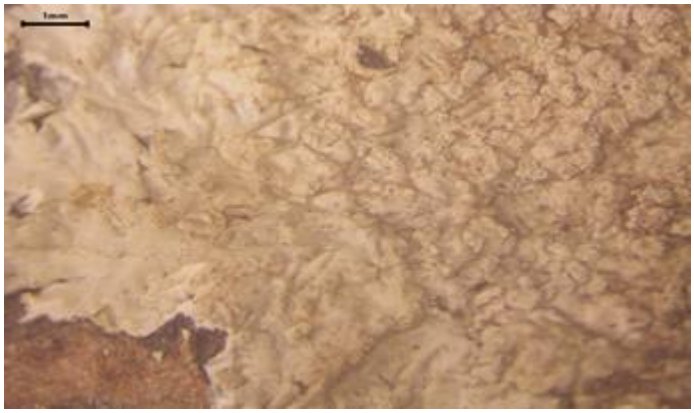
(a) *Diorygma roseopruinatum* (scale bar 1mm)



(b) *Diorygma soozanum* (scale bar 1mm)

(c) *Dirinaria aegialita* (scale bar 1mm)

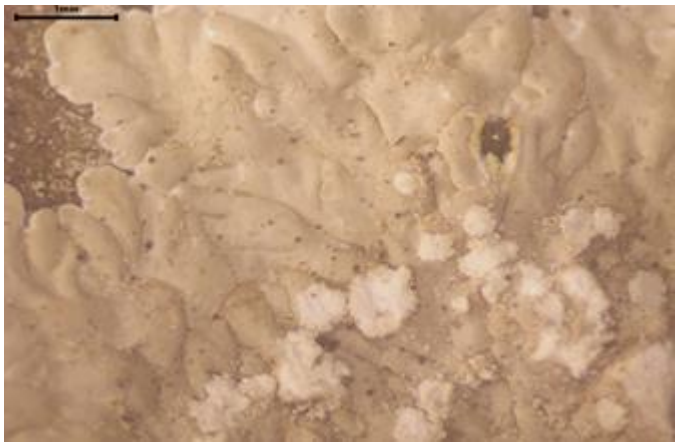
(d) *Dirinaria applanata* (scale bar 1mm)



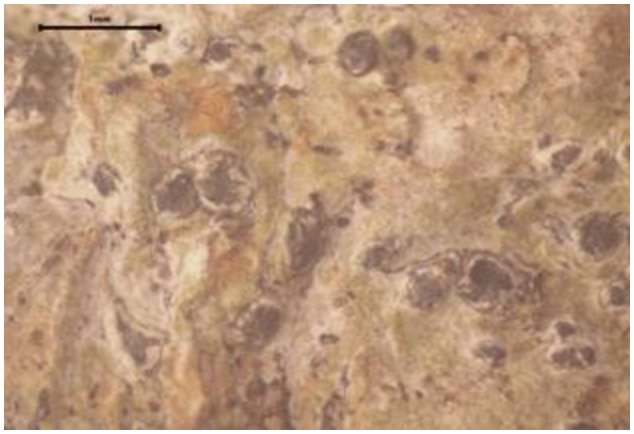
(e) *Dirinaria consimilis* (scale bar 1mm)

(f) *Dirinaria papillulifera* (scale bar 1mm)

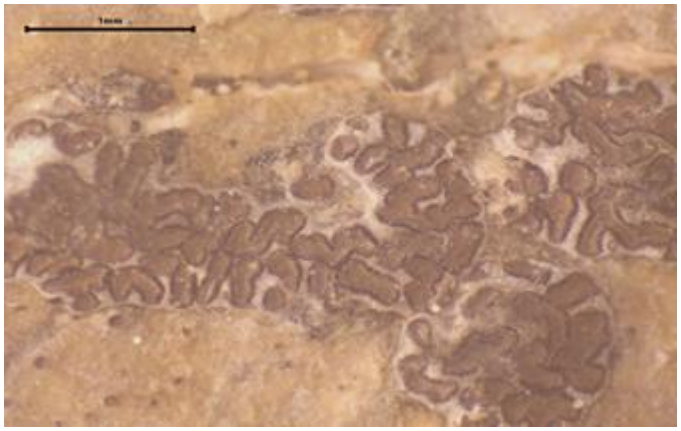
PLATE 8



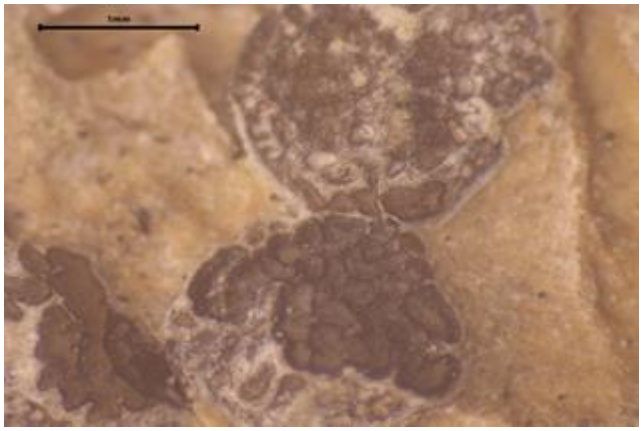
(a) *Dirinaria picta* (scale bar 1mm)



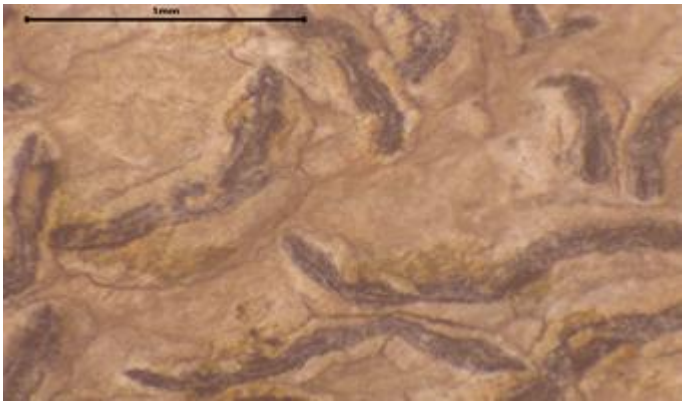
(b) *Enterographa mesomela* (scale bar 1mm)



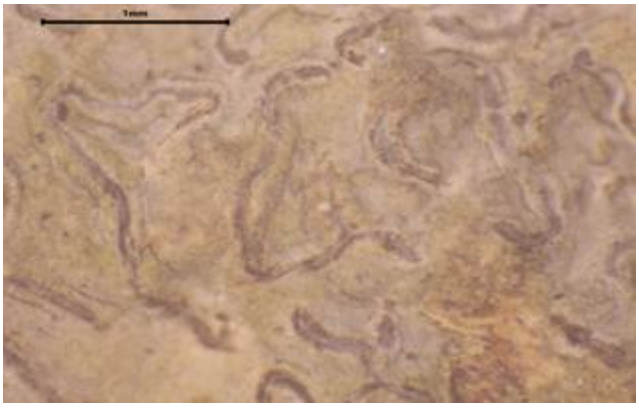
(c) *Glyphis cicatricosa* (scale bar 1mm)



(d) *Glyphis duriuscula* (scale bar 1mm)

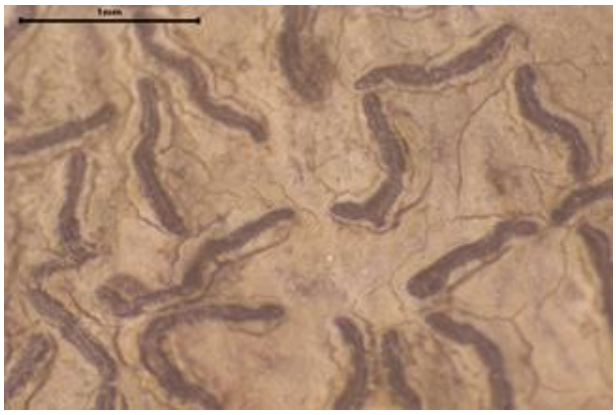


(e) *Graphis ajarekarii* (scale bar 1mm)

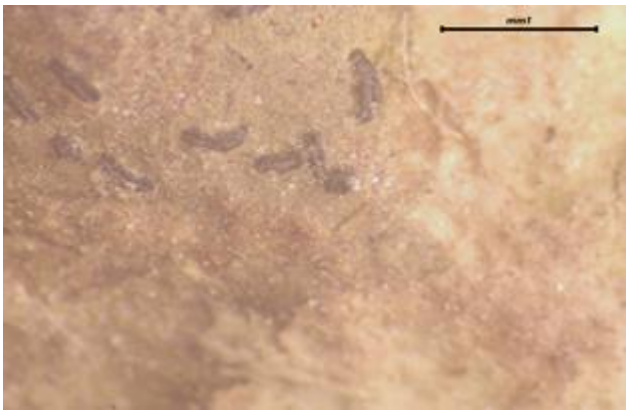


(f) *Graphis alboglaucescens* (scale bar 1mm)

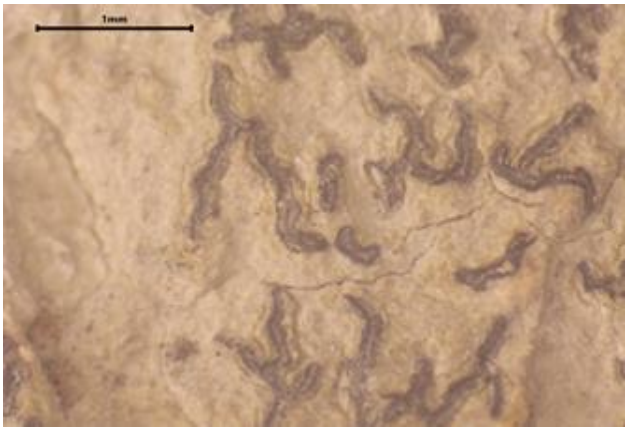
PLATE 9



(a) *Graphis analoga* (scale bar 1mm)

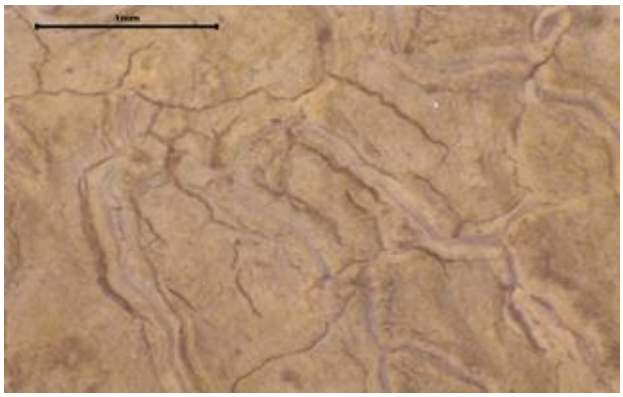


(b) *Graphis anfractuosa* (scale bar 1mm)

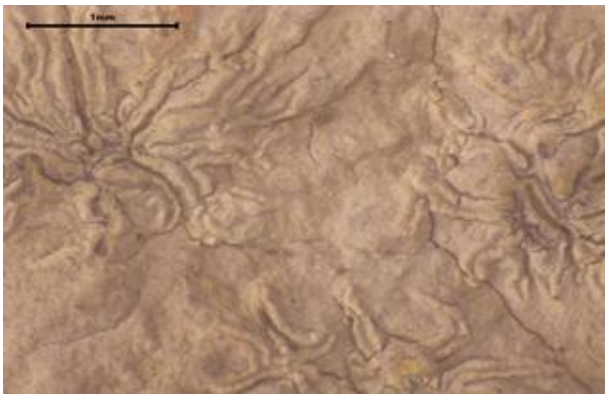


(c) *Graphis aperiens* (scale bar 1mm)

(d) *Graphis arbusculaeformis* (scale bar 1mm)

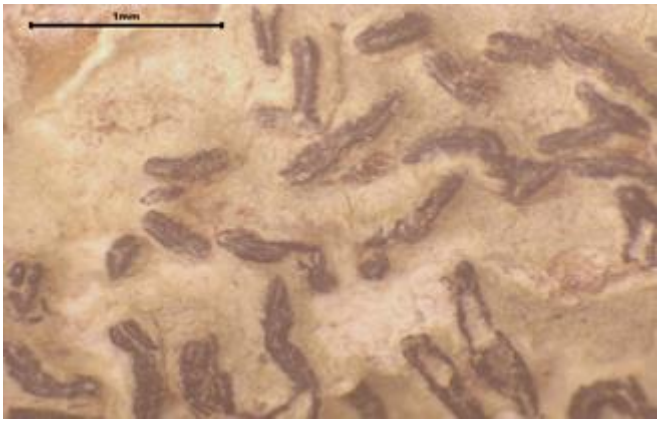


(e) *Graphis arecae* (scale bar 1mm)

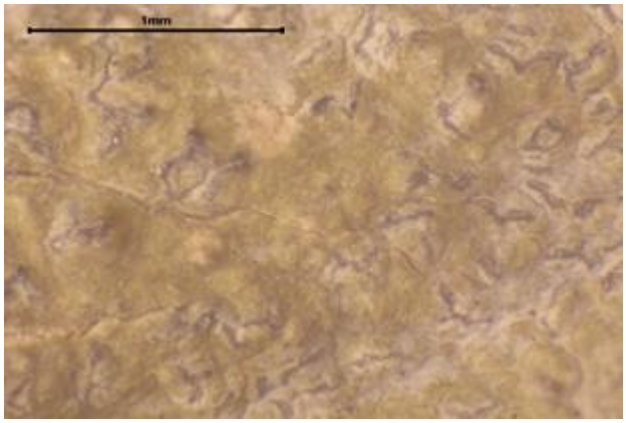


(f) *Graphis argentia* (scale bar 1mm)

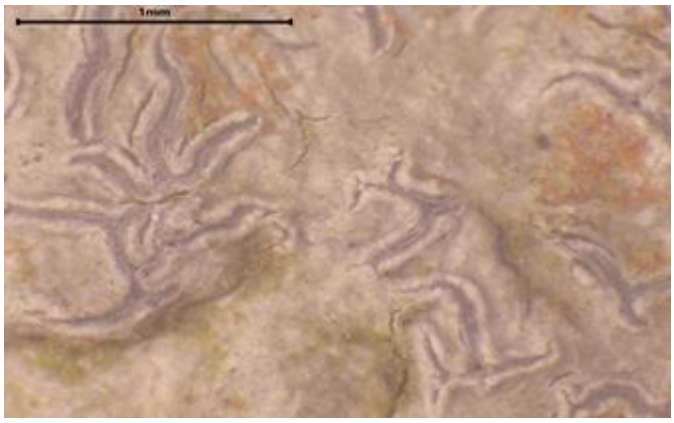
PLATE 10



(a) *Graphis asahinae* (scale bar 1mm)

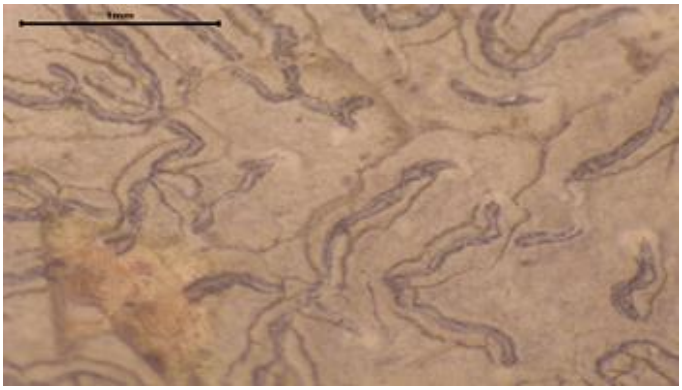


(b) *Graphis bakeri* (scale bar 1mm)

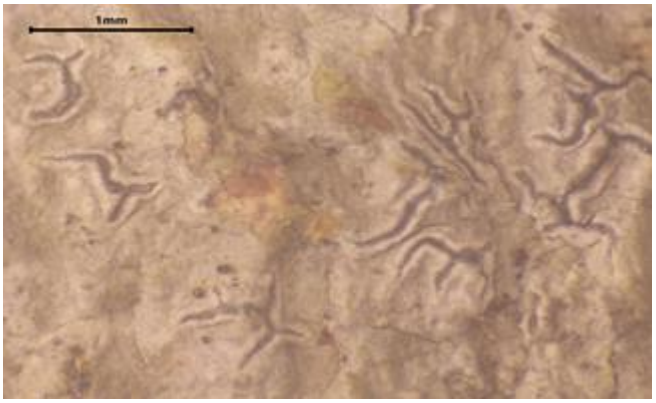


(c) *Graphis caesiella* (scale bar 1mm)

(d) *Graphis caesiocarpa* (scale bar 1mm)

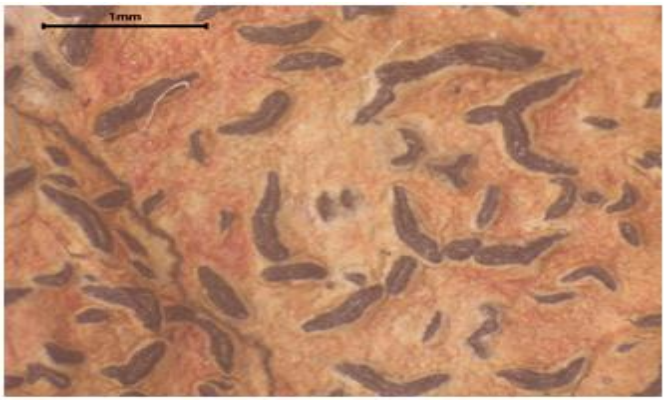


(e) *Graphis capillacea* (scale bar 1mm)



(f) *Graphis cervina* (scale bar 1mm)

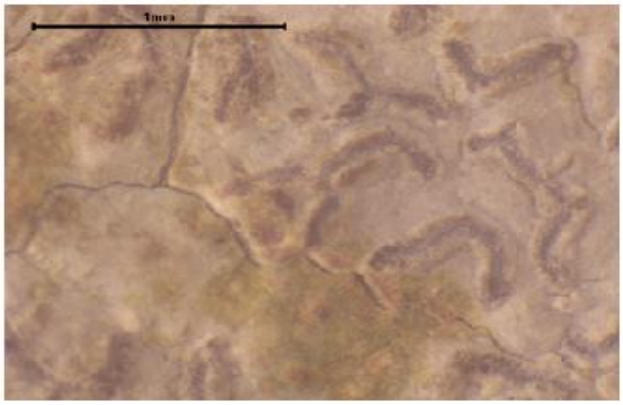
PLATE 11



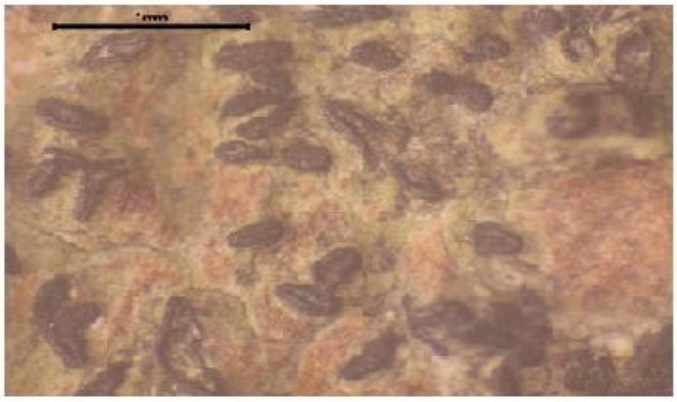
(a) *Graphis cervinonigra* (scale bar 1mm)

(b) *Graphis cinnamomea* (scale bar 1mm)

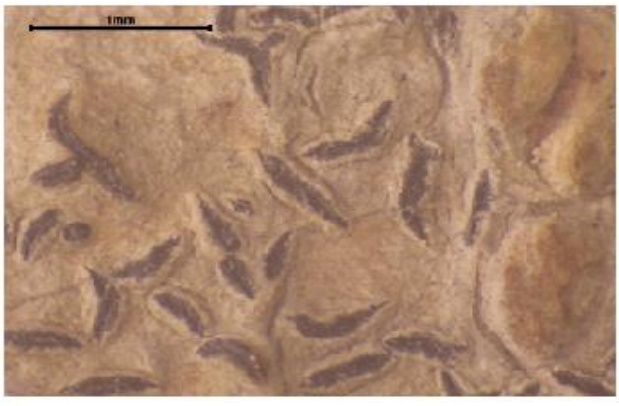
(c) *Graphis cincta* (scale bar 1mm)



(d) *Graphis coarctata* (scale bar 1mm)

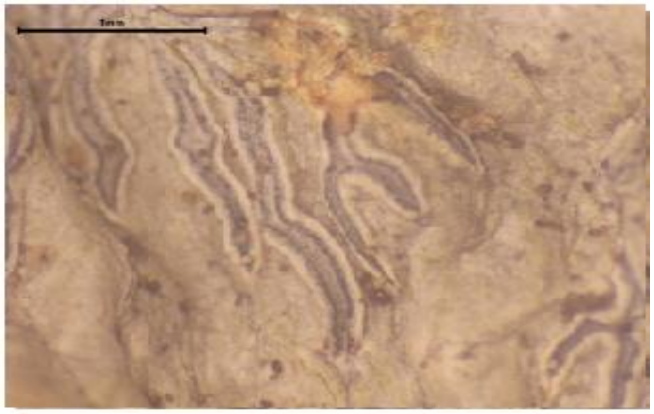


(e) *Graphis conferta* (scale bar 1mm)

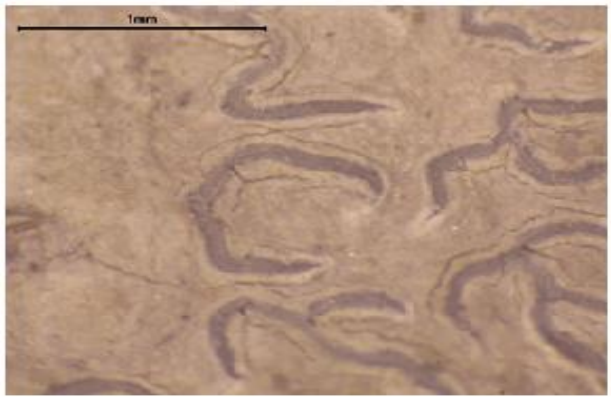


(f) *Graphis consimilis* (scale bar 1mm)

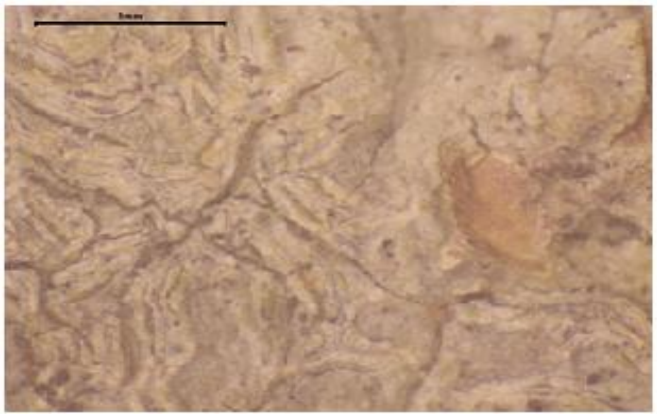
PLATE 12



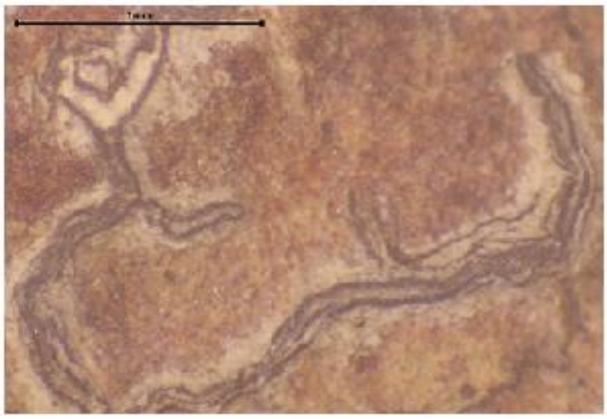
(a) *Graphis crebra* (scale bar 1mm)



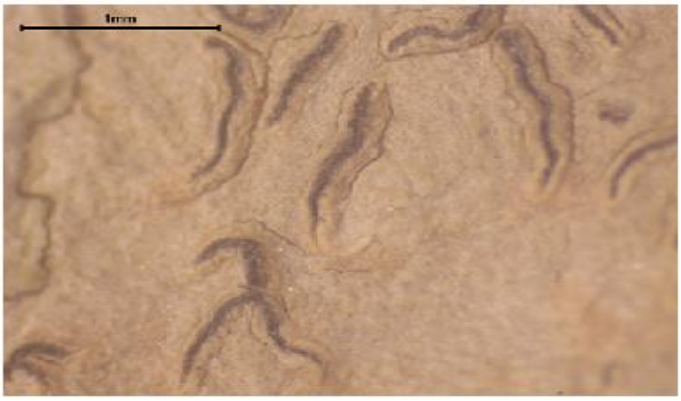
(b) *Graphis cremicolor* (scale bar 1mm)



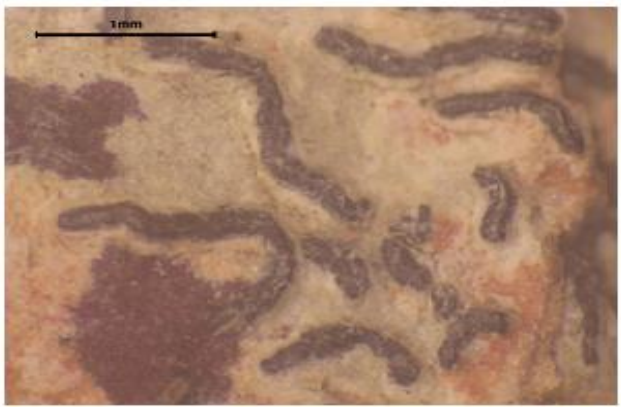
(c) *Graphis dendrogramma* (scale bar 1mm)



(d) *Graphis distincta* (scale bar 1mm)

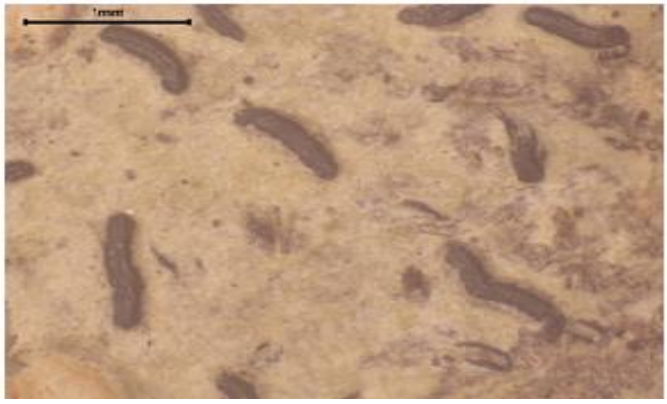


(e) *Graphis dracaenae* (scale bar 1mm)

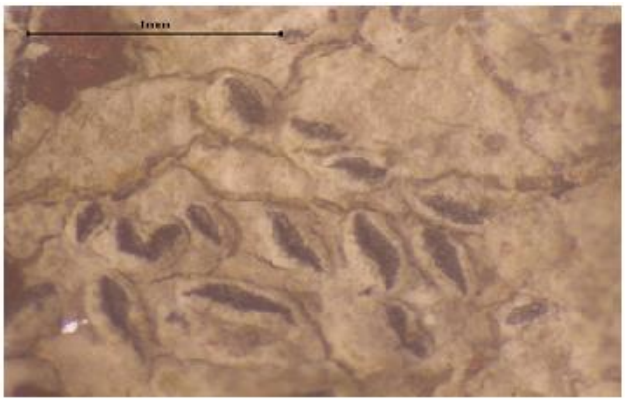


(f) *Graphis eburnea* (scale bar 1mm)

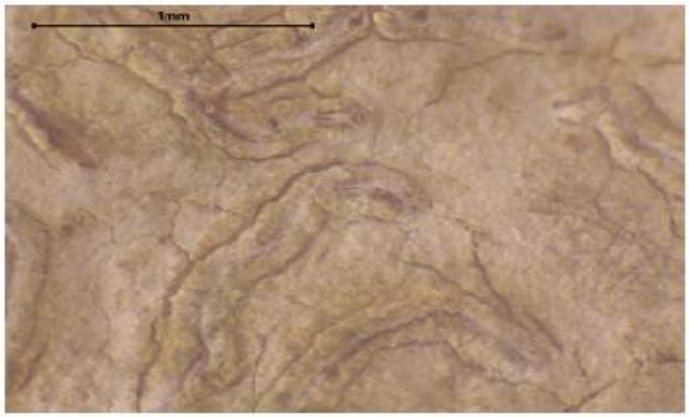
PLATE 13



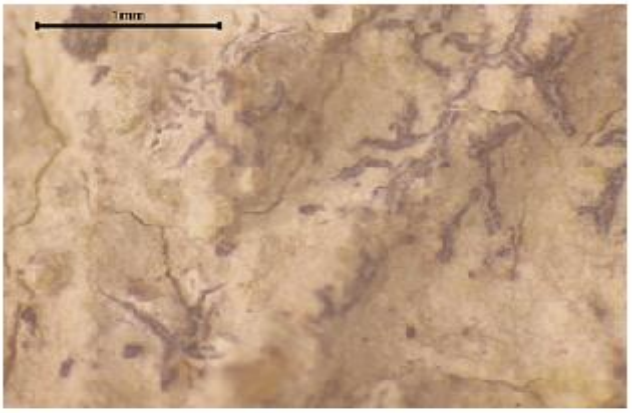
(a) *Graphis emersa* (scale bar 1mm)



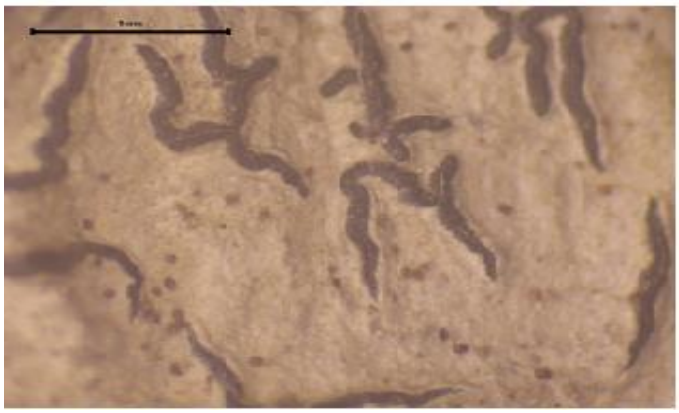
(b) *Graphis enteroleuca* (scale bar 1mm)



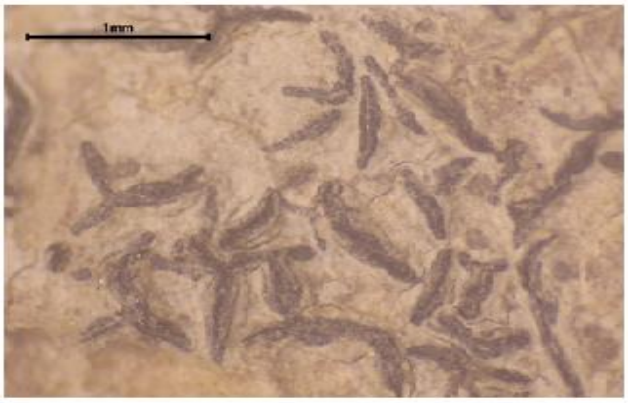
(c) *Graphis epimelaena* (scale bar 1mm)



(d) *Graphis ficicola* (scale bar 1mm)

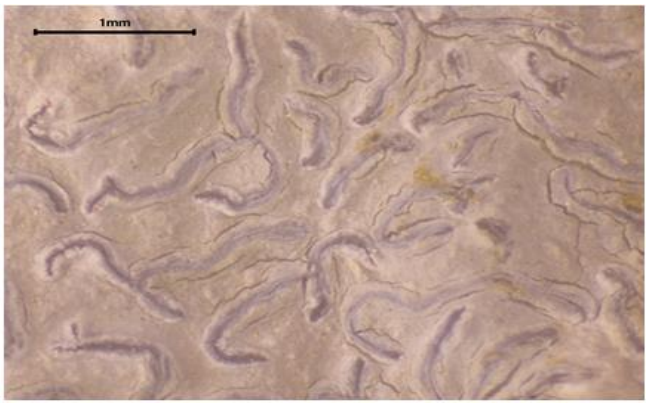


(e) *Graphis filiformis* (scale bar 1mm)

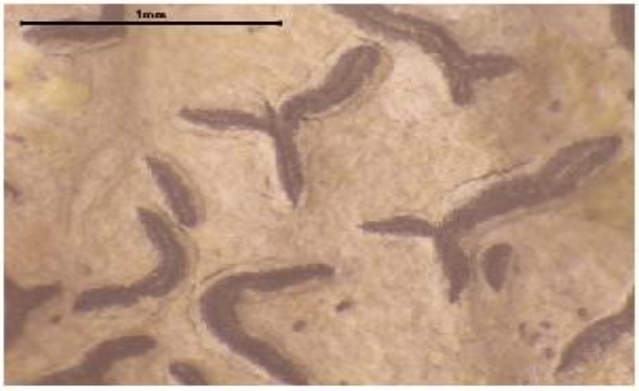


(f) *Graphis furcata* (scale bar 1mm)

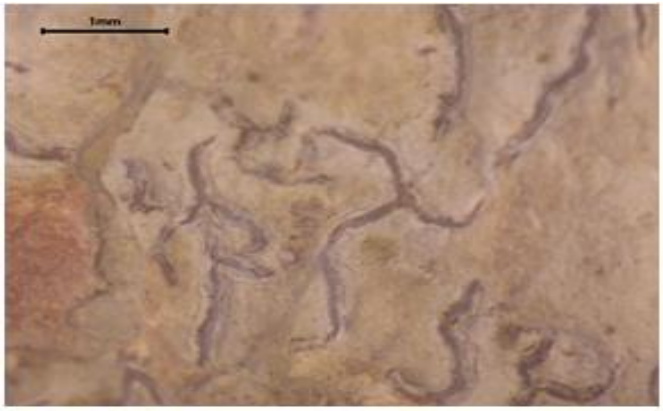
PLATE 14



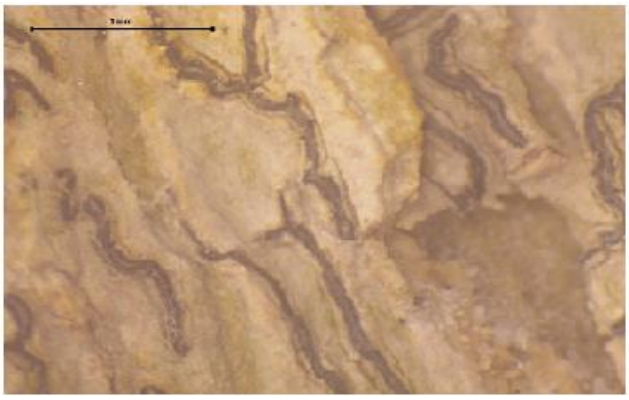
(a) *Graphis glaucescens* (scale bar 1mm)



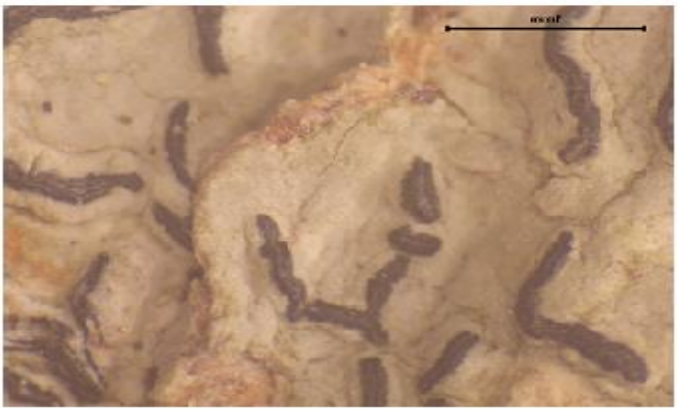
(b) *Graphis handelii* (scale bar 1mm)



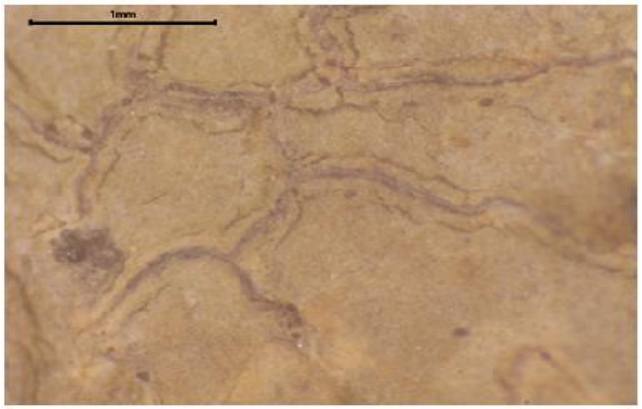
(c) *Graphis hyphosa* (scale bar 1mm)



(d) *Graphis immersella* (scale bar 1mm)

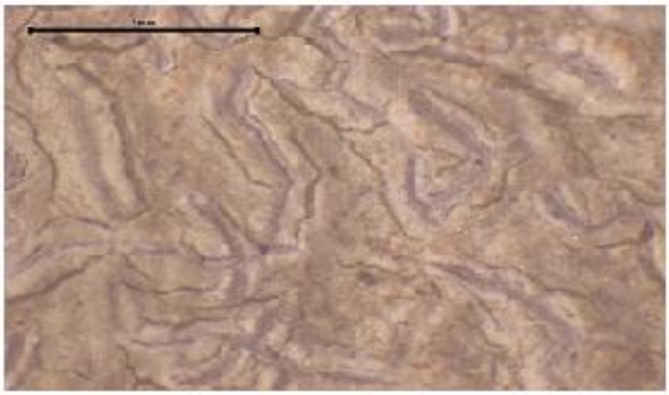


(e) *Graphis immersicans* (scale bar 1mm)

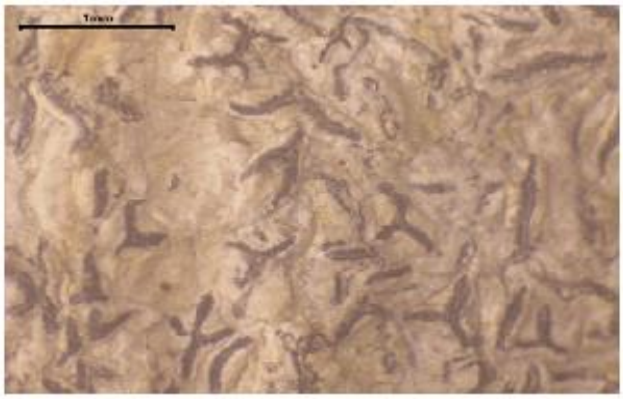


(f) *Graphis intermediella* (scale bar 1mm)

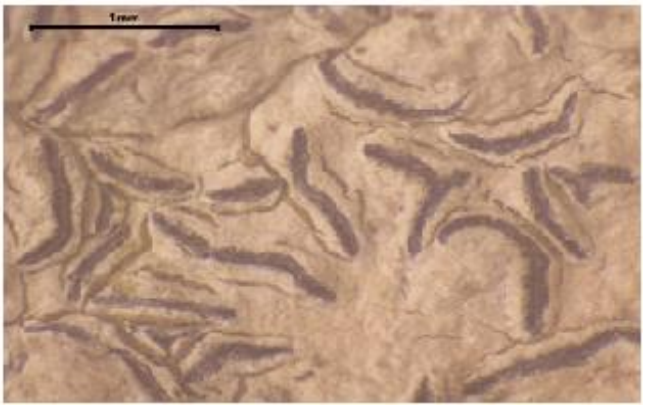
PLATE 15



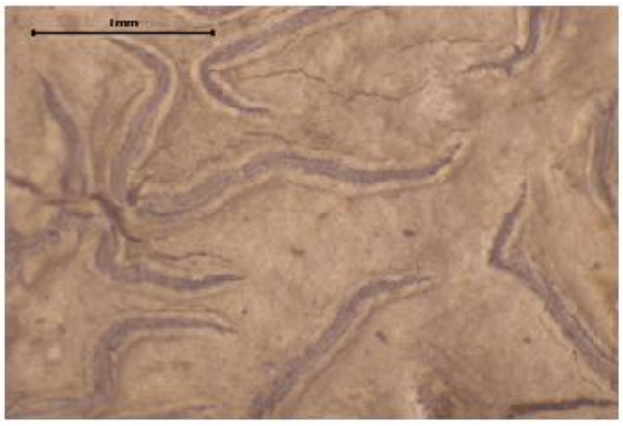
(a) *Graphis leptocarpa* (scale bar 1mm)



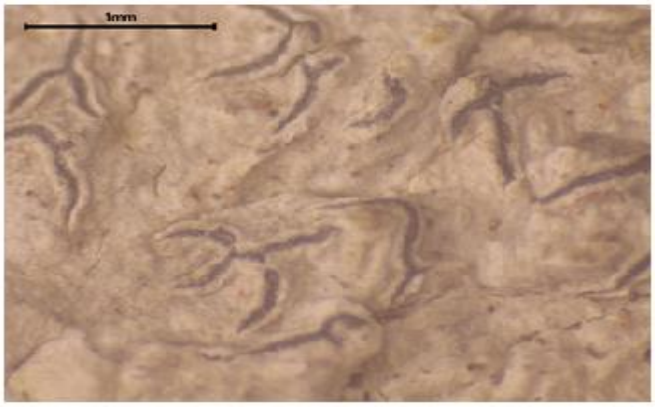
(b) *Graphis librata* (scale bar 1mm)



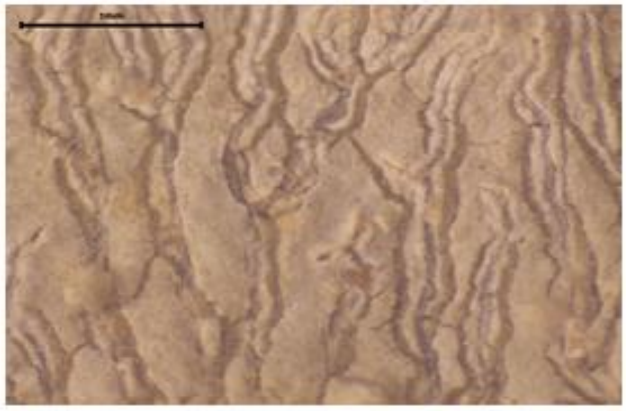
(c) *Graphis lineola* (scale bar 1mm)



(d) *Graphis litoralis* (scale bar 1mm)



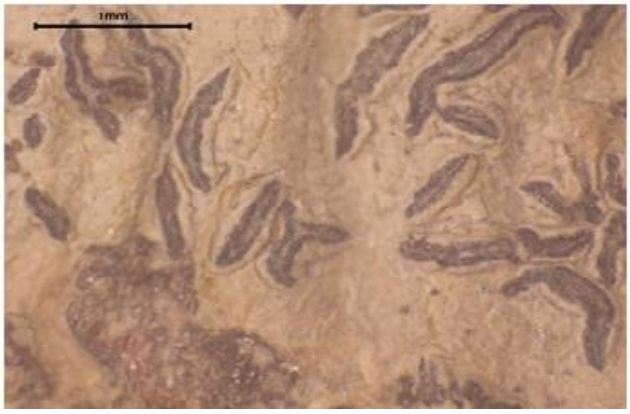
(e) *Graphis luluensis* (scale bar 1mm)



(f) *Graphis modesta* (scale bar 1mm)

PLATE 16

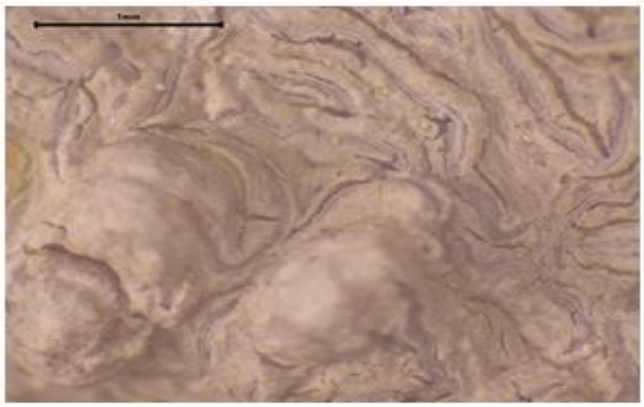
(a) *Graphis nematoides* (scale bar 1mm)



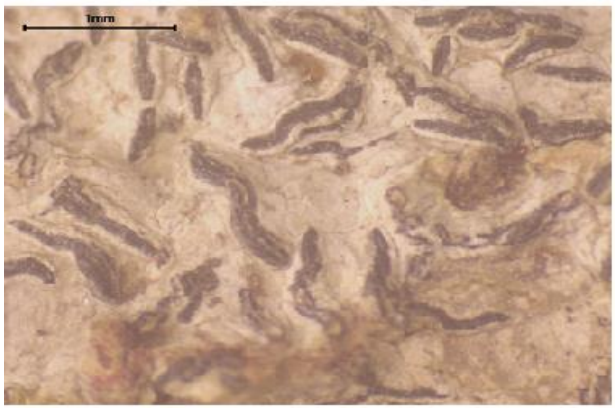
(b) *Graphis palmicola* (scale bar 1mm)

(c) *Graphis pertricosa* (scale bar 1mm)

(d) *Graphis pinicola* (scale bar 1mm)

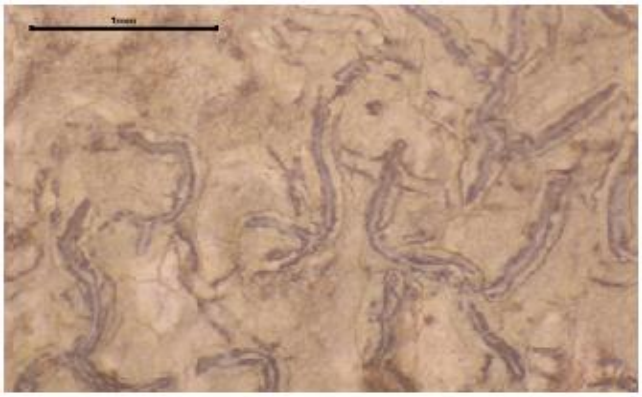


(e) *Graphis plumierae* (scale bar 1mm)

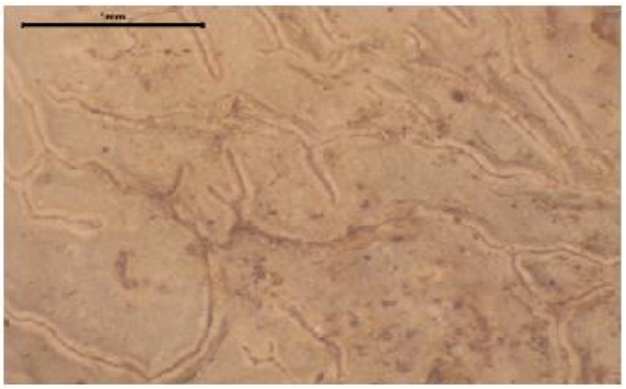


(f) *Graphis prunicola* (scale bar 1mm)

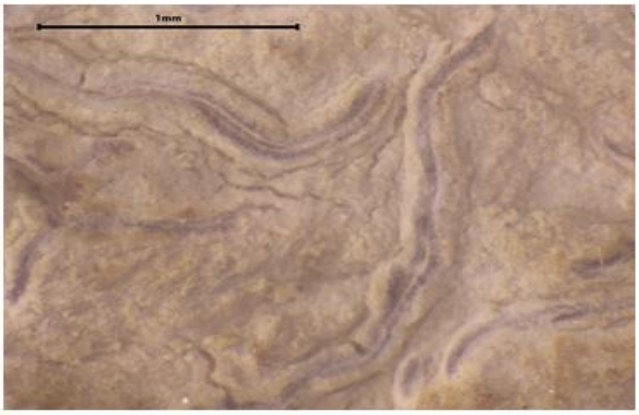
PLATE 17



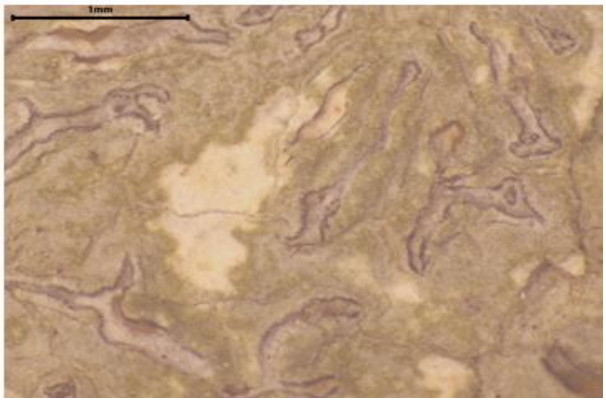
(a) *Graphis pyrrhocheiloides* (scale bar 1mm)



(b) *Graphis renschiana* (scale bar 1mm)



(c) *Graphis riopiedrensis* (scale bar 1mm)

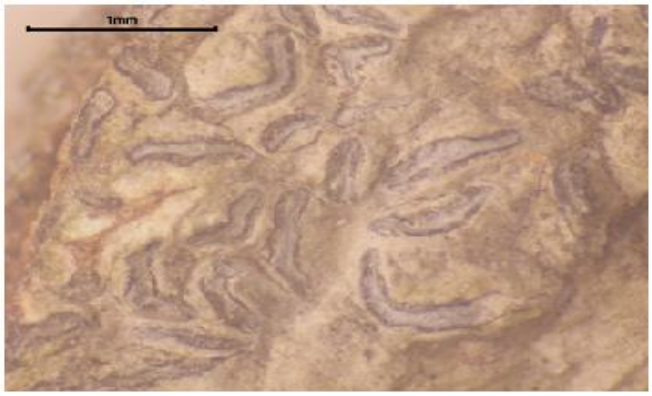


(d) *Graphis scripta* (scale bar 1mm)

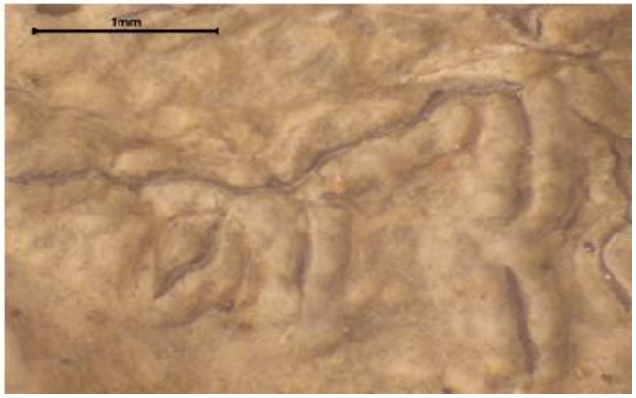
(e) *Graphis stipitata* (scale bar 1mm)

(f) *Graphis subasahinae* (scale bar 1mm)

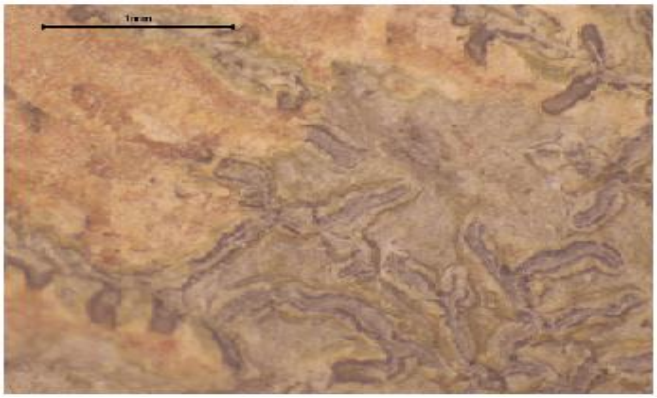
PLATE 18



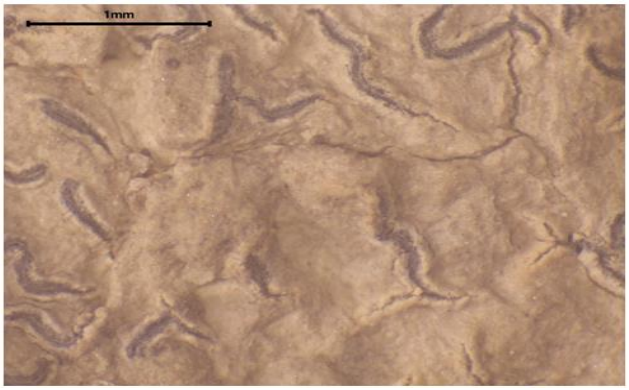
(a) *Graphis submarginata* (scale bar 1mm)



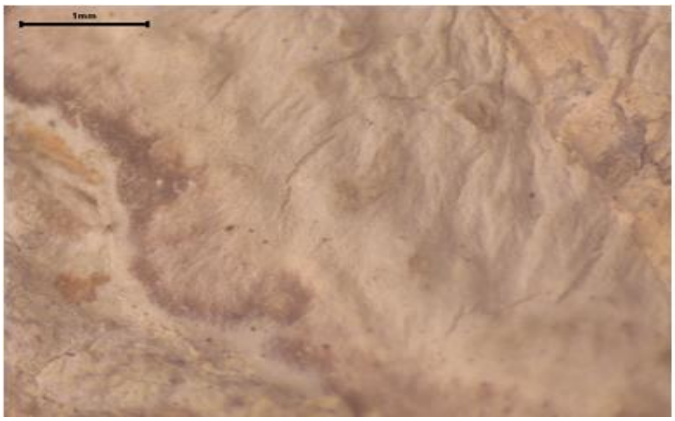
(b) *Graphis sulphurella* (scale bar 1mm)



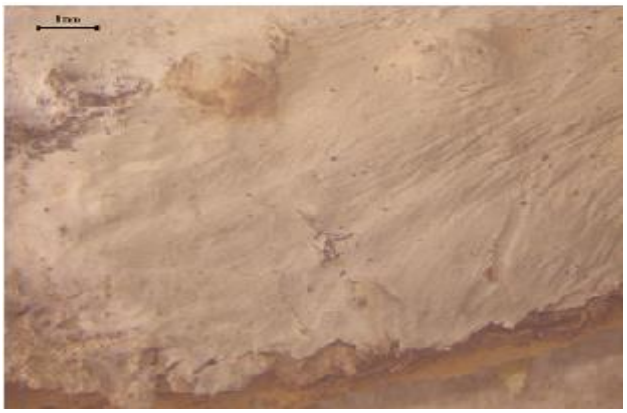
(c) *Graphis sundarbanensis* (scale bar 1mm)



(d) *Graphis supracola* (scale bar 1mm)

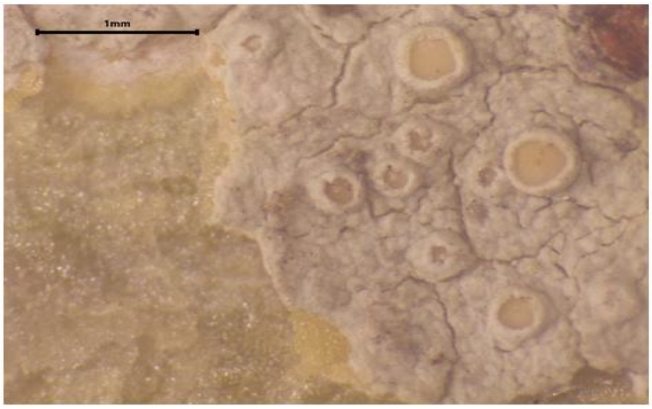


(e) *Herpothallon himalayanum* (scale bar 1mm)



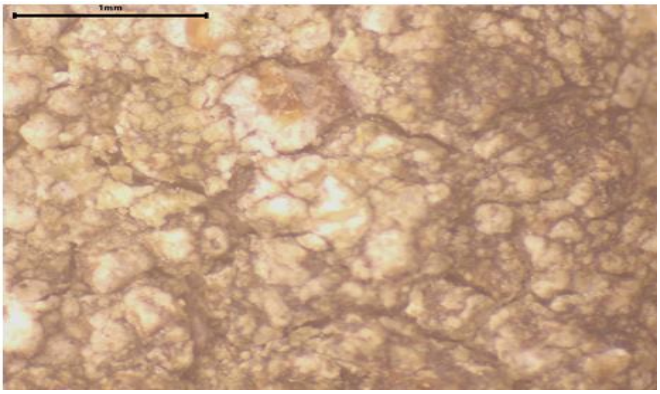
(f) *Herpothallon philippinum* (scale bar 1mm)

PLATE 19



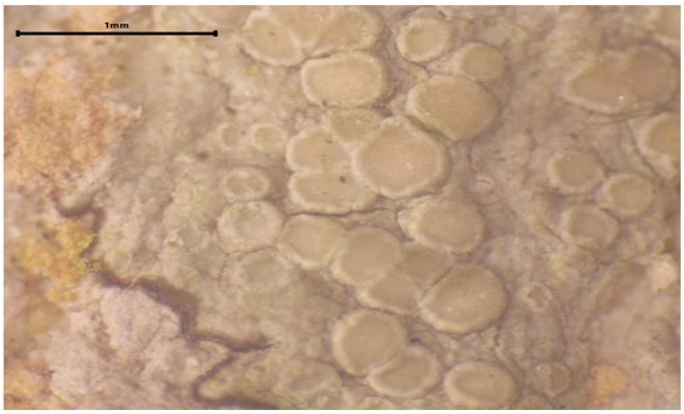
(a) *Lecanora achroa* (scale bar 1mm)

(b) *Lecanora helva* (scale bar 1mm)

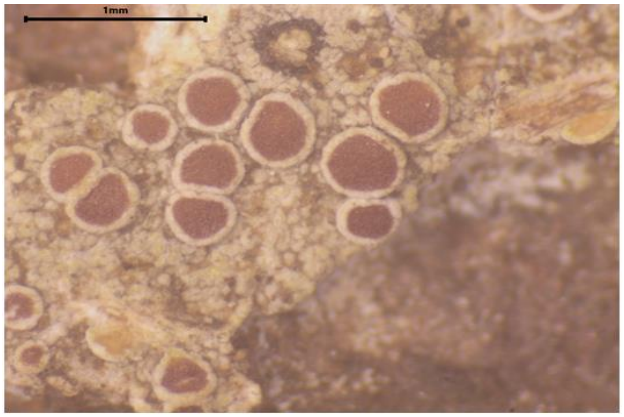


(c) *Lecanora insignis* (scale bar 1mm)

(d) *Lecanora leproplaca* (scale bar 1mm)

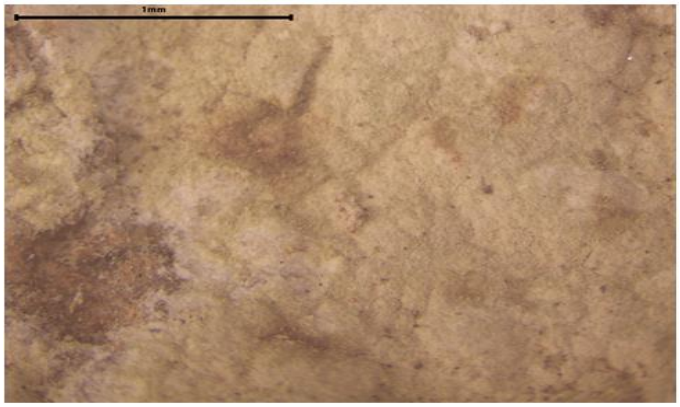


(e) *Lecanora leprosa* (scale bar 1mm)

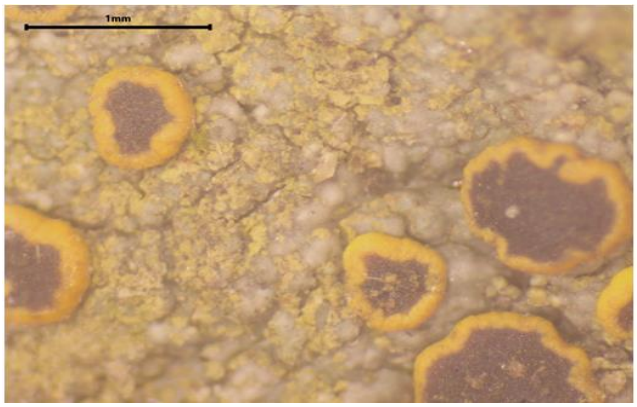


(f) *Lecanora tropica* (scale bar 1mm)

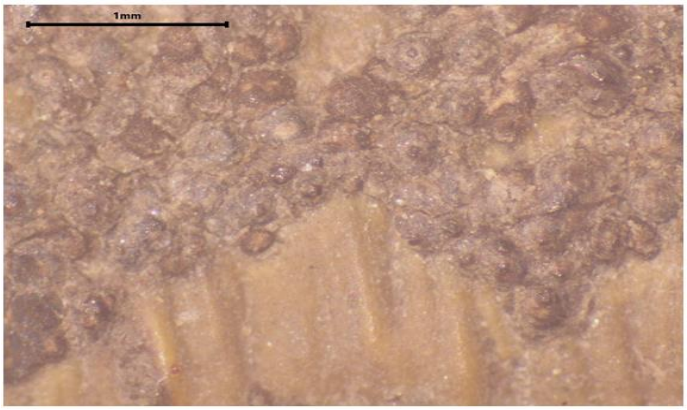
PLATE 20



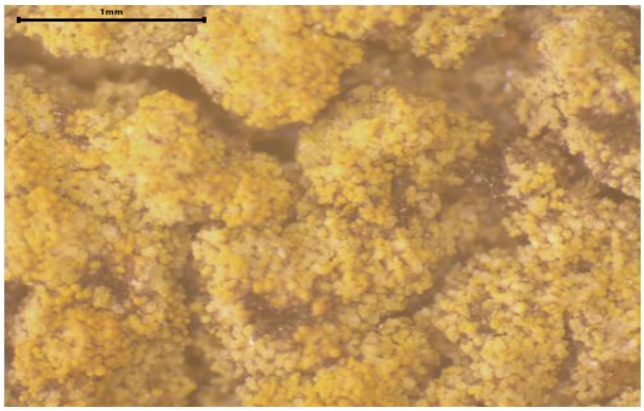
(a) *Lepraria incana* (scale bar 1mm)



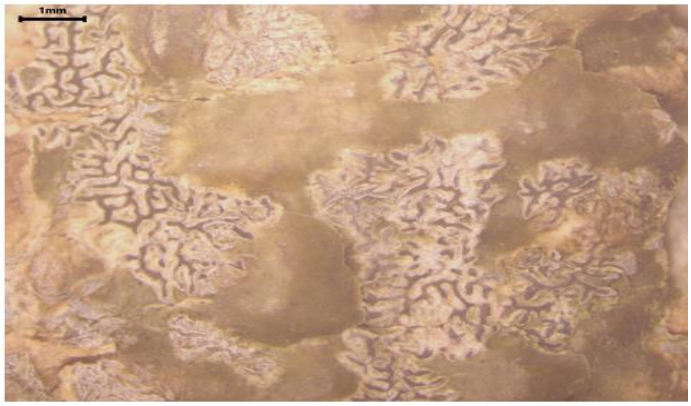
(b) *Letrouitia transgressa* (scale bar 1mm)



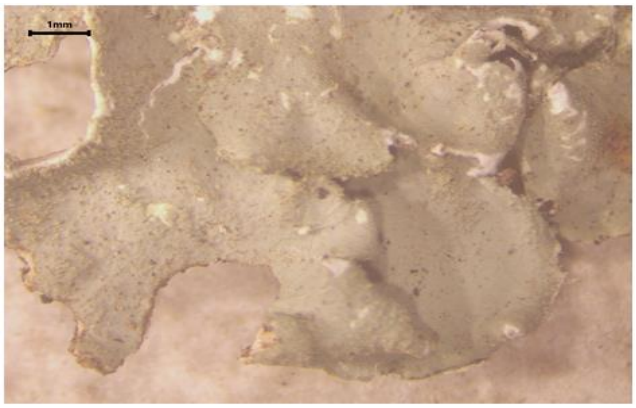
(c) *Nigrovothelium tropicum* (scale bar 1mm)



(d) *Oxneriopsis bassiae* (scale bar 1mm)

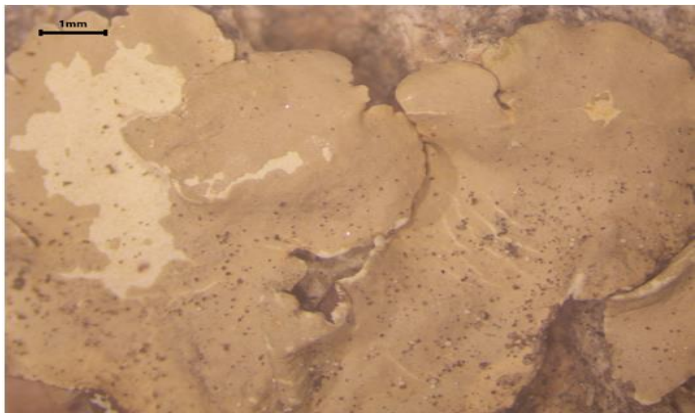


(e) *Pallidogramme divaricoides* (scale bar 1mm)

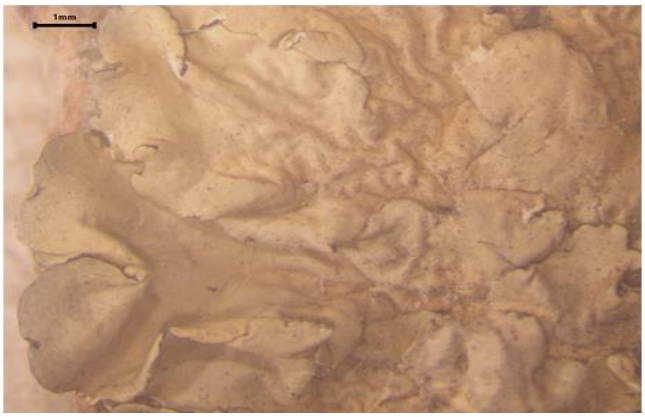


(f) *Parmotrema crinitoides* (scale bar 1mm)

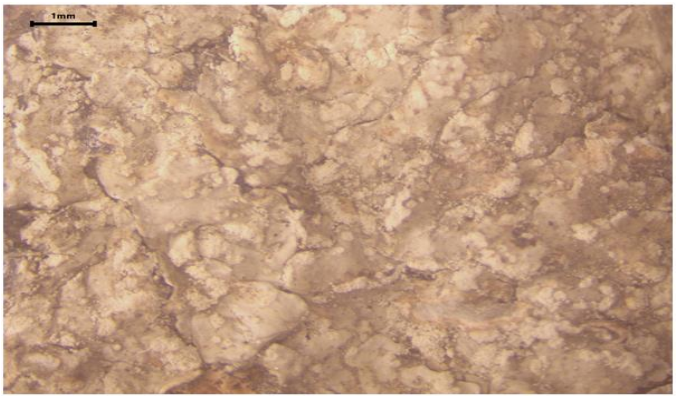
PLATE 21



(a) *Parmotrema disparile* (scale bar 1mm)

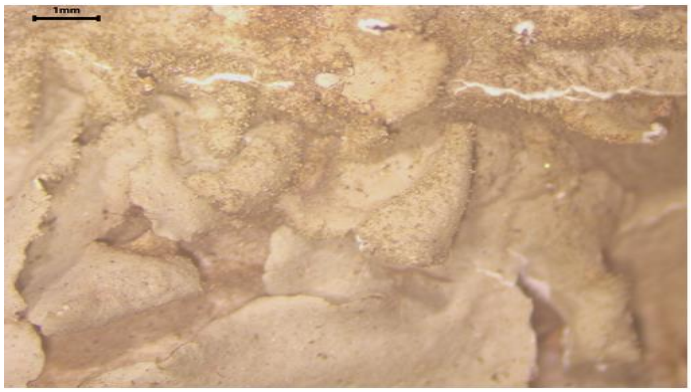


(b) *Parmotrema mesotropum* (scale bar 1mm)



(c) *Parmotrema praesorediosum* (scale bar 1mm)

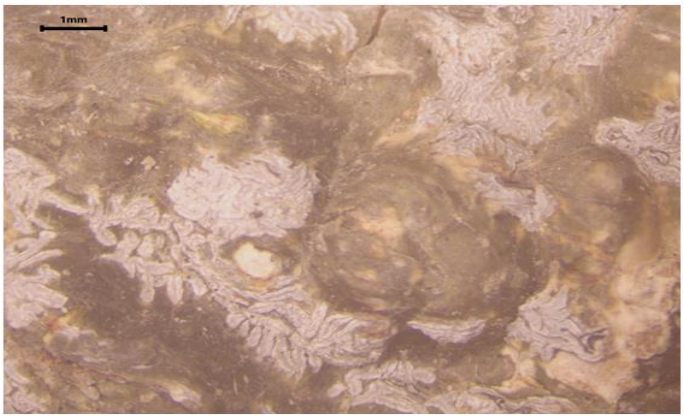
(d) *Parmotrema saccatilobum* (scale bar 1mm)



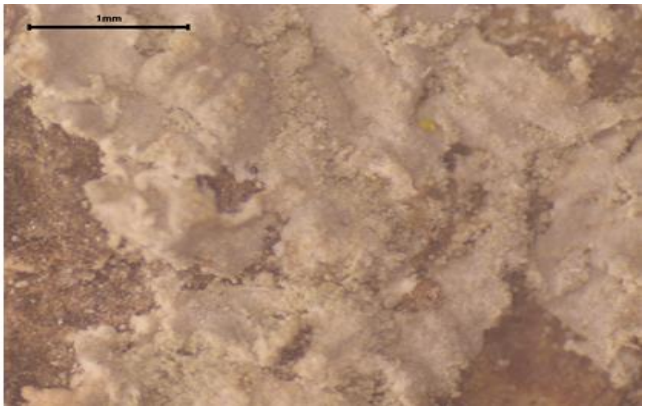
(e) *Parmotrema tinctorum* (scale bar 1mm)

(f) *Parmotrema tsavoense* (scale bar 1mm)

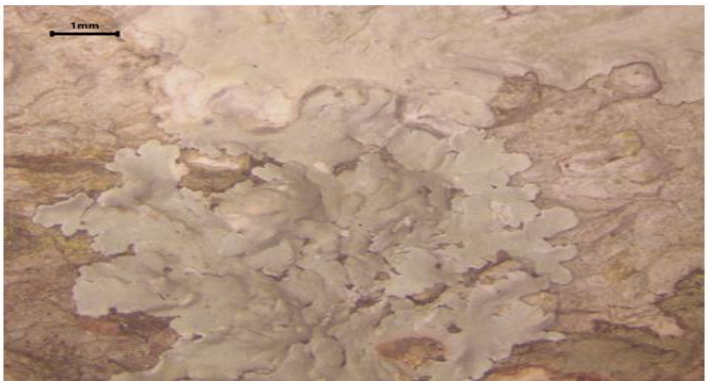
PLATE 22



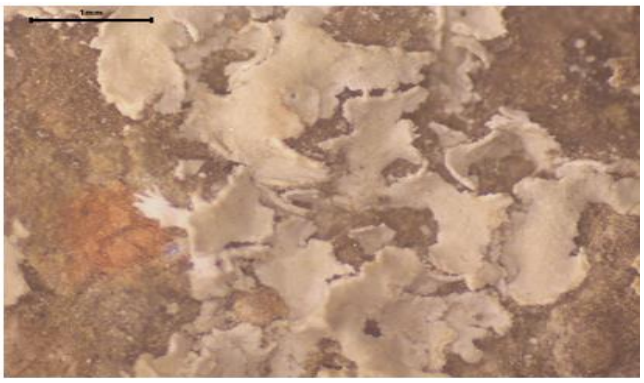
(a) *Phaeographis manipurensis* (scale bar 1mm)



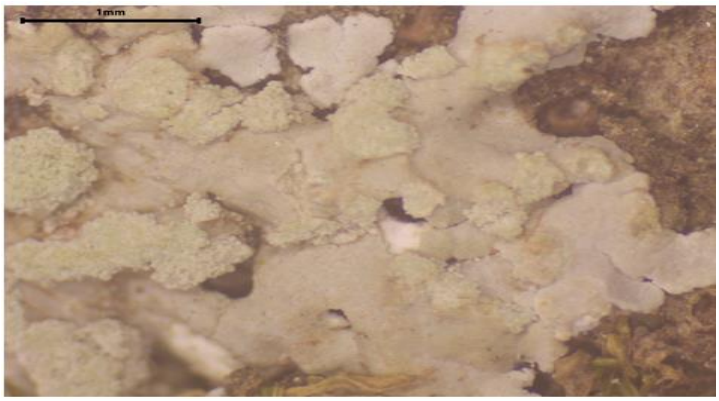
(b) *Physcia abuensis* (scale bar 1mm)



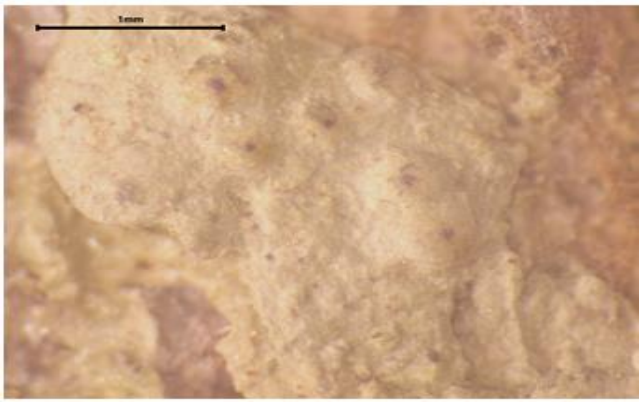
(c) *Physcia aipolia* (scale bar 1mm)



(d) *Physcia alba* (scale bar 1mm)

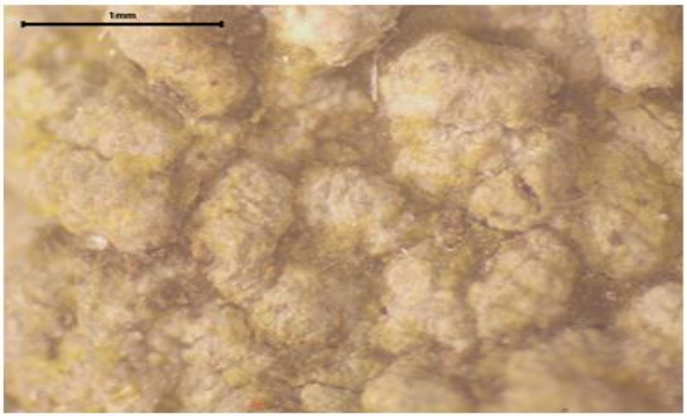


(e) *Physcia tribacoides* (scale bar 1mm)

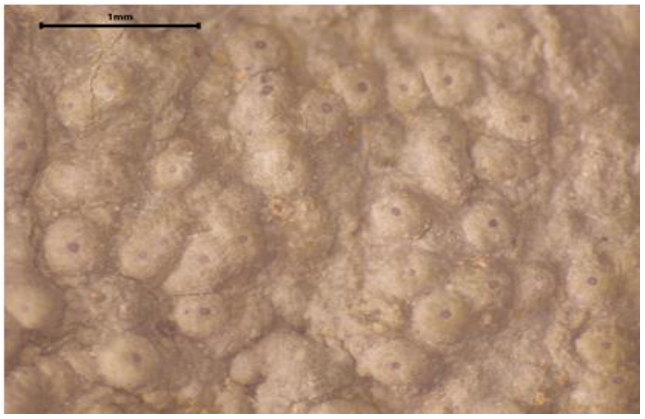


(f) *Porina belanospora* (scale bar 1mm)

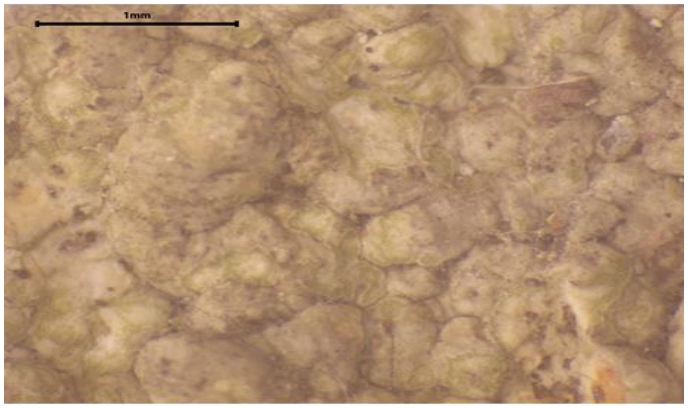
PLATE 23



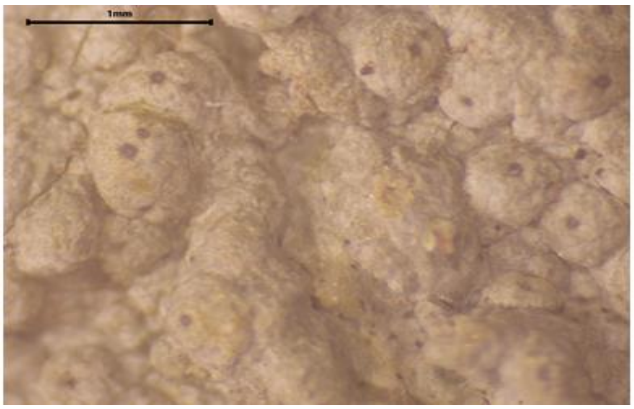
(a) *Porina bellendenica* (scale bar 1mm)



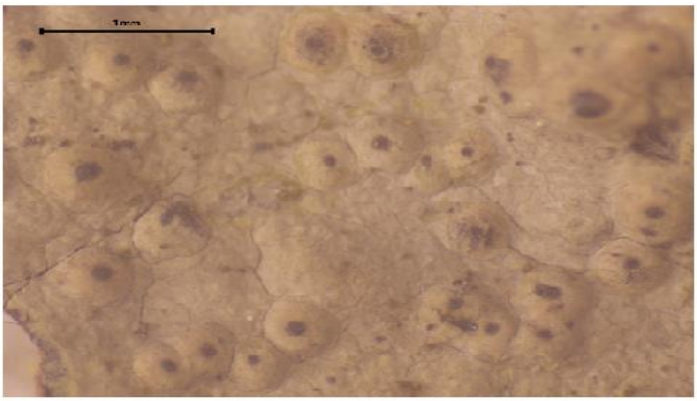
(b) *Porina effilata* (scale bar 1mm)



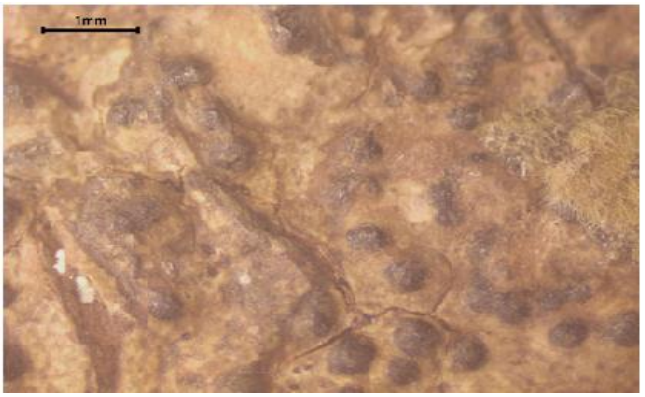
(c) *Porina interestes* (scale bar 1mm)



(d) *Porina internigrans* (scale bar 1mm)

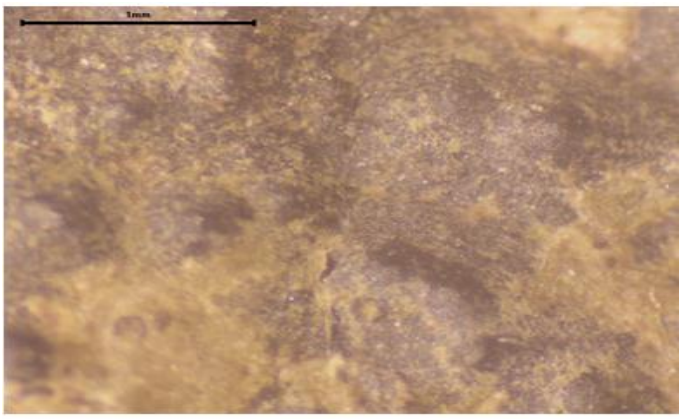


(e) *Porina subhibernica* (scale bar 1mm)

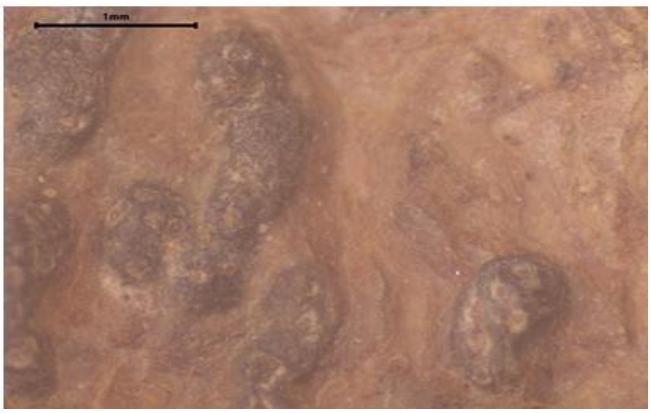


(f) *Pyrenula acutalis* (scale bar 1mm)

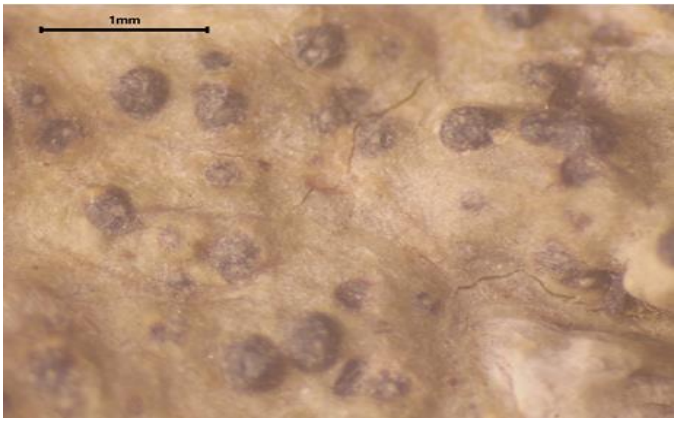
PLATE 24



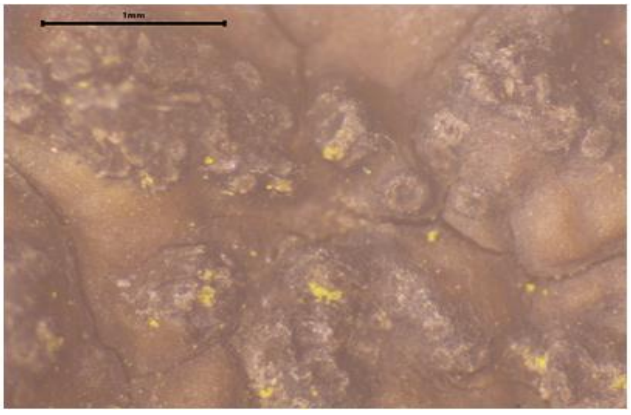
(a) *Pyrenula aggregata* (scale bar 1mm)



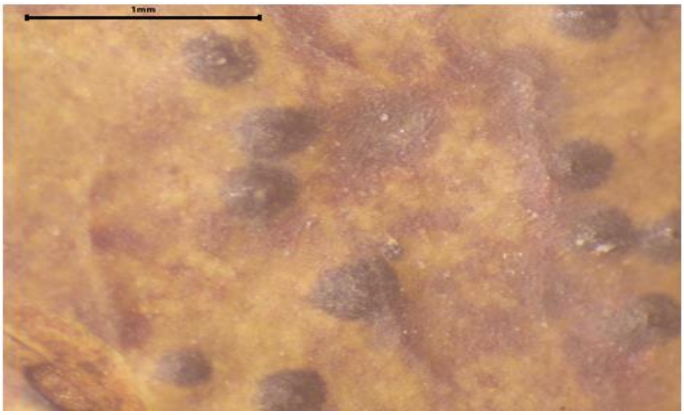
(b) *Pyrenula anomala* (scale bar 1mm)



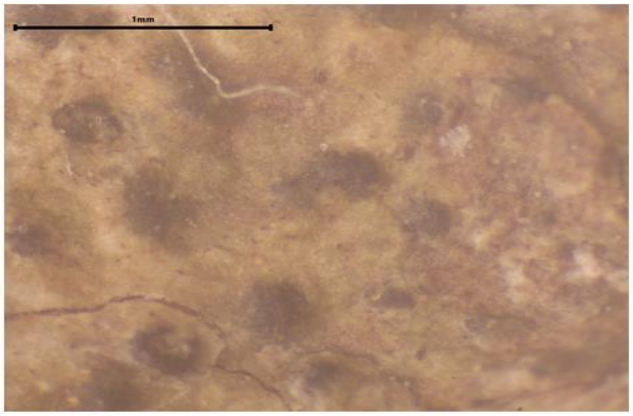
(c) *Pyrenula approximata* (scale bar 1mm)



(d) *Pyrenula arthoniotheca* (scale bar 1mm)

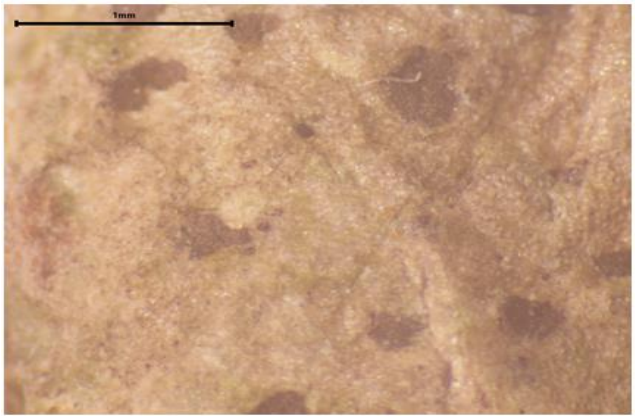


(e) *Pyrenula aspistea* (scale bar 1mm)

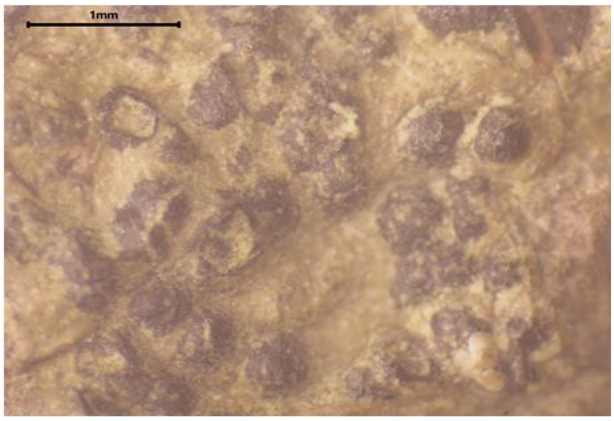


(f) *Pyrenula brunnea* (scale bar 1mm)

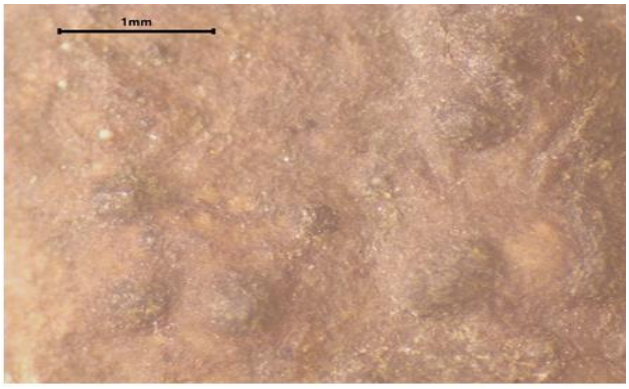
PLATE 25



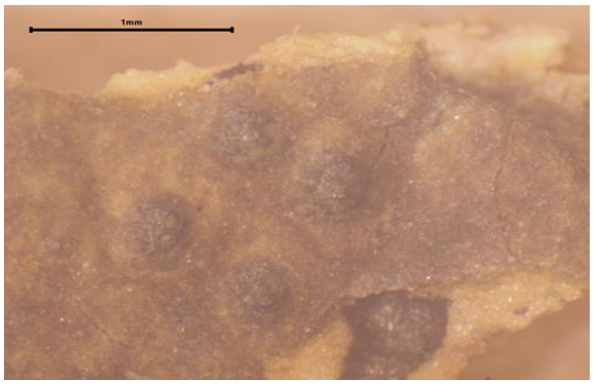
(a) *Pyrenula cayennensis* (scale bar 1mm)



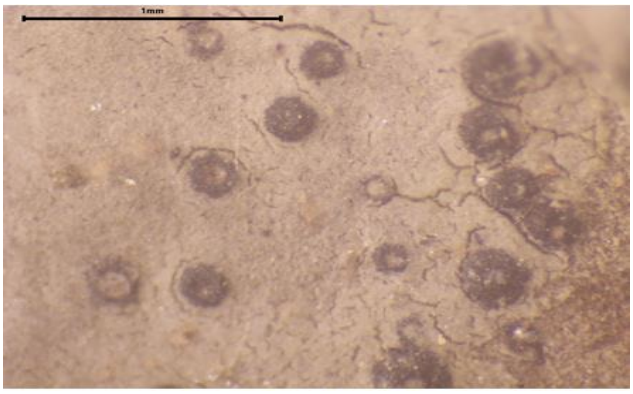
(b) *Pyrenula chlorospila* (scale bar 1mm)



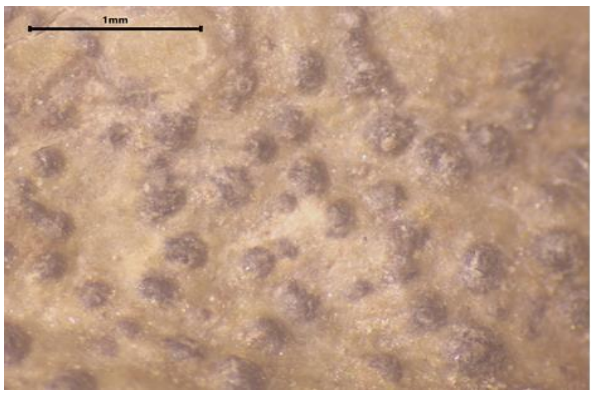
(c) *Pyrenula circumfinens* (scale bar 1mm)



(d) *Pyrenula citriformis* (scale bar 1mm)

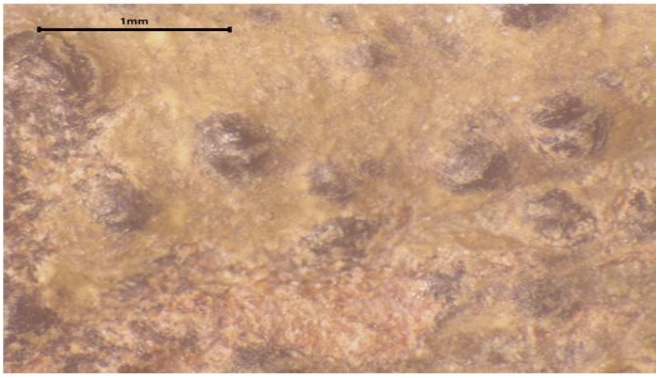


(e) *Pyrnula confinis* (scale bar 1mm)

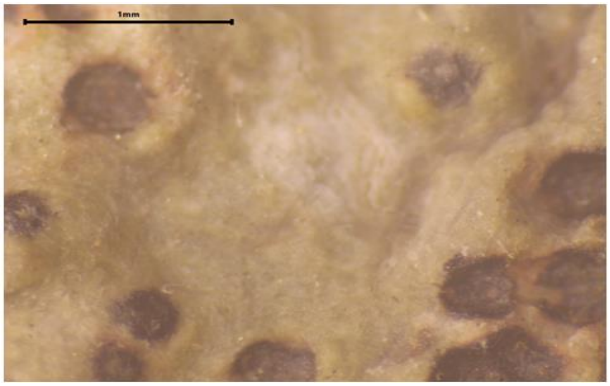


(f) *Pyrenula defossa* (scale bar 1mm)

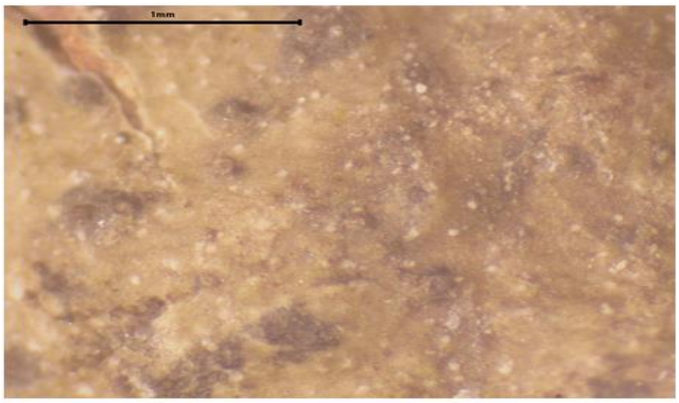
PLATE 26



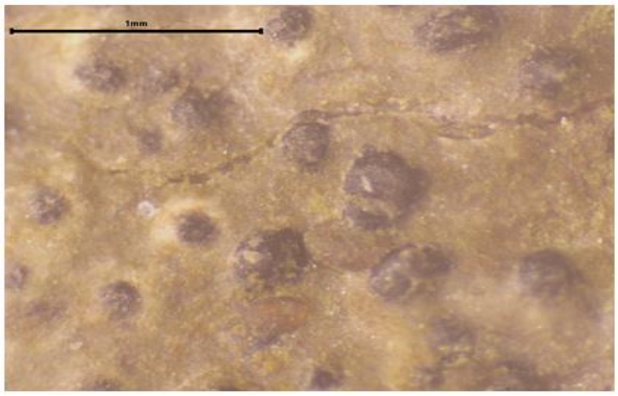
(a) *Pyrenula fuscoolivacea* (scale bar 1mm)



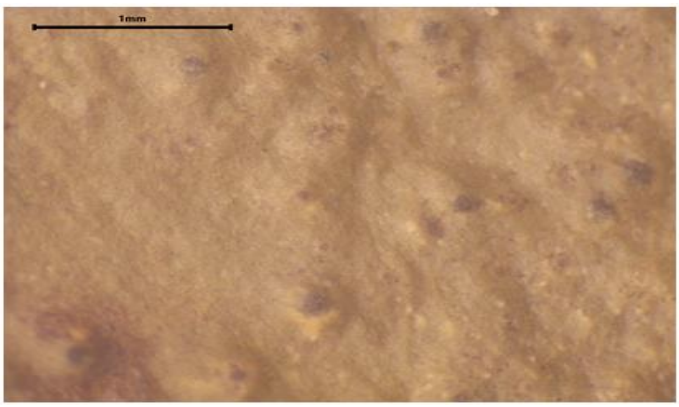
(b) *Pyrenula glabrescens* (scale bar 1mm)



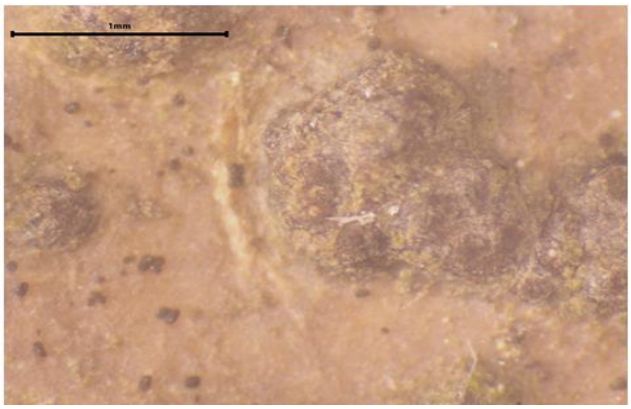
(c) *Pyrenula introducta* (scale bar 1mm)



(d) *Pyrenula lamprocarpa* (scale bar 1mm)

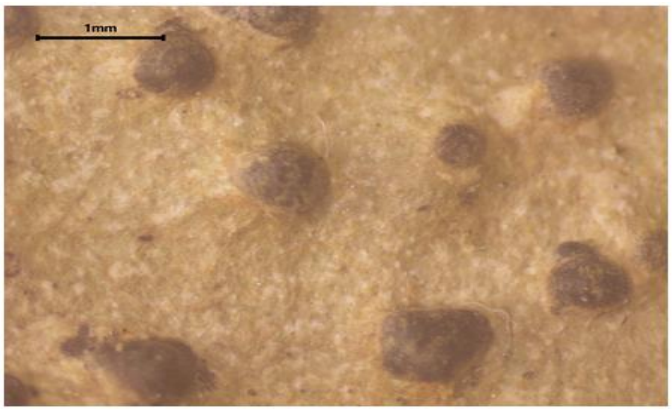


(e) *Pyrenula leucostoma* (scale bar 1mm)

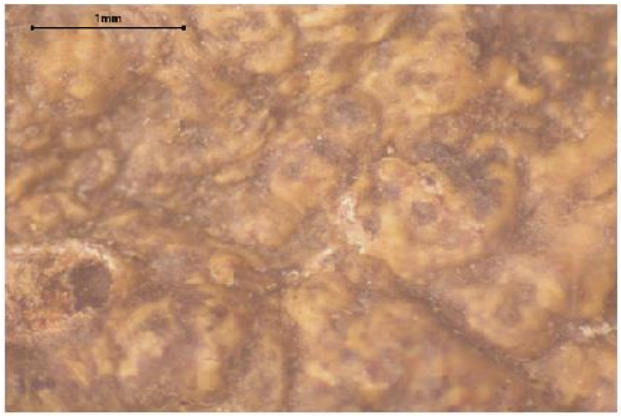


(f) *Pyrenula leucotrypa* (scale bar 1mm)

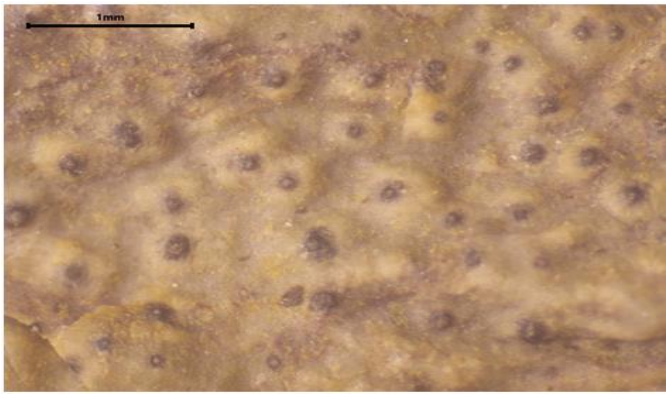
PLATE 27



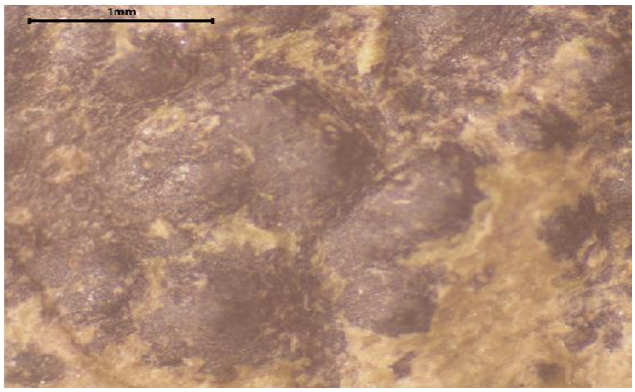
(a) *Pyrenula macrospora* (scale bar 1mm)



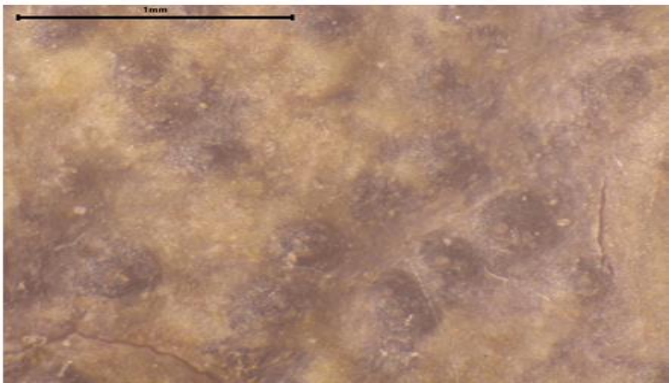
(b) *Pyrenula macularis* (scale bar 1mm)



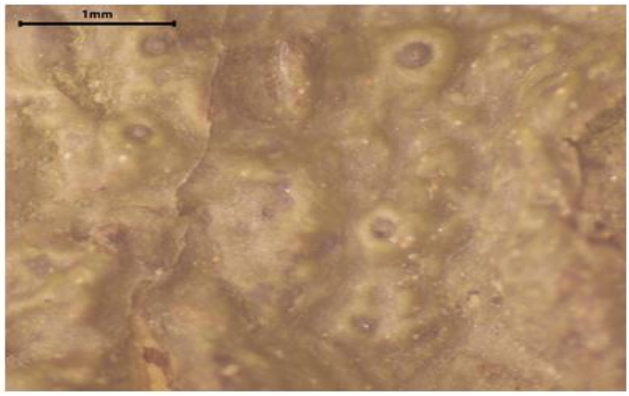
(c) *Pyrenula mamillana* (scale bar 1mm)



(d) *Pyrenula mastophora* (scale bar 1mm)

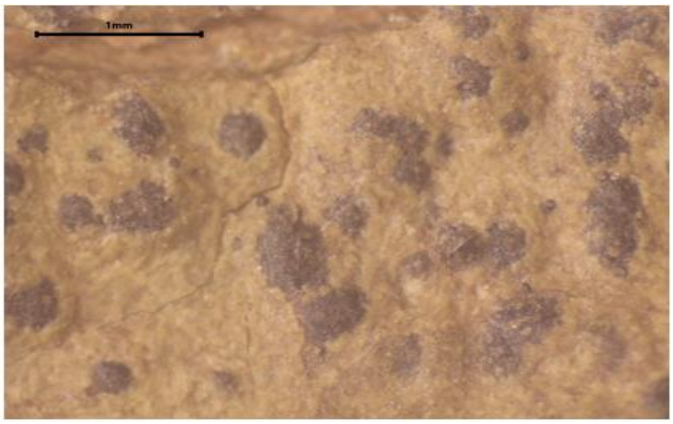


(e) *Pyrenula mastophoriza* (scale bar 1mm)

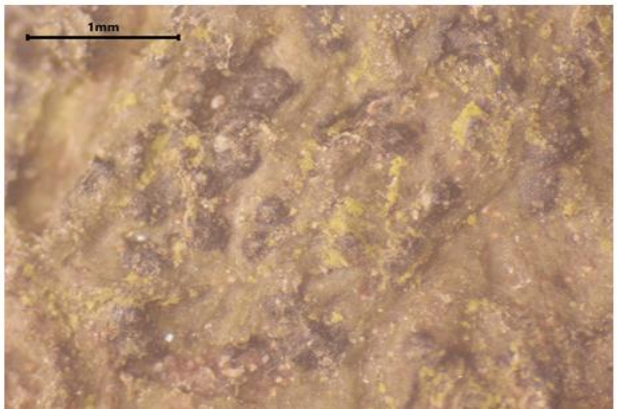


(f) *Pyrenula mastophoroides* (scale bar 1mm)

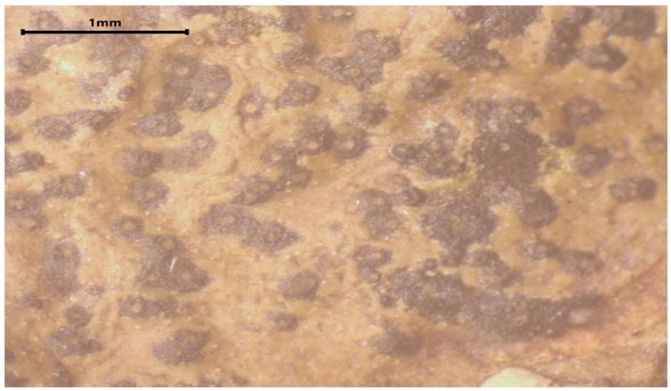
PLATE 28



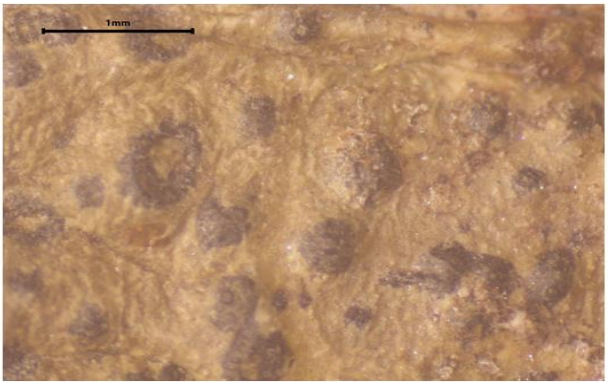
(a) *Pyrenula minor* (scale bar 1mm)



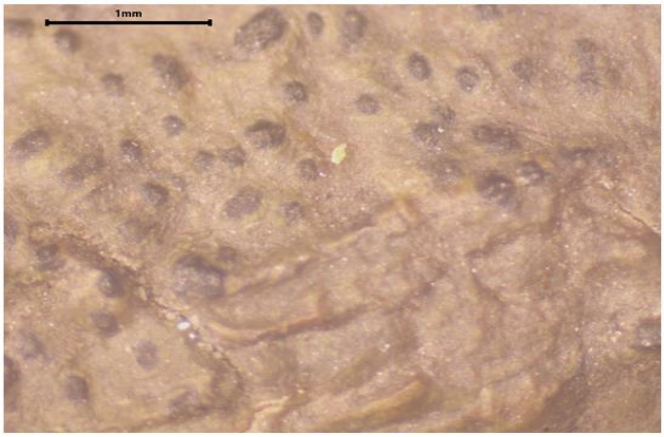
(b) *Pyrenula nitida* (scale bar 1mm)



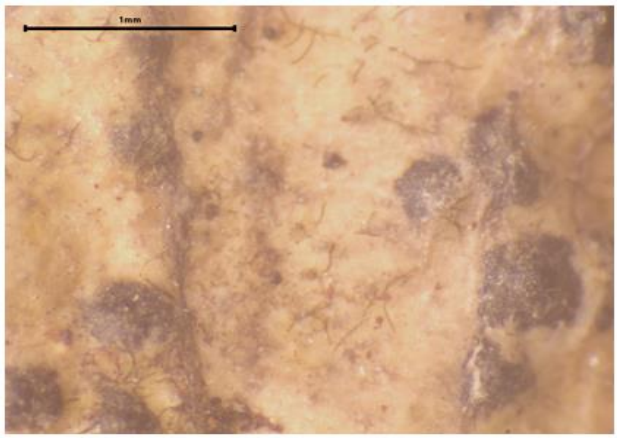
(c) *Pyrenula nodulata* (scale bar 1mm)



(d) *Pyrenula oculata* (scale bar 1mm)

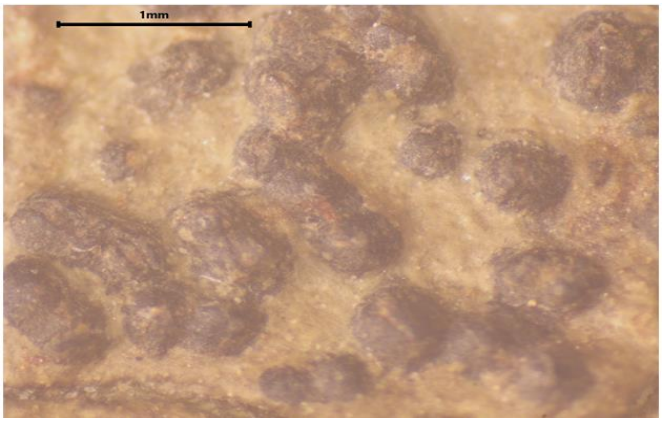


(e) *Pyrenula oxysporiza* (scale bar 1mm)

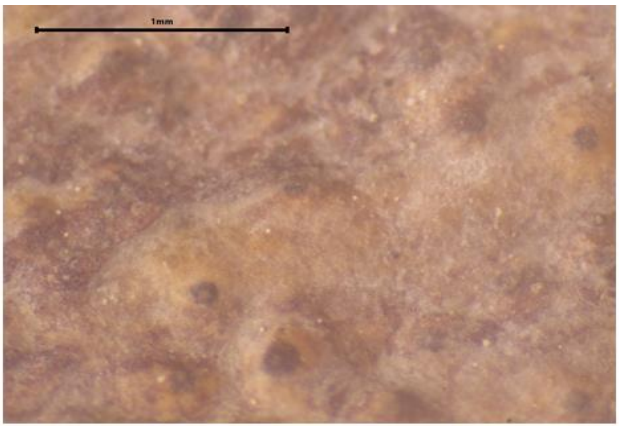


(f) *Pyrenula pinguis* (scale bar 1mm)

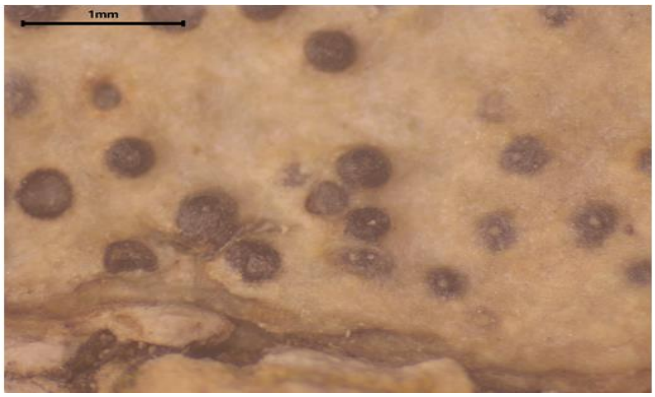
PLATE 29



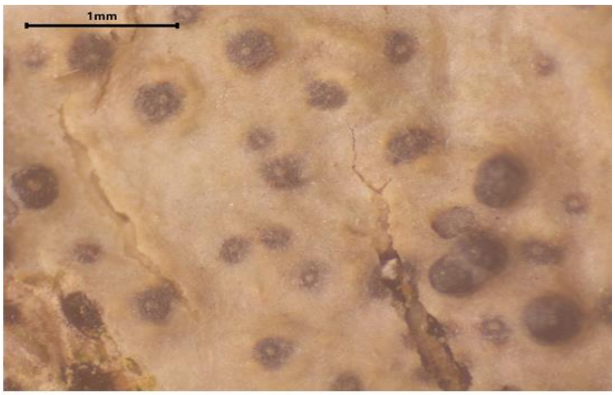
(a) *Pyrenula quassicola* (scale bar 1mm)



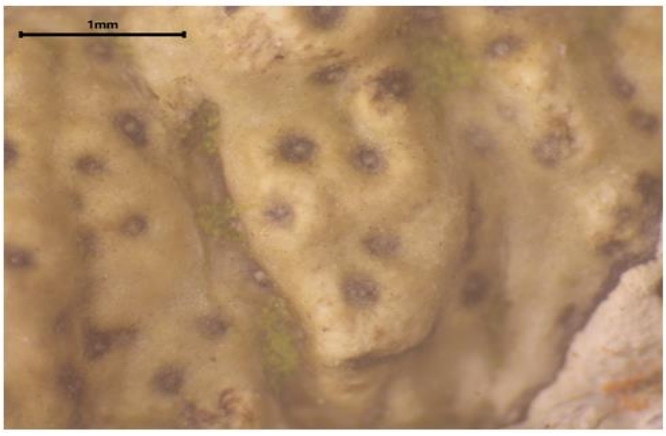
(b) *Pyrenula scutata* (scale bar 1mm)



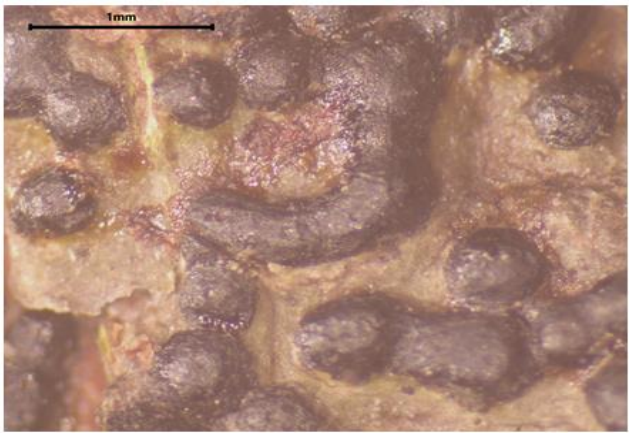
(c) *Pyrenula subacutalis* (scale bar 1mm)



(d) *Pyrenula subducta* (scale bar 1mm)

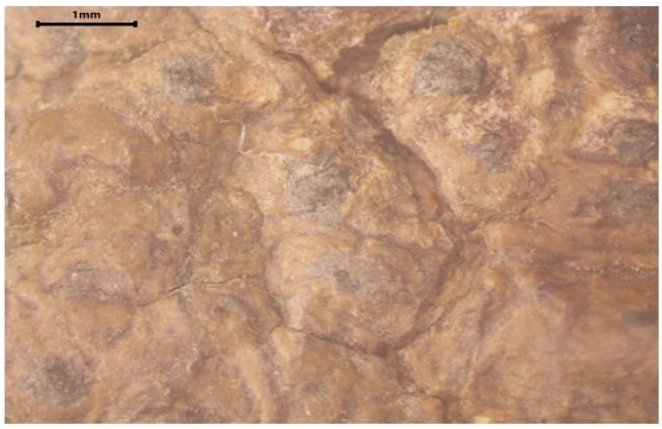


(e) *Pyrenula subglabriuscula* (scale bar 1mm)

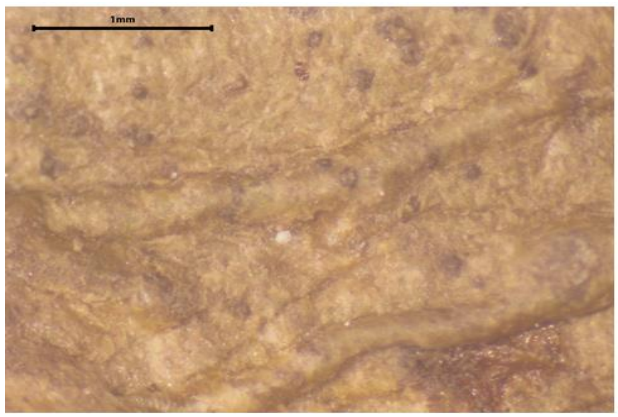


(f) *Pyrenula subindica* (scale bar 1mm)

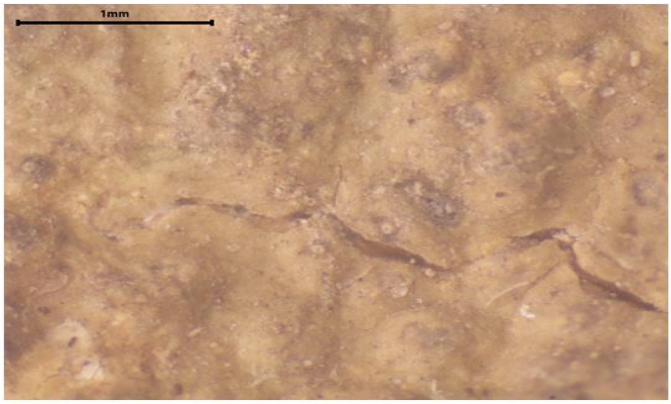
PLATE 30



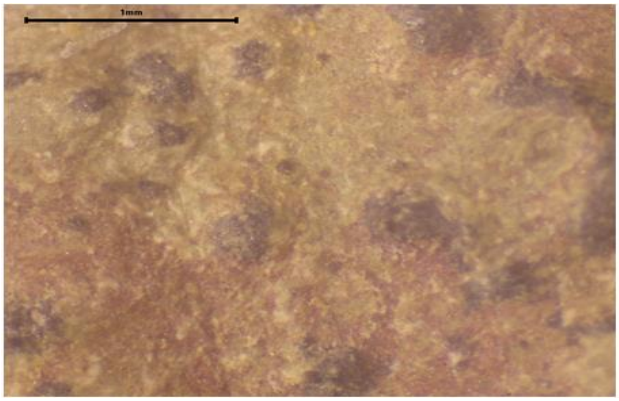
(a) *Pyrenula sublaevigata* (scale bar 1mm)



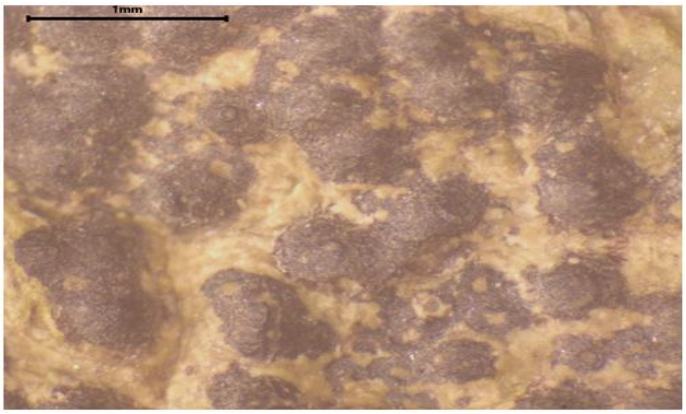
(b) *Pyrenula submastophora* (scale bar 1mm)



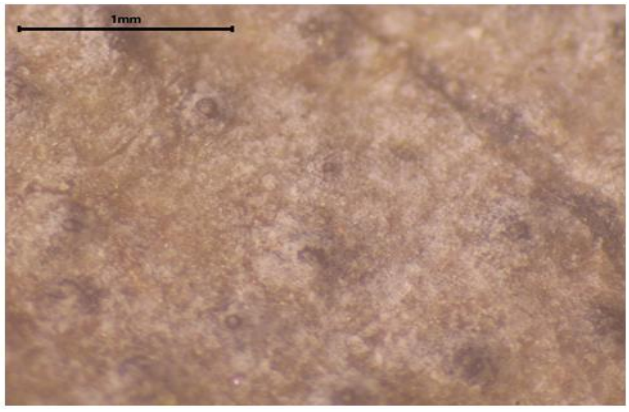
(c) *Pyrenula thelomorpha* (scale bar 1mm)



(d) *Pyrenula welwitschii* (scale bar 1mm)



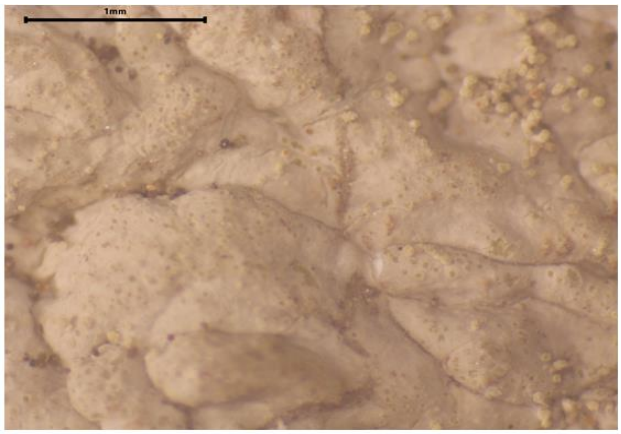
(e) *Pyrenula wrightii* (scale bar 1mm)



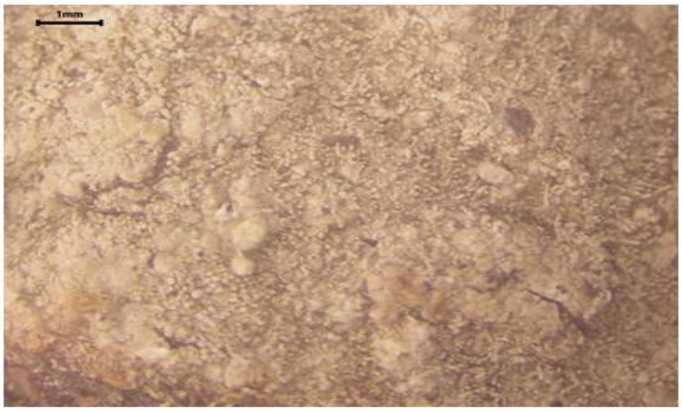
(f) *Pyrenula zeylanica* (scale bar 1mm)

PLATE 31

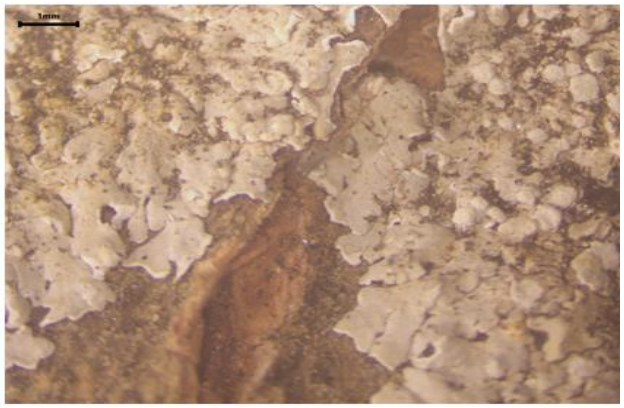
(a) *Pyxine cocoes* (scale bar 1mm)



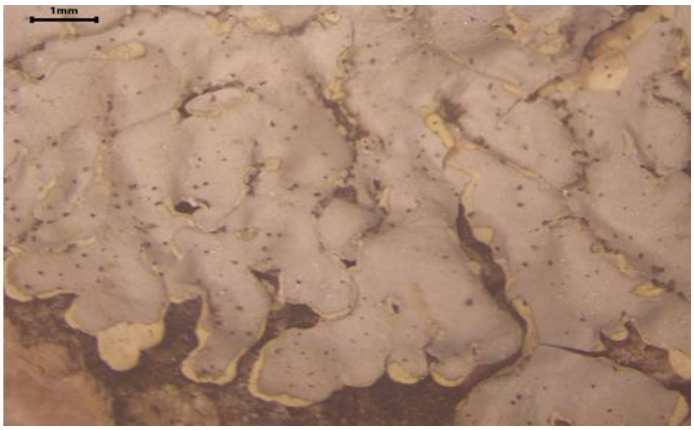
(b) *Pyxine coralligera* (scale bar 1mm)



(c) *Pyxine isidiophora* (scale bar 1mm)



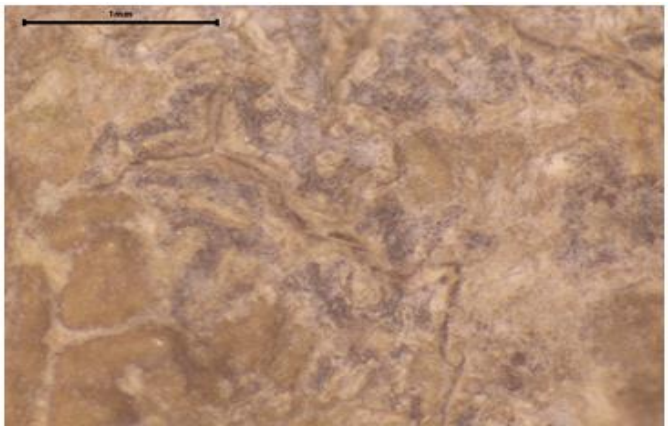
(d) *Pyxine reticulata* (scale bar 1mm)



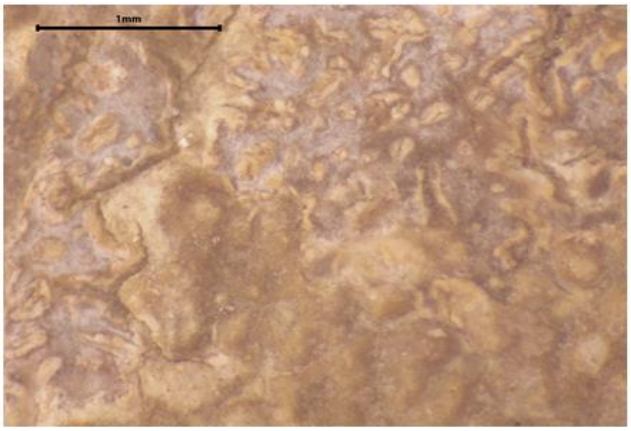
(e) *Pyxine sorediata* (scale bar 1mm)

(f) *Sarcographa glyphiza* (scale bar 1mm)

PLATE 32



(a) *Sarcographa heteroclita* (scale bar 1mm)



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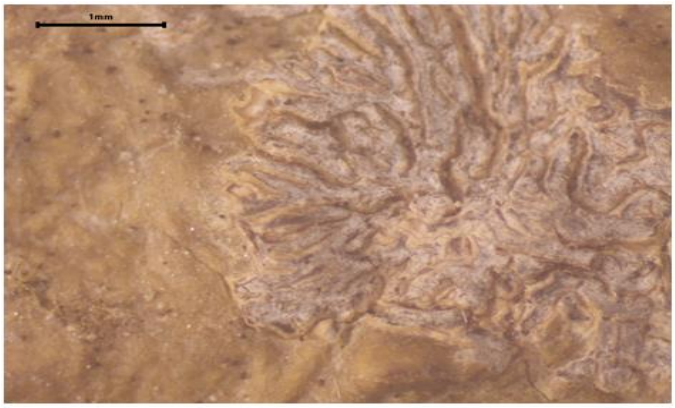
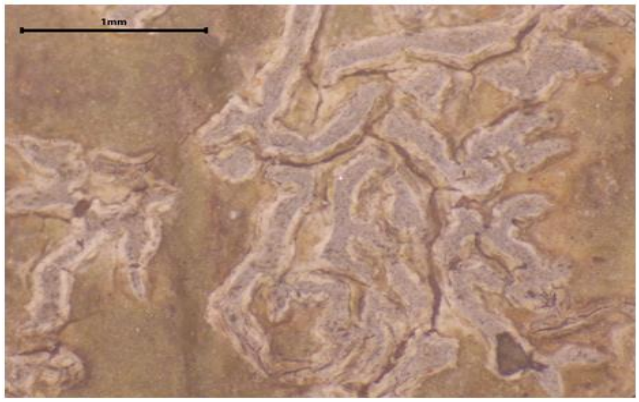
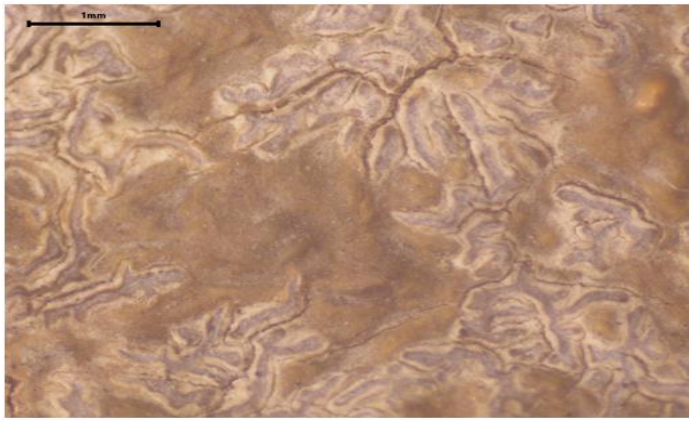


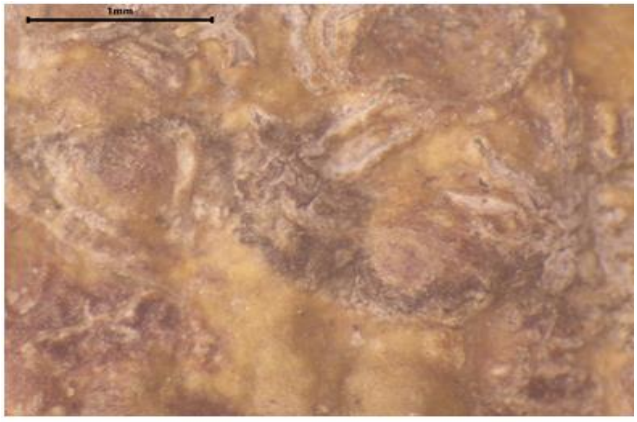
(c) *Sarcographa labyrinthica* (scale bar 1mm)



(d) *Sarcographa maculosa* (scale bar 1mm)

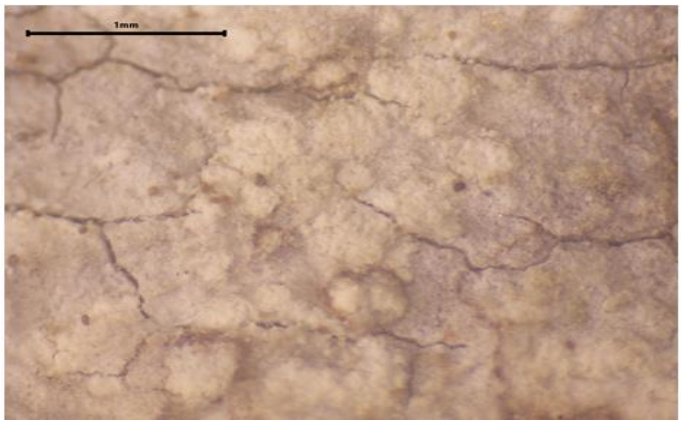


(e) *Sarcographa subtricosa* (scale bar 1mm)

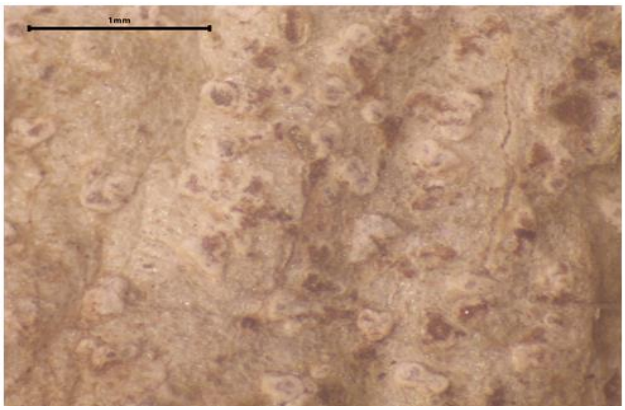


(f) *Sarcographa tricosa* (scale bar 1mm)

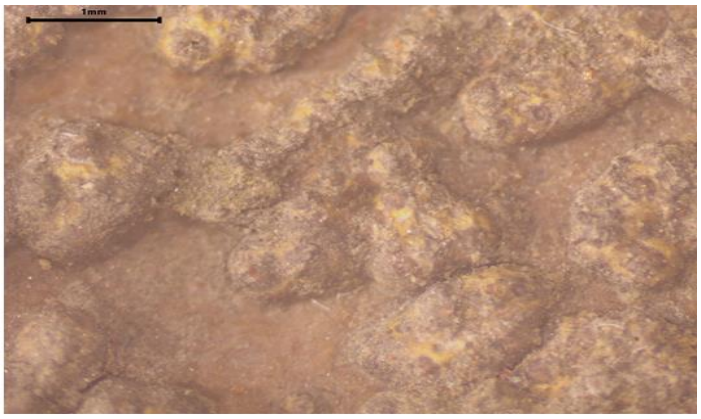
PLATE 33



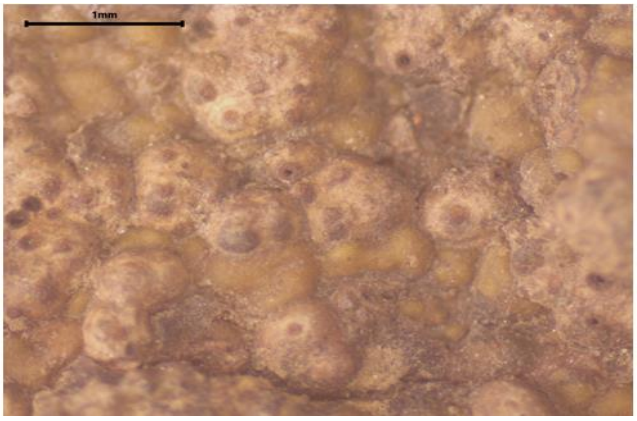
(a) *Stirtonia macrocarpa* (scale bar 1mm)



(b) *Synarthonia inconspicua* (scale bar 1mm)



(c) *Trypethelium eluteriae* (scale bar 1mm)

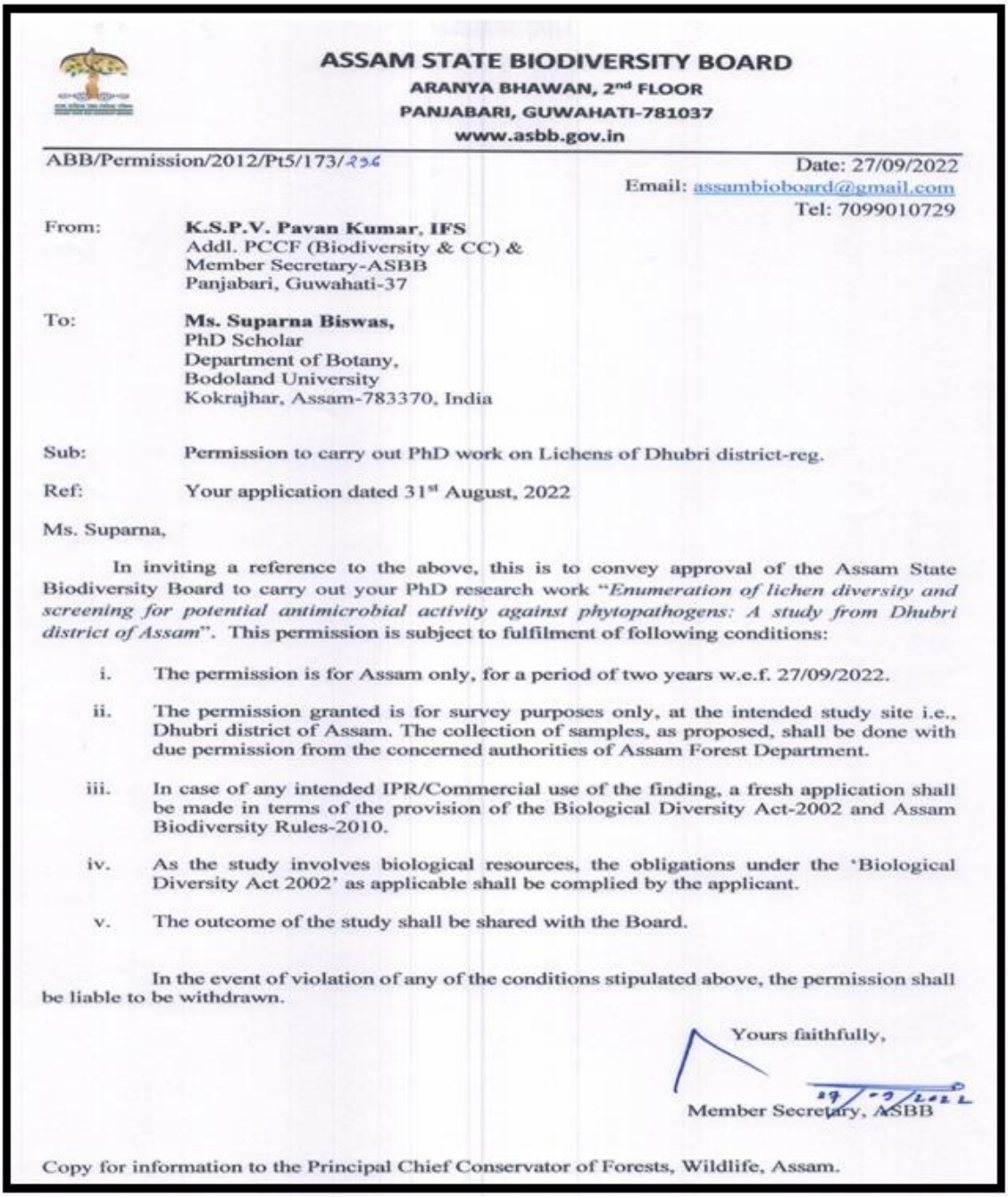


(d) *Viridothelium virens* (scale bar 1mm)

APPENDIX 1

PERMISSION LETTER

For filed survey and collection of the lichen specimens, permission was taken from the Assam State Biodiversity Board, Guwahati, Assam, India.



ASSAM STATE BIODIVERSITY BOARD
ARANYA BHAWAN, 2nd FLOOR
PANJABARI, GUWAHATI-781037
www.asbb.gov.in

ABB/Permission/2012/Pt5/173/256

Date: 27/09/2022
Email: assambioboard@gmail.com
Tel: 7099010729

From: **K.S.P.V. Pavan Kumar, IFS**
Addl. PCCF (Biodiversity & CC) &
Member Secretary-ASBB
Panjabari, Guwahati-37

To: **Ms. Suparna Biswas,**
PhD Scholar
Department of Botany,
Bodoland University
Kokrajhar, Assam-783370, India

Sub: Permission to carry out PhD work on Lichens of Dhubri district-reg.

Ref: Your application dated 31st August, 2022

Ms. Suparna,

In inviting a reference to the above, this is to convey approval of the Assam State Biodiversity Board to carry out your PhD research work "*Enumeration of lichen diversity and screening for potential antimicrobial activity against phytopathogens: A study from Dhubri district of Assam*". This permission is subject to fulfilment of following conditions:

i. The permission is for Assam only, for a period of two years w.e.f. 27/09/2022.

ii. The permission granted is for survey purposes only, at the intended study site i.e., Dhubri district of Assam. The collection of samples, as proposed, shall be done with due permission from the concerned authorities of Assam Forest Department.

iii. In case of any intended IPR/Commercial use of the finding, a fresh application shall be made in terms of the provision of the Biological Diversity Act-2002 and Assam Biodiversity Rules-2010.

iv. As the study involves biological resources, the obligations under the 'Biological Diversity Act 2002' as applicable shall be complied by the applicant.

v. The outcome of the study shall be shared with the Board.

In the event of violation of any of the conditions stipulated above, the permission shall be liable to be withdrawn.

Yours faithfully,

27/9/2022

Member Secretary, ASBB

Copy for information to the Principal Chief Conservator of Forests, Wildlife, Assam.

APPENDIX 2

Climatic data of the study site during the period of field survey

Month	Parameters				
	Temperature	Dew point	Precipitation	Wind	Sea level pressure
Dec 2019	23°-32° C	21°c	2.6 mm	23.0 km/h	2.6 mb
Jan-20	18°-26° C	13°c	8.0 mm	21.0 km/h	8.0 mb
Feb-20	21°-30° C	15°c	18.4 mm	19.0 km/h	18.4 mb
Mar-20	26°-37° C	15°c	5.2 mm	18.0 km/h	5.2 mb
Apr-20	27°-39° C	20°c	42.3 mm	19.0 km/h	42.3 mb
May-20	29°-38° C	24°c	42.3 mm	40.0 km/h	127.8 mb
Jun-20	28°-35° C	26°c	155.6 mm	25.0 km/h	155.6 mb
Jul-20	28°-34° C	26°c	87.0 mm	19.0 km/h	87.0 mb
Aug-20	31°-37° C	26°c	94.1 mm	19.0 km/h	94.1 mb
Sep-20	28°-35° C	26°c	87.5 mm	19.0 km/h	87.5 mb
Oct-20	29°-35° C	25°c	44.2 mm	19.0 km/h	44.2 mb
Nov-20	24°-30° C	22°c	1.0 mm	15.0 km/h	1.0 mb
Dec-20	18°-27° C	15°c	0.2 mm	12.0 km/h	0.2 mb
Jan-21	13°-20° C	15°c	5.8 mm	5.8 km/h	1.2 mb
Feb-21	14°-24° C	15°c	5.2 mm	6.2 km/h	0.2 mb
Mar-21	18°-28° C	15°c	0.2 mm	12.0 km/h	0.2 mb

Source: https://weatherandclimate.com/india/assam/dhubri

APPENDIX 3

Lichen samples on tree trunk

Collection of samples

Crustose lichens on tree trunk

Drying of samples

APPENDIX 4

PUBLICATIONS

Research Articles:

1. Biswas S, Daimari R, Islary P, Nayaka S, Joseph S, Upreti DK, Sarma PK. (2022), New additions to the lichen biota of Assam from Dhubri district, northeastern India, *Journal of Threatened Taxa*, 14(5): 21084-21090.

2. Biswas S, Daimari R, Islary P, Nayaka S, Upreti DK, Sarma PK. (2022), *Pyrenula chlorospila* (Nyl.) Arnold (Pyrenulaceae), a new addition to lichen biota of India, *Checklist*, 18(4): 773-777.

Book chapters:

3. Biswas S, Daimari R and Islary P (2022), Graphidaceae from Dhubri district of Assam, North-East India, Biological Spectrum of Northeast India, Vol 11, Chapter 8, 77-81.

4. Biswas S, Islary P and Daimari R (2023), Secondary compounds of macrolichens from Dhubri district of Assam, Northeast India , Biological Spectrum of NorthEast India, Vol 11I, Chapter 14, 161-171.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 May 2022 | 14(5): 21084–21090
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.7606.14.5.21084-21090
#7606 | Received 04 August 2021 | Final received 18 May 2022 | Finally accepted 18 May 2022
COMMUNICATION

New additions to the lichen biota of Assam from Dhubri district, northeastern India

Suparna Biswas [1], Rebecca Daimari [2], Pungbili Islary [3], Sanjeeva Nayaka [4], Siljo Joseph [5], Dalip Kumar Upreti [6] & Pranjit Kumar Sarma [7]

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Abstract: The present study deals with the exploration of lichen diversity in Dhubri district of Assam state. A total of 42 lichen species belonging to 10 families and 16 genera were recorded, the majority of which were crustose (93%) with Graphidaceae as the dominant family. Eleven of the lichen species under eight genera are new additions to the lichen biota of Assam.

Keywords: Biodiversity, Brahmaputra River, Corticolous, crustose, Graphidaceae, Indo-Bangladesh border.

সাংক্ষিপ্তসাৰ: এই গৱেষণা পত্ৰখনত ভাৰতবৰ্ষৰ অসম ৰাজ্যৰ ধুবুৰী জিলাৰ পৰা ৪২ টা লাইকেন প্ৰজাতিৰ উল্লেখ কৰা হৈছে। ইয়াৰে ১১ টা লাইকেন প্ৰজাতি ৮ টা গণ আৰু ৭ টা গোত্ৰৰ অন্তৰ্গত, অসমত প্ৰথমবাৰৰ বাবে পোৱা গৈছে।

Editor: Anonymity requested. **Date of publication:** 26 May 2022 (online & print)

Citation: Biswas, S., R. Daimari, P. Islary, S. Nayaka, S. Joseph, D.K. Upreti & P.K. Sarma (2022). New additions to the lichen biota of Assam from Dhubri district, northeastern India. *Journal of Threatened Taxa* 14(5): 21084–21090. https://doi.org/10.11609/jott.7606.14.5.21084-21090

Funding: None.

Competing interests: The authors declare no competing interests.

Author details: Suparna Biswas is a researcher in the department of Botany, Bodoland University, Assam, India. She works on the field of lichen taxonomy. Pungbili Islary is a researcher in the department of Botany, Bodoland University, Assam, India. Dr. Sanjeeva Nayaka is a Senior Principal Scientist at CSIR- National Botanical Research Institute, Lucknow, India. His expertise includes taxonomy of lichens and their bio-prospection for air pollution monitoring and various biological activities. Dr. Siljo Joseph, a Scientist of Kerala Forest Research Institute, Kerala, India is an expert of lichen taxonomy. Dr. Dalip Kumar Upreti is an emeritus Scientist at CSIR- National Botanical Research Institute, Lucknow, India. His expertise includes lichenology, bio-systematics, environmental and climate change. Pranjit Kumar Sarma is an assistant professor in the department of Geography, Mangaldai College, Upahupara, Assam , India. He is an expert on remote sensing, GIS, natural resource management and natural resource conservation.

Author contributions: Biswas, S., R. Daimari & P. Islary—concept and documentation of manuscript. S. Nayaka, S. Joseph & D.K. Upreti—identification of specimens. P.K. Sarma—mapping.

Acknowledgements: We are thankful to the Department of Botany, Bodoland University, Kokrajhar, Assam for providing the facility to carry out the research works and director of CSIR-NBRI, Lucknow for permitting access to LWG herbarium and library. Rebecca Damari is thankful to DST-SERB, New Delhi for financial assistance under EMEQ scheme (EEQ/2019/000547).One of the author Siljo Joseph would like to thank financial assistance under DST-INSPIRE Faculty scheme (IFA 18- LSPA 124).

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NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 18 (4): 773–777
https://doi.org/10.15560/18.4.773

PENSOFT

Pyrenula chlorospila (Nyl.) Arnold (Pyrenulaceae), a new addition to lichen biota of India

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* Corresponding author

Abstract

Climatic conditions and physical features of the Eastern Himalayan region encompasses a rich diversity of lichen biota. However, the region's lichens are still far from extensively explored. Here, we study the genus *Pyrenula* Ach. from the Dhubri district of Assam in North-East India. Twelve species of *Pyrenula* have been recorded, of which one of the species, *P. chlorospila* (Nyl.) Arnold, is a newly reported from India. Morphotaxonomic comments on this species, emphasizing its distribution, are provided.

Keywords

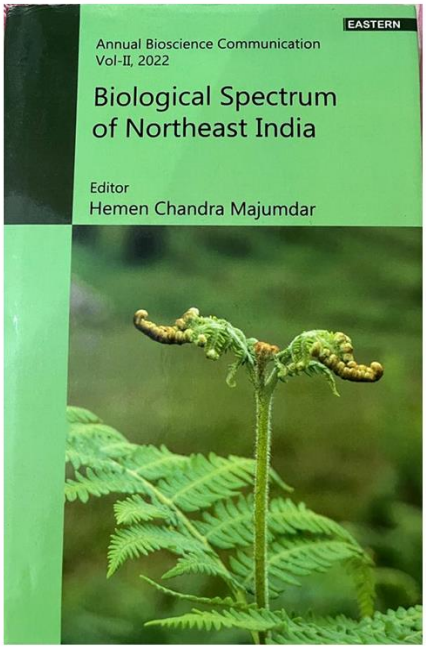
New record, North-East India, taxonomy

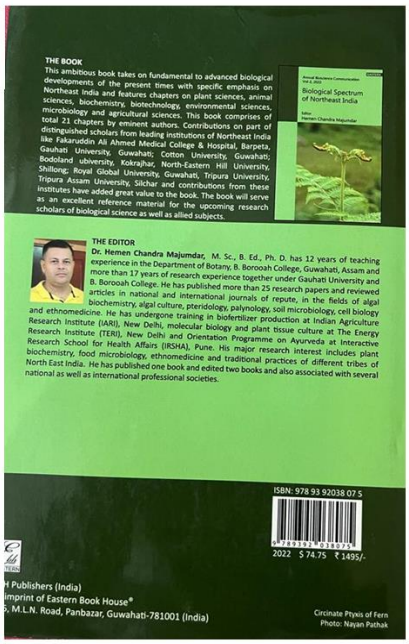
Academic editor: Marcos Kitaura | Received 8 November 2021 | Accepted 30 June 2022 | Published 12 July 2022

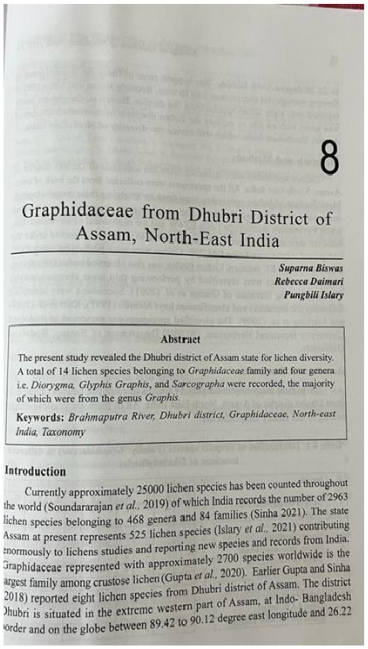
Citation: Biswas S, Daimari R, Islary P, Nayaka S, Upreti DK, Sarma PK (2022) *Pyrenula chlorospila* (Nyl.) Arnold (Pyrenulaceae), a new addition to lichen biota of India. Check List 18 (4): 773–777. https://doi.org/10.15560/18.4.773

Introduction

The number of lichens known from India continues to increase and currently 2963 species in 468 genera and 84 families are known (Sinha 2021). India has rich diversity of pyrenocarpous lichens, with about 382 species in 49 genera and 12 families. The warm, moist conditions in the Eastern Himalaya, including Assam, favours a rich diversity of pyrenocarpous lichens of about 295 species (Mishra et al. 2020). Generally, these lichens grow on tree bark, rocks, soil, and leaves. Trees having smooth, shaded bark are the most preferred. Among the pyrenocarpous lichens, the family Pyrenulaceae is dominant with *Pyrenula* Ach. the dominant genus. Aptroot (2012) listed 745 species of *Pyrenula* worldwide. The genus is characterized by an olivaceous green or brownish to yellowish thallus. Pseudocyphellae and maculae may be or may not be present. The ascocarp is of the perithecia type, which may be covered by the thallus or naked in upper part solitary or rarely 2 or 3 confluent. The peridium is carbonized and either spreading laterally or not. The ostioles are apical or lateral, and the paraphyses are simple and rarely branched. Each asci bears eight spores. Ascospores are brown and transversely septate or







8

Graphidaceae from Dhubri District of Assam, North-East India

Suparna Biswas
Rebecca Daimari
Pungbili Islary

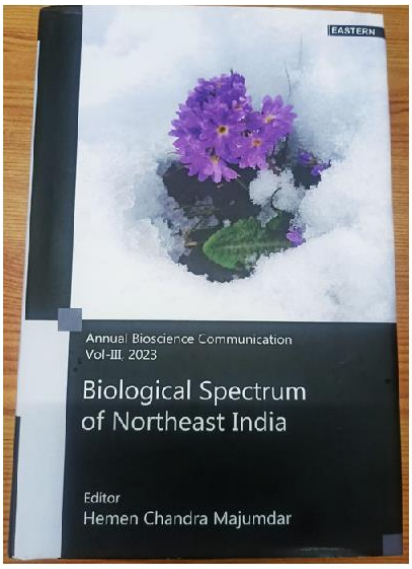
Abstract

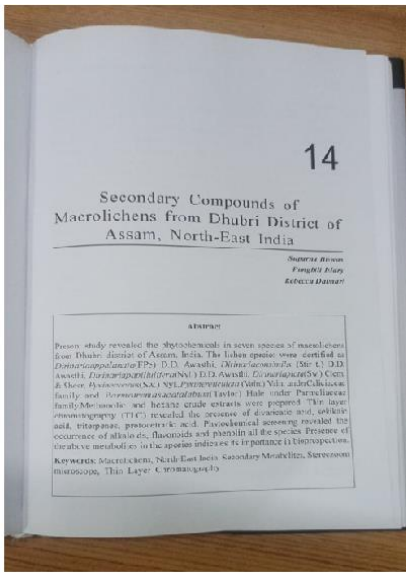
The present study revealed the Dhubri district of Assam state for lichen diversity. A total of 14 lichen species belonging to *Graphidaceae* family and four genera i.e. *Diorygma, Glyphis Graphis*, and *Sarcographa* were recorded, the majority of which were from the genus *Graphis*.

Keywords: *Brahmaputra River, Dhubri district, Graphidaceae, North-east India, Taxonomy*

Introduction

Currently approximately 25000 lichen species has been counted throughout the world (Soundararajan *et al.*, 2019) of which India records the number of 2963 lichen species belonging to 468 genera and 84 families (Sinha 2021). The state Assam at present represents 525 lichen species (Islary *et al.*, 2021) contributing enormously to lichens studies and reporting new species and records from India. Graphidaceae represented with approximately 2700 species worldwide is the largest family among crustose lichen (Gupta *et al.*, 2020). Earlier Gupta and Sinha 2018) reported eight lichen species from Dhubri district of Assam. The district Dhubri is situated in the extreme western part of Assam, at Indo- Bangladesh border and on the globe between 89.42 to 90.12 degree east longitude and 26.22





14

Secondary Compounds of Macrolichens from Dhubri District of Assam, North-East India

Suparna Biswas
Pungbili Islary
Rebecca Daimari

Abstract

APPENDIX 5

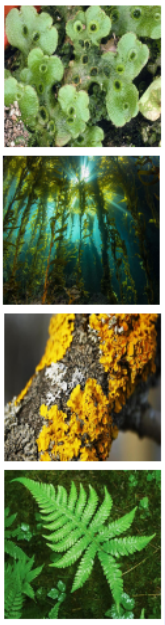
SEMINARS/WORKSHOPS ATTENDED

1. New records of *Graphis* from Dhubri district of Assam, North-East India, International Webinar on recent trends in autotrophic cryptogam research organized by Department of Ecology and Environmental Science, Assam University, Silchar, CSIR- National Botanical Research Institute, Lucknow, and Indian Lichenological Society (ILS), Lucknow, 7-8 october, 2021.

2. Diversity and distribution of lichen genus *Graphis* from Dhubri district of Assam, India, Assam Botany Congress (ABC-02) & International Conference on Plant Science, Organized by Botanical Society of Assam, Guwahati and Department of Botanny, Cachar College, Silchar, Assam, 3-5 December, 2021.

3. Workshop on Research manuscript writing and publication in reputed journal organized by Centre of Bodo Studies, Bodoland University, Kokrajhar, Assam, 7th October, 2021.

4. Seven days workshop on "Advance techniques in plant stress biology", organized by Department of Botany, Gauhati University, Guwahati, Assam, and funded by Department of Science and Technology (DST) under STUTI (Synergistic Training Program Utilizing the Scientific and Technological infrastructure), Govt. of India, 7-13 November, 2022.



Department of Ecology & Environmental Science, Assam University, Silchar
CSIR-National Botanical Research Institute, Lucknow
Indian Lichenological Society (ILS), Lucknow

International Webinar on Recent Trends in Autotrophic Cryptogam Research
7 - 8 October, 2021

CERTIFICATE

This certificate is proudly presented to

Suparna Biswas

Bodoland University, Kokrajhar

for attending the International Webinar on RTACR-2021 and presenting the paper entitled "New records of graphis from Dhubri district of Assam, North-east india" (**oral**).

Prof. J. Rout	Dr. D.K. Upreti	Prof. A. K. Das	Dr. S. Nayaka	Dr. P. Deb
Co-Patron	Co-Patron	Convener	Organizing Secretary	Organizing Secretary

Assam Botany Congress (ABC-02)
&
International Conference on Plant Science

(on blended mode)
3-5 December, 2021
Venue: Cachar College, Silchar, Assam

Organized by
Botanical Society of Assam, Guwahati
Department of Botany, Cachar College, Silchar, Assam

CERTIFICATE

Certified that Dr./Mr./Ms. **Suparna Biswas** of **Bodoland University** participated in the "Assam Botany Congress (ABC-02) and International Conference on Plant Science" held on 3-5 December, 2021 at Cachar College and delivered an oral presentation entitled **Diversity and distribution of lichen genus Graphis from Dhubri district of Assam, India.**

Dr. Tapan Dutta	Dr. Mukul Kr. Baruah	Prof. Manabendra Dutta Choudhury	Prof. Partha Pratim Baruah
Secretary (BSA)	Organising Secretary	Convenor (Technical Program)	Convenor (Technical Program)

Certificate No. CBS/145

Date. 23/10/21

बर' फरायसं मिरु

CENTRE FOR BODO STUDIES

Bodoland University, Kokrajhar

CERTIFICATE

This is to certify that Prof./Dr./Mr./Ms. Suparna Biswas
Working as Research Scholar, B.U has participated in the one-day workshop on **RESEARCH MANUSCRIPT WRITING AND PUBLICATION IN REPUTED JOURNAL** held on 7th October, 2021, organised by the Centre for Bodo Studies, Bodoland University

Vice-Chancellor
Bodoland University

Director
Centre for Bodo Studies, BU

SHOT ON REDMI 7
AI DUAL CAMERA

Department of Science and Technology (DST) Funded Training Workshop under STUTI (Synergistic Training Program Utilizing the Scientific and Technological Infrastructure)

Seven days Workshop on

"Advance Techniques in Plant Stress Biology"

7-13 November, 2022

Venue: Department of Botany, Gauhati University

Certificate of participation

Certified that **Ms. Suparna Biswas** of **Bodoland University, Kokrajhar, Assam** has participated and successfully completed seven days Workshop on **"Advance Techniques in Plant Stress Biology"** sponsored by DST-STUTI, Govt. of India conducted during 7-13 November 2022, organized by Department of Botany, Gauhati University, Guwahati, Assam, India.

We wish him/her good luck and success in future.

Dr. Niraj Agarwala
Coordinator,DST- STUTI Workshop &
Assistant Professor
Department of Botany,
Gauhati University

Prof. Bhaben Tanti
Convenor DST- STUTI Workshop &
Head,Department of Botany,
Gauhati University

New additions to the lichen biota of Assam from Dhubri district, northeastern India

Article *in* Journal of Threatened Taxa · May 2022

DOI: 10.11609/jott.7606.14.5.21084-21090

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Bodoland University
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Journal of Threatened Taxa | www.threatenedtaxa.org | 26 May 2022 | 14(5): 21084–21090

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

https://doi.org/10.11609/jott.7606.14.5.21084-21090

#7606 | Received 04 August 2021 | Final received 15 May 2022 | Finally accepted 18 May 2022

OPEN ACCESS

COMMUNICATION

New additions to the lichen biota of Assam from Dhubri district, northeastern India

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Abstract: The present study deals with the exploration of lichen diversity in Dhubri district of Assam state. A total of 42 lichen species belonging to 10 families and 16 genera were recorded, the majority of which were crustose (93%) with Graphidaceae as the dominant family. Eleven of the lichen species under eight genera are new additions to the lichen biota of Assam.

Keywords: Biodiversity, Brahmaputra River, Corticolous, crustose, Graphidaceae, Indo-Bangladesh border.

সাংক্ষিপ্তসাৰ: এই গৱেষণা পত্রখনত ভাৰতবর্ষৰ অসম ৰাজ্যৰ ধুবুৰী জিলাৰ পৰা ৪২ টা লাইকেন প্রজাতিৰ উল্লেখ কৰা হৈছে। ইয়াৰে ১১ টা লাইকেন প্রজাতি ৮ টা গণ আৰু ৭ টা গোত্রৰ অন্তর্গত, অসমত প্রথমবাৰৰ বাবে পোৱা গৈছে।

Editor: Anonymity requested.

Date of publication: 26 May 2022 (online & print)

Citation: Biswas, S., R. Daimari, P. Islary, S. Nayaka, S. Joseph, D.K. Upreti & P.K. Sarma (2022). New additions to the lichen biota of Assam from Dhubri district, northeastern India. *Journal of Threatened Taxa* 14(5): 21084–21090. https://doi.org/10.11609/jott.7606.14.5.21084-21090

Funding: None.

Competing interests: The authors declare no competing interests.

Author details: Suparna Biswas is a researcher in the department of Botany, Bodoland University, Assam, India. Dr. Rebecca Daimari is an assistant professor in the department of Botany, Bodoland University, Assam, India. She works on the field of lichen taxonomy. Pungbili Islary is a researcher in the department of Botany, Bodoland University, Assam, India. Dr. Sanjeeva Nayaka is a Senior Principal Scientist at CSIR- National Botanical Research Institute, Lucknow, India. His expertise includes taxonomy of lichens and their bio-prospection for air pollution monitoring and various biological activities. Dr. Siljo Joseph, a Scientist of Kerala Forest Research Institute, Kerala, India is an expert of lichen taxonomy. Dr. Dalip Kumar Upreti is an emeritus Scientist at CSIR- National Botanical Research Institute, Lucknow, India. His expertise includes lichenology, bio-systematics, environmental and climate change. Pranjit Kumar Sarma is an assistant professor in the department of Geography, Mangaldai College, Upahupara, Assam , India. He is an expert on remote sensing, GIS, natural resource management and natural resource conservation.

Author contributions: Biswas, S., R. Daimari & P. Islary—concept and documentation of manuscript. S. Nayaka, S. Joseph & D.K. Upreti—identification of specimens. P.K. Sarma—mapping.

Acknowledgements: We are thankful to the Department of Botany, Bodoland University, Kokrajhar, Assam for providing the facility to carry out the research works and director of CSIR-NBRI, Lucknow for permitting access to LWG herbarium and library. Rebecca Damari is thankful to DST-SERB, New Delhi for financial assistance under EMEQ scheme (EEQ/2019/000547).One of the author Siljo Joseph would like to thank financial assistance under DST-INSPIRE Faculty scheme (IFA 18- LSPA 124).

INTRODUCTION

Lichens are highly cosmopolitan in nature. Lichenogeographically, India is divided into eight regions (Nayaka & Asthana 2014). Among these, the Western Ghats, the eastern Himalaya and northeastern India are regarded as biodiversity hotspots both for higher plants and lower cryptogams. The physical structures as well as the climatic conditions of the region support the luxuriant growth of lichens. From the state of Assam, there is a report on lichen which covers 20 out of 34 districts (Behera et al. 2021; Gupta & Sinha 2018). However, extensive exploration of most of the districts for lichen diversity study is indispensable. Literature on lichenology from Dhubri district is very limited. Recently Gupta & Sinha (2018) reported six lichen species—*Graphis subasahinae* Nagarkar & Patw., *Lecanora alba* Lumbsch, *Lecanora helva* Stizenb., *Parmotrema saccatilobum* (Taylor) Hale, *Protoparmelia hesperia* (Kantvilas & Elix) Kantvilas, Papong & Lumbsch, and *Letrouitia flavocrocea* (Nyl.) Hafellner & Bellem—from various parts of the district. Therefore, the present study was undertaken to explore and enumerate the lichen diversity of Dhubri district. The district is situated in the extreme western part of Assam in the Indo-Bangladesh border and on the northern bank of the river Brahmaputra.

MATERIALS & METHODS

For the present study, about 700 lichen specimens were collected from January to December 2020 from 13 different localities of Dhubri district of Assam (Figure 1). All the specimens were collected from the bark of trees, air-dried and stored in paper packets. The lichen specimens were identified morphologically, anatomically and chemically. The morphological characters were studied under stereozoom microscope Leica EZ4W. For anatomical details, thin sections of the apothecia or perithecia were mounted in water and observed under the compound microscope Leica DM 750. The presence of chemical substances was analysed by performing colour tests using K, P, and C solutions and thin layer chromatography (Orange et al. 2001). The lichen thallus was also observed under the UV cabinet. The specimens were identified following relevant literature (Nayaka 2004; Awasthi 2007; Lücking et al. 2009; Ram et al. 2009; Aptroot 2012; Sharma et al. 2012). The families of the identified species were assigned as per the literature of Lücking et al. (2016). Specimens were identified up to the species following relevant literature and updated as per the databases available for lichen taxonomy.

The identified specimens are housed in the Bodoland University Botanical Herbarium (BUBH), Department of Botany, Bodoland University. A set of voucher specimens is deposited in the herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG), Uttar Pradesh, India.

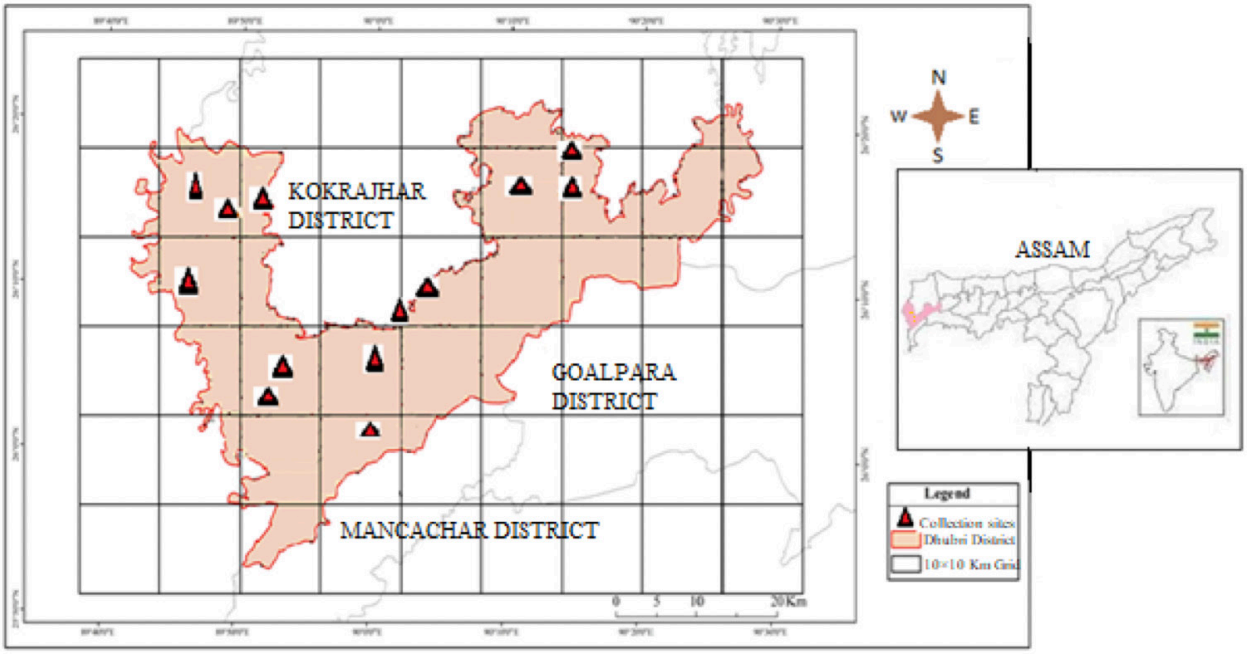

Figure 1. Map of Dhubri district, Assam showing the collection sites.

RESULTS

The present study identified 42 lichen species under 10 families and 16 genera (Table 1). The majority of the lichen species are crustose (93%) followed by 7% foliose. Among the lichen families Graphidaceae emerged as the dominant family with 15 species, followed by Caliciaceae with nine species.

DISCUSSION

Based on Joseph et al. (2020), the annotated checklist by Singh & Sinha (2010) and literature available on lichens for Assam state (Awasthi 1961; Rout et al. 2005, 2010, 2012; Das et al. 2013; Gupta et al. 2013; Daimari et al. 2014; Gogoi et al. 2019; Gupta & Sinha 2018; Behera et al. 2021), 11 species under eight genera and seven families are listed as new records to Assam and brief descriptions of these species are provided.

A comparative study of the six lichen species reported by Gupta & Sinha (2018) from Dhubri district with the present study reveals that only two of the species are found to be common and therefore, till date the district records a total of 46 species. However, the list may further go up with the exploration of more locations for the lichen study.

Enumeration of the newly recorded lichen species

Family: Arthoniaceae

Herpothallon himalayanum Jagadeesh Ram & G.P. Sinha (Image 1D)

Distribution: India (West Bengal, Darjeeling district), Endemic.

Specimen examined: 2020-0169 (BUBH), India, Assam, Dhubri district, Khajurbari part 1, on the bark of *Lannea coromandelica*, 24.xii.2020, 39 m, 26.262 N, 90.179 E, coll. S. Biswas & P. Biswas.

Family: Caliceaceae

Pyxine isidiophora (Müll. Arg.) Imshaug (Image 2H)

Distribution: India (West Bengal), Sri Lanka, Columbia.

Specimen examined: 2020-0170 (BUBH), India, Assam, Dhubri district, Debotar hasdaha part 4, on the bark of *Lannea coromandelica*, 22.xi.2020, 27.73 m, 26.050 N, 89.893 E, coll. S. Biswas & P. Biswas.

Family: Graphidaceae

Allographa stictilabiata (Patw. & C.R. Kulk.) J. Kalb & Kalb (Image 1C)

Distribution: India (Karnataka and Maharashtra), Endemic

Specimen examined: 2020-0171 (BUBH), India, Assam, Dhubri district, Alokjhari, on the bark of *Shorea robusta*, 12.i.2020, 52.82 m, 26.253 N, 89.860 E, coll. S. Biswas & P. Biswas.

Graphis asahinae Patw. & C.R. Kulk. (Image 1A)

Distribution: India (Kerala and Tamil Nadu), Brazil.

Specimen examined: 2020-0172 (BUBH), India, Assam, Dhubri district, Gopigoan part 3, on the bark of *Lannea coromandelica*, 26.Xii.2020, 44.14 m, 26.257 N, 90.232 E, coll. S. Biswas & P. Biswas.

Graphis modesta Zahlbr. (Image 1B)

Distribution: India (Maharashtra), Brazil, Mexico, Papua New Guinea, Seychelles.

Specimen examined: 2020-0173 (BUBH), India, Assam, Dhubri district, Rangamati part 3, on the bark of *Artocarpus heterophyllus*, 27.Xi.2020, 28.84 m, 26.161 N, 90.059 E, coll. S. Biswas & P. Biswas.

Family: Lecanoraceae

Lecanora leproplaca Zahlbr. (Image 1E)

Distribution: India (Madhya Pradesh), Australia, Brazil, Central and South America, Dominica, El Salvador, Fiji, Hawaiian Islands, Jamaica, Seychelles, South Africa, Thailand.

Specimen examined: 2020-0174 (BUBH), India, Assam, Dhubri district, Gauripur Matiabag Hawakhana, on the bark of *Michelia champaca*, 8.ii.2020, 44.82 m, 26.097 N, 89.975 E, coll. S. Biswas & P. Biswas.

Family: Parmeliaceae

Parmotrema mesotropum (Müll. Arg.) Hale. (Image 1F)

Distribution: India (Arunachal Pradesh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Uttarakhand), Argentina, Brazil, Bolivia, Central & South America, China, Colombia, Costa Rica, Guyana, Mexico, Paraguay, Venezuela.

Specimen examined: 2020-0175 (BUBH), India, Assam, Dhubri district, Alomganj part 9, on the bark of *Lannea* sp., 27.xii.2020, 43.48 m, 26.135 N, 90.036 E, coll. S. Biswas & P. Biswas.

Family: Physciaceae

Physcia abuensis D.D. Awasthi & S.R. Singh (Image 2G)

Distribution: India (Rajasthan), Endemic

Specimen examined: 2020-0176 (BUBH), India, Assam, Dhubri district, Dhubri town, on the bark of *Litchi chinensis*, 10.i.2020, 41.43 m, 26.022 N, 89.959 E, coll. S.

Table 1. Distribution of lichen species in the study site along with their growth form.

	Species	GF	Locations												
			1	2	3	4	5	6	7	8	9	10	11	12	13
Arthoniaceae															
1	*Coniocarpon cinnabarinum* DC.	C	-	-	-	+	-	-	+	-	-	-	-	-	-
2	*Cryptothecia lunulata* (Zahlbr.) Makhija & Patw.	C	-	-	-	-	-	-	-	-	-	+	-	-	+
3	* *Herpothallon himalayanum* Jagad. Ram & G.P. Sinha	C	-	-	-	-	-	-	-	-	-	-	+	-	-
Caliciaceae															
4	*Cratiria lauri-cassiae* (Fée) Marbach	C	-	-	-	-	-	-	-	-	-	-	-	+	-
5	*Dirinaria applanata* (Fée) D.D. Awasthi	F	-	+	+	+	-	-	-	-	-	-	+	-	-
6	*D. consimilis* (Stirt.) D.D. Awasthi	F	-	-	-	-	-	-	-	-	-	-	-	-	+
7	*D. papillulifera* (Nyl.) D.D. Awasthi	F	-	-	-	-	-	+	+	-	-	+	+	-	-
8	*D. picta* (Sw.) Clem. & Shear.	F	-	+	-	-	-	-	-	-	-	-	+	-	-
9	*Pyxine cocoes* (Sw.) Nyl.	F	-	+	+	+	-	+	+	-	-	-	+	+	-
10	*P. coralligera* Malme.	F	-	-	-	-	-	+	-	-	-	-	-	-	-
11	* *P. isidiophora* (Müll. Arg.) Imshaug	F	-	-	-	-	-	+	-	-	-	-	-	-	-
12	*P. reticulata* (Vain.) Vain.	F	-	-	+	-	-	-	-	-	-	-	-	-	-
Graphidaceae															
13	**Allographa stictilabiata* (Patw. & C.R. Kulk.) J. Kalb & Kalb.	C	+	-	-	-	-	-	-	-	-	-	-	-	-
14	*Diorygma junghuhnii* (Mont. & Bosch) Kalb, Staiger & Elix	C	+	-	-	-	-	-	-	-	-	-	-	-	-
15	*D. soozanum* (Zahlbr.) M. Nakan. & Kashiw.	C	+	-	-	-	-	-	-	-	-	-	-	-	-
16	*Graphis analoga* Nyl.	C	-	-	-	-	-	-	+	-	-	-	-	-	-
17	*G. arecae* Vain.	C	-	-	-	-	-	-	-	+	-	-	-	-	-
18	* *G. asahinae* Patw. & C.R. Kulk.	C	-	-	-	-	-	-	-	-	+	-	-	-	-
19	*G. furcata* Fée	C	+	-	-	-	-	-	-	-	-	-	+	-	-
20	*G. glaucescens* Fée	C	+	-	-	-	-	-	-	-	-	-	-	-	-
21	* *G. modesta* Zahlbr.	C	-	-	-	-	-	-	-	-	-	-	-	+	-
22	*G. pyrrhocheiloides* Zahlbr.	C	+	-	-	-	-	-	+	-	-	-	-	-	-
23	*G. sayeri* Müll. Arg.	C	-	-	-	-	-	-	-	-	-	+	-	-	-
24	*G. scripta* (L.) Ach.	C	-	-	-	-	-	-	-	-	-	-	-	+	-
25	*G. sulphurella* (Zahlbr.) Lücking	C	-	-	-	-	+	-	-	-	-	-	-	-	-
26	*G. sundarbanensis* Jagad. Ram & G.P. Sinha	C	-	-	-	-	-	-	+	-	+	-	-	-	-
27	*G. xanthospora* Müll. Arg.	C	+	-	-	-	+	-	-	-	-	-	-	-	-
Lecanoraceae															
28	*Lecanora helva* Stizenb.	C	-	+	+	-	-	+	-	-	-	+	-	+	-
29	* *L. leproplaca* Zahlbr.	C	-	-	-	-	-	-	-	+	-	-	-	-	-
Parmeliaceae															
30	* *Parmotrema mesotropum* (Müll. Arg.) Hale	F	-	+	-	-	-	-	-	-	-	-	-	-	-
31	*P. saccatilobum* (Taylor) Hale	F	-	-	-	-	-	-	-	-	-	+	-	-	-
Physciaceae															
32	* *Physcia abuensis* D.D. Awasthi & S.R. Singh	F	-	-	-	-	-	-	+	-	-	-	-	-	-
Porinaceae															
33	*Porina suhibernica* Upreti	C	+	-	-	-	-	-	-	-	-	-	-	-	-
Pyrenulaceae															
34	*Pyrenula aggregata* (Fée) Fée	C	-	-	+	-	-	-	-	-	-	-	-	-	-
35	*P. aspistea* (Afzel. Ex Ach.) Ach.	C	-	-	-	-	-	-	-	+	-	-	-	-	-
36	* *P. mastophora* (Nyl.) Müll. Arg.	C	-	-	-	+	-	-	-	-	-	-	-	-	-
37	* *P. minor* Fée	C	-	-	-	-	-	-	-	-	-	-	-	-	+
38	*P. thelomorpha* Tuck.	C	-	-	-	-	-	-	-	-	-	+	-	-	-
39	* *P. welwitschii* (Upreti & Ajay Singh) Aptroot	C	-	-	-	-	-	-	-	-	-	+	-	-	-
Ramalinaceae															
40	*Bacidia medialis* (Tuck.) Zahlbr.	C	-	-	+	-	-	-	-	-	-	-	-	-	-
41	*B. rubella* (Hoffm.) A. Massal.	C	-	-	-	-	-	-	-	-	-	-	+	-	-
Trypetheliaceae															
42	*Trypethelium eluteriae* Spreng.	C	-	-	-	-	-	-	-	-	-	+	-	-	-

GF—Growth form | C—Crustose | F—Foliose | 1—Alokjhari | 2—Alomganj part 9 | 3—Barobalurchar | 4—Bhasani goan | 5—Bidyadabri part 5 | 6—Debotar hasdaha part 4 | 7—Dhubri town | 8—Gauripur Matiabag Hawakhana | 9—Gopigoan part 3 | 10—Kismat hasdaha part 2 | 11—Khajurbari part 1 | 12—Rangamati part 3 | 13—Satrasal. (*) denotes new records to Assam, (+) present and (–) absent.

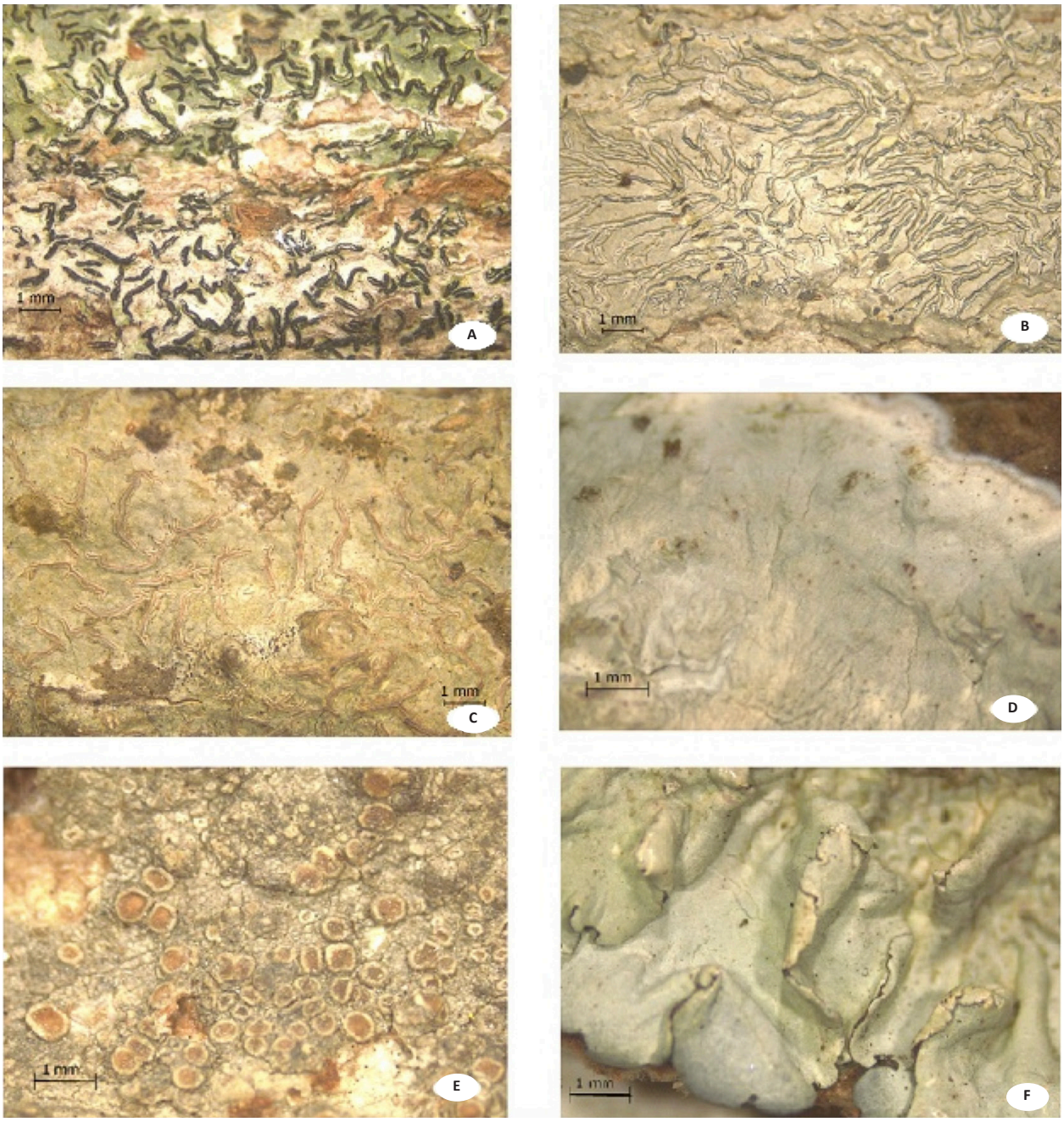

Image 1. Habits of lichen new records: A—*Graphis asahinae* Patw. & C.R. Kulk. | B—*Graphis modesta* Zahlbr. | C—*Allographa stictilabiata* (Patw. & C.R. Kulk.) J. Kalb & Kalb | D—*Herpothallon himalayanum* Jagad. Ram & G.P. Sinha | E—*Lecanora leproplaca* Zahlbr. | F—*Parmotrema mesotropum* (Müll. Arg.) Hale | (Scale bar = 1mm).

Biswas & P. Biswas.

Family: Pyrenulaceae

Pyrenula mastophora (Nyl.) Müll. Arg. (Image 2K)

Distribution: India (Tamil Nadu), Philippines

Specimen examined: 2020-0177 (BUBH), India, Assam, Dhubri district, Bhasani goan, on the bark of *Lannea coromandelica*, 26.xii.2020, 36.22 m, 26.301 N, 90.224 E, coll. S. Biswas & P. Biswas.

Pyrenula minor Fée (Image 2I)

Distribution: India (Andaman and Nicobar Islands), Brazil, El Salvador, French Guiana, USA

Specimen examined: 2020-0178 (BUBH), India, Assam, Dhubri district, Satrasal, on the bark of *Lannea coromandelica*, 4.i.2020, 36.89 m, 26.131 N, 89.734 E,

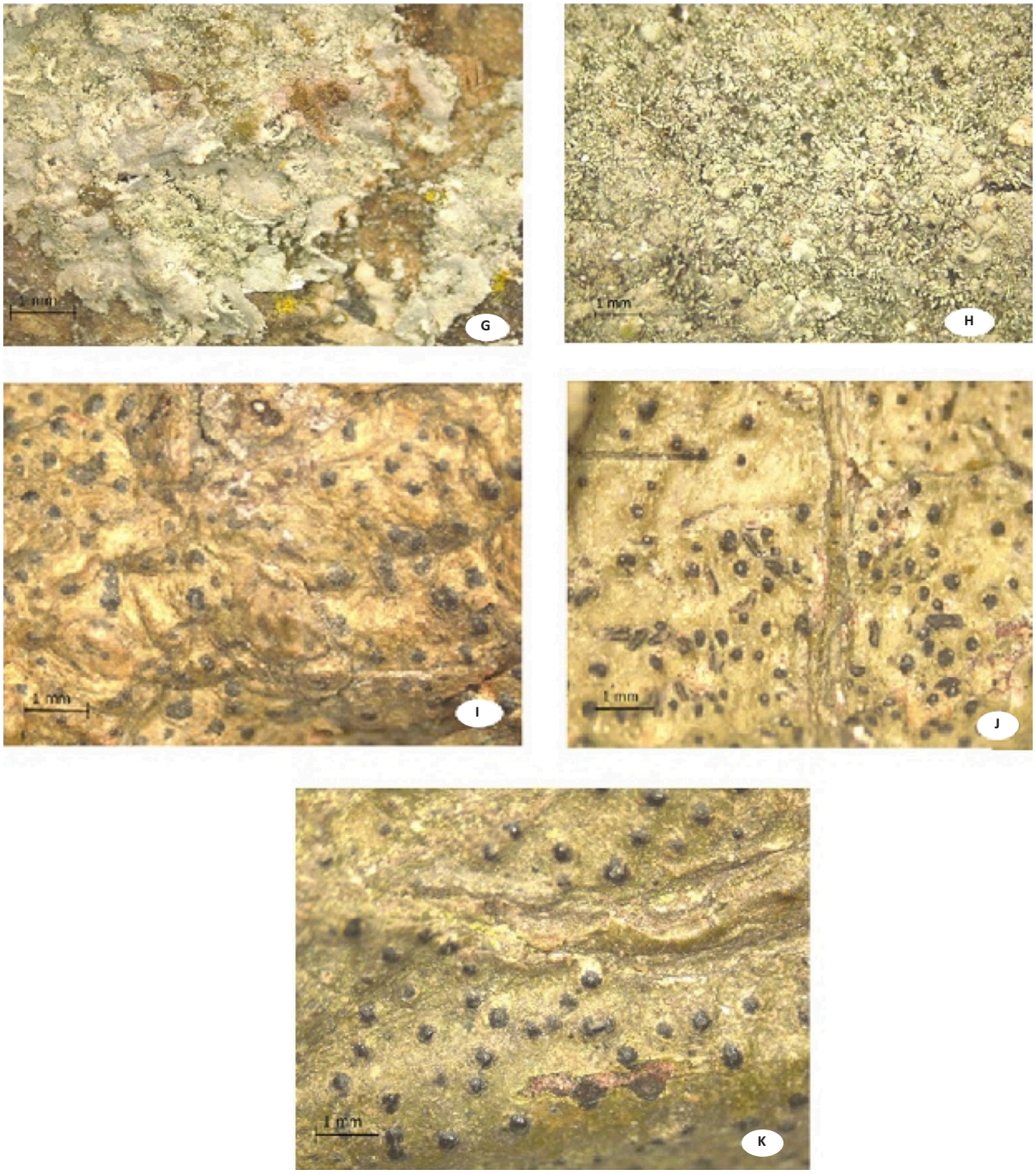

Image 2. Habits of lichen new records: G—*Physcia abuensis* D.D. Awasthi & S.R. Singh | H—*Pyxine isidiophora* (Müll. Arg.) Imshaug | I—*Pyrenula minor* Fée | J—*Pyrenula welwitschii* (Upreti & Ajay Singh) Aptroot | K—*Pyrenula mastophora* (Nyl.) Müll. Arg. | (Scale bar = 1mm).

coll. S. Biswas & P. Biswas.

Pyrenula welwitschii (Upreti & Ajay Singh) Aptroot (Image 2J)

Distribution: India (Uttarakhand), Angola

Specimen examined: 2020-0179 (BUBH), India, Assam, Dhubri district, Kismat hasdaha part 2, on the bark of *Lannea coromandelica*, 22.xi.2020, 37.07 m, 26.050 N, 89.893 E, coll. S. Biswas & P. Biswas.

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NAAS rating (India) 5.64

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Journal of Threatened Taxa

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

May 2022 | Vol. 14 | No. 5 | Pages: 20951–21126
Date of Publication: 26 May 2022 (Online & Print)
DOI: 10.11609/jott.2022.14.5.20951-21126

Publisher & Host

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NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 18 (4): 773–777
https://doi.org/10.15560/18.4.773

PENSOFT

Pyrenula chlorospila (Nyl.) Arnold (Pyrenulaceae), a new addition to lichen biota of India

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Abstract

Climatic conditions and physical features of the Eastern Himalayan region encompasses a rich diversity of lichen biota. However, the region's lichens are still far from extensively explored. Here, we study the genus *Pyrenula* Ach. from the Dhubri district of Assam in North-East India. Twelve species of *Pyrenula* have been recorded, of which one of the species, *P. chlorospila* (Nyl.) Arnold, is a newly reported from India. Morphotaxonomic comments on this species, emphasizing its distribution, are provided.

Keywords

New record, North-East India, taxonomy

Academic editor: Marcos Kitaura | Received 8 November 2021 | Accepted 30 June 2022 | Published 12 July 2022

Citation: Biswas S, Daimari R, Islary P, Nayaka S, Upreti DK, Sarma PK (2022) *Pyrenula chlorospila* (Nyl.) Arnold (Pyrenulaceae), a new addition to lichen biota of India. Check List 18 (4): 773–777. https://doi.org/10.15560/18.4.773

Introduction

The number of lichens known from India continues to increase and currently 2963 species in 468 genera and 84 families are known (Sinha 2021). India has rich diversity of pyrenocarpous lichens, with about 382 species in 49 genera and 12 families. The warm, moist conditions in the Eastern Himalaya, including Assam, favours a rich diversity of pyrenocarpous lichens of about 295 species (Mishra et al. 2020). Generally, these lichens grow on tree bark, rocks, soil, and leaves. Trees having smooth, shaded bark are the most preferred. Among the pyrenocarpous lichens, the family Pyrenulaceae is dominant with *Pyrenula* Ach. the dominant genus. Aptroot (2012) listed 745 species of *Pyrenula* worldwide. The genus is characterized by an olivaceous green or brownish to yellowish thallus. Pseudocyphellae and maculae may be or may not be present. The ascocarp is of the perithecia type, which may be covered by the thallus or naked in upper part solitary or rarely 2 or 3 confluent. The peridium is carbonized and either spreading laterally or not. The ostioles are apical or lateral, and the paraphyses are simple and rarely branched. Each asci bears eight spores. Ascospores are brown and transversely septate or

muriform, with or without lichexanthone and anthraquinones (Awasthi 1991, Ingle 2018). Upreti (1990, 1991a, 1991b, 1992, 1993) made extensive revisionary studies on the *Pyrenula* of India and described several new species, as well as reports of species from the country. Jagadesh Ram et al. (2005) newly described *Pyrenula subcylindrica* Jagadesh & Upreti from India. Thus, India is represented by 83 species of *Pyrenula* and greatest diversity of species is reported from the Western Ghats and the Eastern Himalayan Region (Mishra et al. 2020; Rajaprabu et al. 2021). Among the northeastern states, Assam is one of the states with significant number of lichen studies and novel species reports from India. Altogether, 525 species of lichens have been reported from Assam, of there are 59 *Pyrenula* species (Daimari 2016; Gupta and Sinha 2018; Gogoi et al. 2019, 2020; Behera et al. 2021). Gupta and Sinha (2018) compiled lichens from the state and mentioned *P. acutalis* R.C. Harris found in the Dhubri district as part of an ongoing study.

Methods

Lichen specimens were collected from 15 locations in the Dhubri district in Assam state. The specimens were collected from the bark of trees, then air dried and stored in acid free paper packets. They were identified morphologically, anatomically and chemically. The morphological characters were studied under a Leica EZ4W stereozoom microscope. For examining anatomical characters, thin sections of the perithecia were mounted in water and observed under a Leica DM 750 compound microscope. The presence of chemical substances was analyzed by performing thin- layer chromatography (Orange et al. 2001) and colour tests using KOH (K), para-phenylenediamine (P) and Calcium hypochlorite (C) solutions. Lichen thallus were also observed under ultraviolet light. The specimens were identified to species following Aptroot (2012) and Upreti (1998) and deposited in the Bodoland University Botanical Herbarium, (BUBH), Department of Botany, Bodoland University (Kokrajhar, Assam, India). A set of voucher specimen is deposited in the herbarium of CSIR–National Botanical Research Institute, LWG; Lucknow Uttar-Pradesh, India

Results

***Pyrenula chlorospila* (Nyl.) Arnold**
Figure 2A–C

Specimens examined. INDIA – **Assam** • Dhubri district, Bidyadabri part v; 26°26′11″N, 089°47′11″E; 34m alt; 21. XII. 2020; S. Biswas & P. Biswas leg.; on the bark of *Lannea* sp.; 2020-0280 (BUBH) • Dhubri district, Debotar hasdaha part 4; 26°05′79″N, 089°83′083″E; 30.23 m alt; 22. XI. 2020; S. Biswas & P. Biswas leg; on the bark of *Lannea* sp.; 2020-0400 (BUBH), 61701 (LWG).

Description. Thallus crustose, corticolous, yellowish; pseudocyphellae present; maculae absent; perithecia numerous, black; ascomata 0.15–0.20 mm in diameter; ostiole white, apical to lateral; peridium black, carbonized, spreading laterally; hamathecium not inspersed, ; hymenium clear; asci 8- spored; ascospores brown, transversely 3-septate; middle locules diamond-shaped and terminal locules triangular with their base towards the end, 26–30 ×10–12 µm.

Chemistry: Thallus K–, C–, P–, TLC–no chemical present.

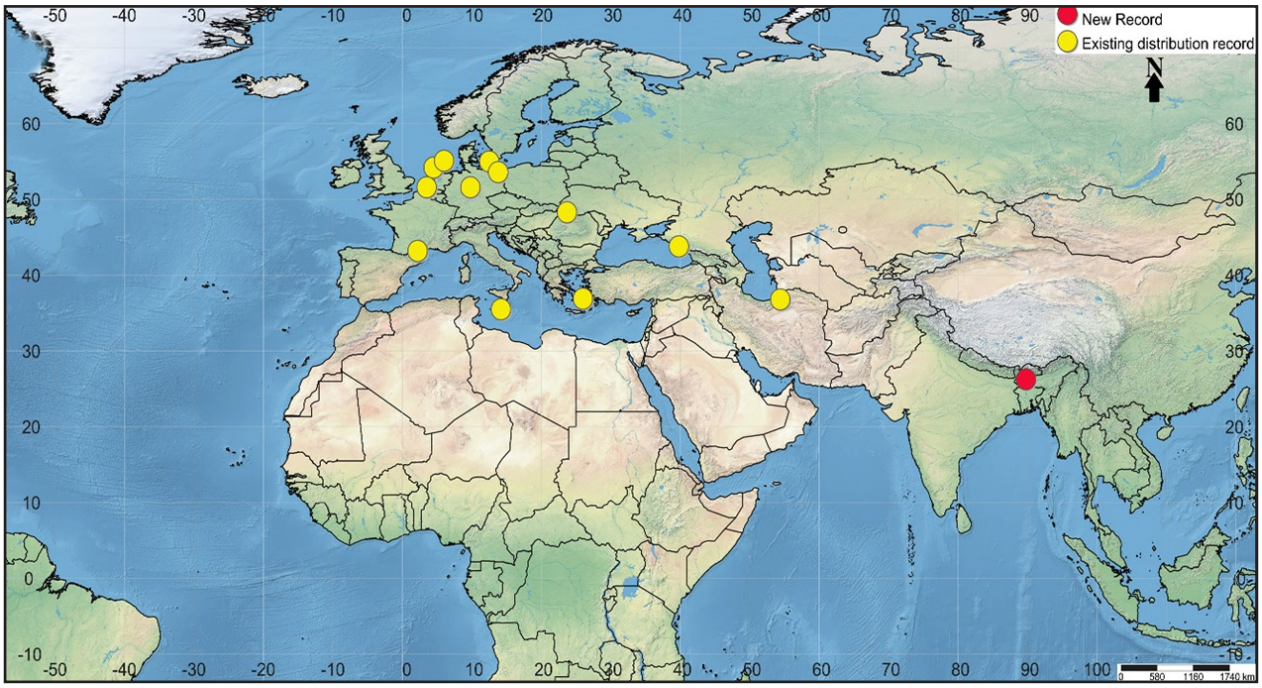

Figure 1. Geographic distribution of *Pyrenula chlorospila* around the world. Yellow circles: occurrence data from GBIF. Red circle: new record of *P. chlorospila* in Assam, India.

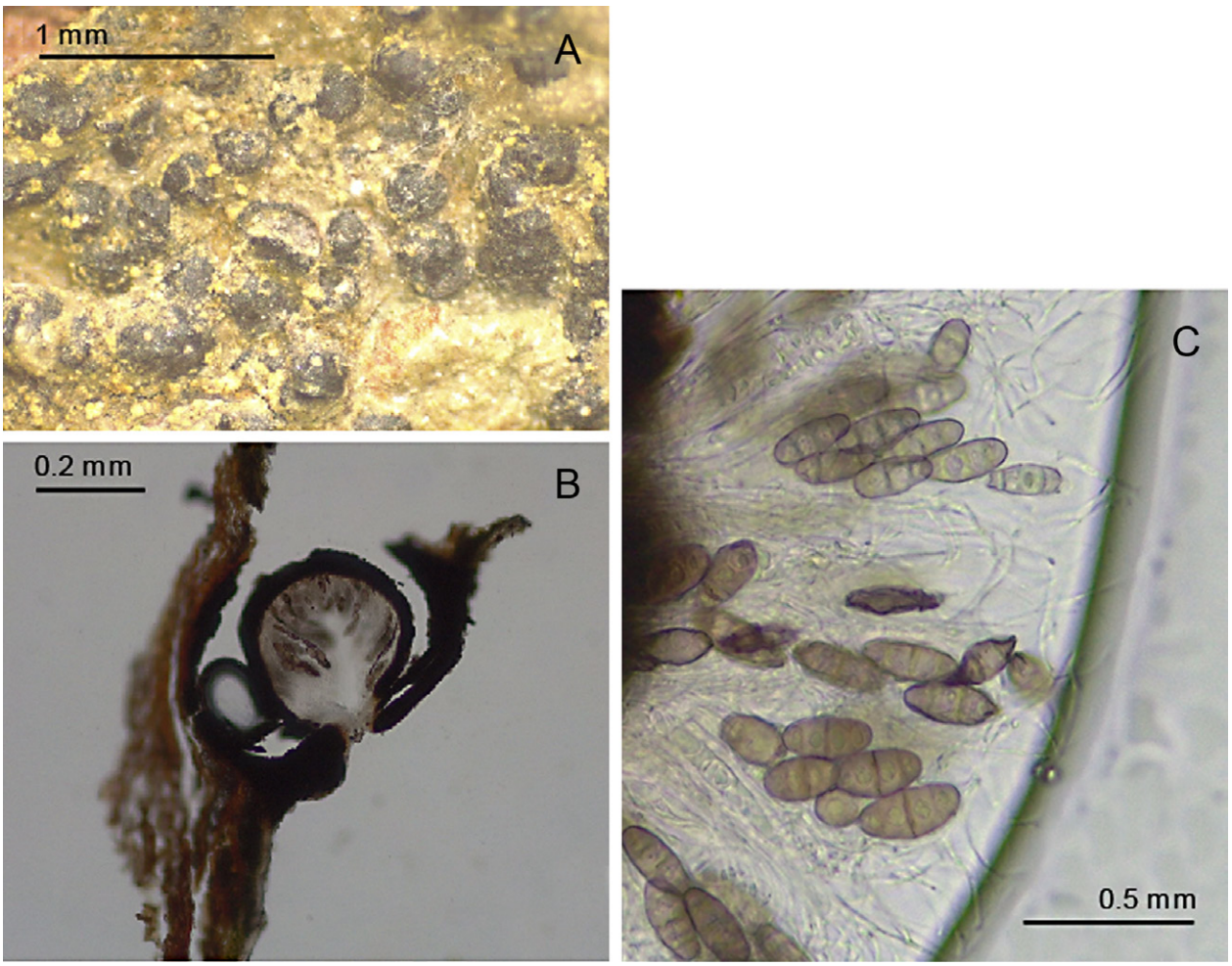

Figure 2. *Pyrenula chlorospila* from Dhubri district, Assam, India. **A.** Habitus with perithecia. **B.** Vertical section of ascomata **C.** Ascospores (26–30 µm).

Ecology. The species was found growing on smooth bark of *Lannea* sp.

Remarks. *Pyrenula chlorospila* is similar with *P. macrospora* (Degel.) Coppins & P. James. (Weerakoon et al. 2012), in its thallus colour, presence of pseudocyphellae on the thallus and absence of chemicals in TLC. Both of the species luxuriously grow on smooth bark of the trees. On the other hand, both of the species differs with their ascomata size. *Pyrenula chlorospila* has 0.1–0.4 mm diameter ascomata but *P. macrospora* has ascomata size approximately 0.5–0.9 mm in diameter (Orange 2013). Globally, *P. chlorospila* is reported from Denmark, France, Germany, Greece, Iran, Ireland, Isle of Man, Malta, the Netherlands, Russian Federation, Spain, Ukraine (GBIF 2022) (Fig. 1).

Discussion

Pyrenula species mostly prefer to grow on the smooth bark of *Alnus*, *Quercus*, and *Ficus* species (Ingle et al. 2018), and in India, most *Pyrenula* species have been found on the smooth bark of *Lannea* sp. and some on the bark of species of *Artocarpous*, *Mangifea*, *Michelia*, *Polyalthia*, and *Ricinus*. Based on the literature (Awasthi 1961; Rout et al. 2005, 2010, 2012; Singh and Sinha 2010; Das et al. 2012, 2013; Gupta et al. 2013; Daimari et al. 2014; Dey et al. 2015; Choudhury et al. 2016; Gupta and Sinha 2018; Gogoi et al. 2019; Joseph et al. 2020; Behera et al. 2021), our record of *P. chlorospila* represents a new addition to the lichen biota of India. With this addition, 12 species of *Pyrenula* have been recorded from Dhubri district (Table 1). As the district is mainly plain with deciduous vegetation, crustose lichens are dominant, although a few foliose genera, *Dirinaria*, *Pyxine*, and *Parmotrema*, also occur.

Acknowledgements

We are thankful to the Botany Department, Bodoland University for providing the facilities to carry out our research and the Director of CSIR – National Botanical Research Institute, Lucknow for permitting access to the LWG herbarium and library. We are also thankful to Mr. Sanswrang Basumatary for his help and suggestions. Rebecca Daimari is thankful to Department of Science and Technology – Science and Engineering Research Board, New Delhi, India for financial assistance under the EMEQ scheme (EEQ/2019/000547).

Table 1. Distribution of *Pyrenula* species in different localities of Dhubri district, Assam, India. Locations: 1 = Barobaluchar, 2 = Bidyadabri part 5, 3-Bhalukmari, 4 = Bhelupara part 2, 5 = Brahmin para, 6 = Debotar hasdaha part 4, 7 = Dhubri town, 8 = Falimari, 9 = Gaurangtari part 2, 10 = Gauripur, 11 = Golakganj, 12 = Hatipota part 2, 13 = Khajurbari part 1, 14 = Khalilpur, 15 = Kherbari part 2. (+) presence and (–) absence.

***Pyrenula* species**	**Locations**														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
P. acutalis R.C. Harris	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–
P. anomala (Ach.) Vain.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
P. approximans (Kremp.) Müll. Arg.	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
*P. breutelii (*Müll. Arg.) Aptroot	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
P. chlorospila (Nyl.) Arnold	–	+	–	–	–	+	–	–	–	–	–	–	–	–	–
P. leucostoma Ach.	–	–	–	–	–	–	+	–	–	+	–	–	–	–	–
P. leucotrypa (Nyl.) Upreti	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
P. oculata Ajay Singh & Upreti	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
P. quassicola (Fée)	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+
P. sublaevigata (Patw. & Makhija) Upreti	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
P. submastophora Ajay Singh & Upreti	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–
P. wrightii (Müll. Arg.) R.C. Harris	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–

Authors' Contributions

Conceptualization: SB. Data curation: SB, PI. Formal analysis: SN, DKU, PKS. Funding acquisition: RD.

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