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NEW RECORDS OF LICHENS FROM KHADIMNAGAR NATIONAL PARK SYLHET, BANGLADESH. I.

ABDULLAH-AL-KAIUM, SHAMIM SHAMSI*, MD. ALMUJADDADE ALFASANE AND MD. ABUL BASHAR

Department of Botany, University of Dhaka, Dhaka 1000, Bangladesh

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Abstract

An investigation was carried out from January 2021 to December 2022 to study the lichen flora of Khadimnagar National Park. The present paper deals with 10 new records of lichens, namely, *Acanthothecis asprocarpa* (A.W. Archer) A.W. Archer, Bacidia absistens (Nyl.) Arnold, *Caloplaca cinnabarina* (Ach.) Zahlbr., *Coenogonium implexum* Nyl., *Dirinaria leopoldii* (Stein) D. D. Awasthi, *Echinoplaca campanulata* Kalb & Vězda, *Metamelanea umbonata* Henssen, *Pyrgillus javanicus* (Mont. & Bosch) Nyl., *Ramboldia blastidiata* Kantvilas & Elix and *Trypethelium ochroleucum* (Eschw.) Nyl. Detailed taxonomic description of the newly reported species with photographs are provided.

Introduction

Lichens are duplex organisms formed from a symbiotic association of a fungus and an alga. The fungus partner is denoted as mycobiont and the algal partner as photobiont. Photosynthetic cells are intertwined in a matrix of fungal hyphae. Such a definition sometimes raises the question of whether lichens are technically individual organisms. Various aspects of lichen biology have clarified the interactions of these organisms. Isolation of these partners, physiological study, and anatomical study offers the scientist a fascinating opportunity to study the components and contribute to understanding of the pattern of the symbiosis in lichens. It is present in a wide range of habitats throughout the world and dominates terrestrial ecosystems (about 8%) (Gadd and Geoffrey, 2010). A total of 20,000 species of lichens have been reported globally. The Indian subcontinent has 2,450 species of lichens (Awasthi, 2000). Khadimnagar National Park (KNP) was declared a national park in 2006 under the Wildlife Preservation Act 1974 with an area of 678.8 ha (1676.73 acres) for the preservation of the remaining natural hill forest in Khadimnagar Reserve Forest. The hills are dissected by numerous valleys, separated by ridges up to 50 m in height. The hills are generally low and gently sloping. The soil ranges from clay loams to pale brown (acidic) clay loams on the hills. The landscape has a broken topography comprising of undulating low rolling hills broken by the V-shaped valleys of two main charas (streams) within the National park. KNP is characterized by good rainfall and so a large amount of water is drained from the surrounding and inside hills of KNP. The area is traversed by numerous creeks. Because of deforestation and heavy rainfall, erosion, and gully formation is common in KNP, especially along the charas. Erosion and landslides adversely affect the flow of water in the charas and sediment loads and flash floods to downstream areas. KNP is very much rich in different flora and faunal diversity. It is endowed with 352 species of flora and 83 species of fauna (Uddin, 2015). A little information on taxonomic study of lichen flora in Bangladesh were found (Alam and Gafur, 2008; Aptroot and Iqbal, 2011; Kaium and Shamsi, 2020). So, the present study has been made to attempt the taxonomic study of lichen flora of Khadimnagar National Park.

*Corresponding author. E-mail: prof.shamsi@gmail.com

Materials and Methods

Khadimnagar National Park (KNP) is located in Karimnagar Union of Sylhet Sadar Upazila and Fatehpur Union of Guainghat Upazila at 24°53′52″ N and 91°52′17″ E. The park is under the authority of Khadimnagar forest beat of North Sylhet Range-1 under Sylhet Forest Division. It is situated approximately 15 km northeast of Sylhet City. The park has been divided into three blocks these are North Block (1): 24°58'33.6"N- 24°58'22.6"N and 91°56'33.7"E 91°59'33.8"E; Middle Block (2): 24°58'22.6"N -24°57'42.2"N and 91°55'53.1"E - 91°56‘33.7"E; South-west Block (3): 24°57'42.2"N -24°57'07.3"N and 91°54'51.1"E - 91°55'53.7"E. The lichen materials were collected from January 2021 to December 2022. The samples were examined and transported to the Plant Pathology Laboratory, Department of Botany, University of Dhaka. Several materials were preserved in the herbarium of this laboratory. For collection, preservation and laboratory analyses of the lichen flora the procedure were followed described by Kaium and Shamsi (2020), Hulbert Jr. (2011),Orange *et al*. (2001), May (2000), Albert (1998), McFarlin and Dey (1991) and CAB (1968). The chemical tests were made for the identification of lichens providing the materials as K-potassium hydroxide, C– bleach [Ca(OCl)Cl], L– iodine (Lugol’s solution) and weak acid (lemon juice). The taxonomic identification of lichens were made with consultation of the standard monographs and literature (Archer, 2007; Awasthi, 1975; Ciafré *et al*., 2020; Diederich *et al*., 2017; Elix and McCarthy, 1998; Flakus, 2013; Galloway, 1985, 2007; Gerasimova, 2016; Hulbert Jr., 2011; Kantvilas and Elix, 2007; Kantvilas *et al*., 2018; Kerr, 2014; Lückingl, 1999; Nylander, 1869; Schultz, 2008; Singh and Singh, 2012; Uyenco, 1963; Weber, 1986; Woods and Coppins, 2012). Lichens photographs were taken with the help of Nikon D-3200, Camera. Anatomy and other microscopic observation were made with the help of a Nikon Optiphot, UFX-11A microscope with a Nikon FX-35WA camera, Japan.

Results and Discussion

A total of ca. 40 species of lichens have been recorded during the period of study. Of these 10 species of lichens describe here as new records. These lichens have been recorded from different spots in Khadimnagar National Park, Sylhet. Detailed taxonomic description, anatomy, photographs, illustration and other relevant information are provided below (Plates 1-3).

1. Acanthothecis asprocarpa (A.W. Archer) A.W. Archer (Family-Graphidaceae)
(Archer, 2007; Diederich *et al*., 2017) **(Pl. 1, Figs 1a-b)**

Synonym: *Graphina asprocarpa* A.W. Archer

Thallus crustose, corticolous, episubstrate, epiperidermal, up to 8 cm diam; upper surface grey(ish), yellowish-grey to white (ivory, off white, cream-colored); pigmentation is hyaline, sometimes colourless; thallus in section 200–250 µm thick, apothecial indefinite structure. Algal colony found inside the cortex cell, photobiont *Trentepohlia*, cells irregular arrangement of cells, 9 –11 × 5 –8 µm, green. Fungal spores and mycelial structure are observed in T.S. of the specimen. Ascomata irregular in shape, 1–2 mm long, 0.5 –1.2 mm wide, disc exposed, asci clavate, 100 – 105 × 15 –20 µm. Ascospores 8 per ascus, ellipsoid, 40 –45×10–15 µm, thin walls and septa. In the spot test KOH, bleaching solution and, Logul’s solution showed a positive result.

Specimen examined: Recorded on Champa (*Michelia champaca*) from North Block of Khadimnagar National Park, Sylhet, Collction no.: AAK-12, 05th January 2021.

2. Bacidia absistens (Nyl.) Arnold (Family-Ramalinaceae) **(Pl. 1, Figs 2a-b)**
(Gerasimova, 2016)

Synonyms: *Bacidia intermissa* (Nyl.) Malme; *Lecidea intermissa* Nyl.; *Lecidea absistens* Nyl.

Thallus crustose, thin, whitish to grey; substrate bark, trunks, twigs; continuous, smooth or granular or warted; upper surface white, marginal upper surface rough. Apothecia lecideine, definite structure, 0.5-1 mm across; epithecium blue-violet or purple-brown, rarely green, hypothecium colourless or pale yellowish. Asci 8-spored, clavate to cylindrical. Ascospores 7-16-septate, hyaline, needle-like, conidia thread-like, curved, 8-24 x c. 0.5 µm. Primary photobiont observed in the T.S. of the specimen. Photobiont Chlorococcoid, cells 5-10 µm in diam. Spore size vary from 2-3 µm. Chemical test showed: thallus K+, P-; conidia formation is detected during anatomical analysis.

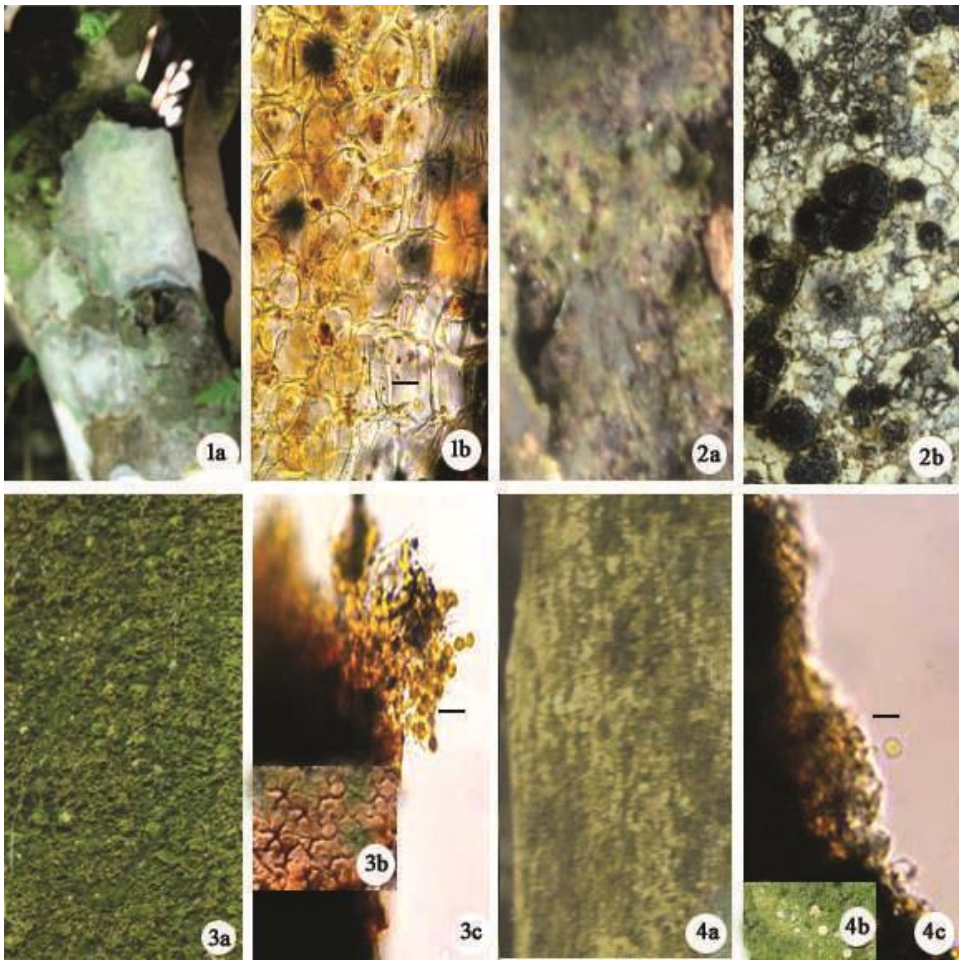

Plate 1. Figs 1-4: 1. *Acanthothecis asprocarpa* (A.W. Archer) A.W. Archer (1a: Thallus, 1b:T.S. of the thallus); 2. *Bacidia absistens* (Nyl.) Arnold (2a: Thallus, 2b: Enlarge view); 3. *Caloplaca cinnabarina* (Ach.) Zahlbr. (3a: Thallus, 3b: Enlarge view, 3c: T.S. of the thallus); 4. *Coenogonium implexum* Nyl. (4a: Thallus, 4b: Enlarge view, 4c: T.S. of the thallus). Scale=10 µm.

Specimen examined: Recorded on Teak (*Tectona grandis*) from North Block of Khadimnagar National Park, Sylhet, AAK-59, 09th November 2021.

3. Caloplaca cinnabarina (Ach.) Zahlbr. (Family-Teloschistaceae) **(Pl. 1, Figs 3a-b)**

(Ciafré *et al*., 2020)

Synonyms: *Caloplaca aequata* (Hue) Zahlbr.; *Neobrownliella cinnabarina* (Ach.) S.Y. Kondr.

Thallus crustose; substrate bark or trunks; brown to various shades of grays, yellowish-orange, blue-grays, and greens; thallus segregated, epi-substrate; upper surface grey to whitish, cracked. Apothecial indefinite structure. Spores are round shaped, 3-5 µm in diameter. Baciliform conidia has been detected, primary photobiont mostly chlorophytaceous (*Trebouxia* spp. and Chlorococcoid). Transverse septation found in fungal mycelium. Chemical test showed positive result.

Specimen examined: Recorded on Debdaru (*Polyalthia longifolia*) from North Block of Khadimnagar National Park, Sylhet, AAK-43, 10th April 2021.

4. Coenogonium implexum Nyl. (Family-Coenogoniaceae) **(Pl. 1, Figs 4a-b)**

(Kantvilas *et al*., 2018; Uyenco, 1963)

Synonyms: *Coenogonium subtorulosum* Müll. Arg.; *Coenogonium acrocephalum* Müll. Arg.; *Coenogonium rigidulum* Müll. Arg.

Corticolous habit; olive-green to greenish or yellow, filamentous, upper surface greenish, hairy structure is found in the upper portion, green pigmentation was observed, thallus thread-like, small, orange-yellow apothecia, scattered, short-fusiform. Ascospores 8 per ascus, 1-septate ascospore, 6–10 × 2.5 µm. Photobiont *Trentepohlia*, filament cells 2-5 times longer than wide. Apothecia scattered, small, 1 mm diam., round, fragmented marginal structure found. Spore circular (3-5 µm).

Specimen examined: Recorded on Pitraj/Rata (*Aphanamixis polystachya*) from North Block of Khadimnagar National Park, Sylhet, AAK-76, 05th January 2021.

5**. Dirinaria leopoldii (**Stein) D. D. Awasthi (Family- Caliciaceae) **(Pl. 2, Figs 1a-b)**

(Weber, 1986; Elix and McCarthy, 1998; Awasthi, 1975; Galloway, 1985, 2007; Hulbert Jr., 2011)

Corticolous, frequently found, eroded thallus, small red patches, black lower portion, edges tightly adhered, rhizines not found, suborbicular to spreading thallus, 2.5-5.0 cm diam.; mostly found in hard bark, lichen forms discontinuous, shade trees have a rich number in counting. Margins loose, mycelium penetrated the bark; lobes dichotomously to irregularly divided, 1.5-2.5 mm wide, apices rounded, upper surface whitish, or yellowish or grey, lower surface black. Apothecia infrequent, 0.5-2.0 mm diam., disc black, margins thick. Ascospores biseriate, 15-20 × 5-10 µm. Cortex K+ yellow; primary photobiont is present.

Kaium and Shamsi (2020) described same organism as *Parmelia* sp. collected from the National Botanical Garden, Mirpur, Dhaka which was misidentified.

Specimen examined: Recorded on Akash moni (*Acacia auriculiformis)* and Mahagoni (*Swietenia mahagoni*) from South-West Block of Khadimnagar National Park, Sylhet, AAK-49, 14th August 2021.

6. **Echinoplaca campanulata** Kalb & Vězda (Family- Gomphillaceae) **(Pl. 2, Figs 2a-b)** (Lückingl, 1999; Flakus, 2013)

Mostly found in hard bark, thallus continuous, crustose type, grey to whitish; marginal upper structure can be easily identified. The apothecial structure is prominent, hyaline pigmentation. Mycelium penetrated the bark, hairy structure is found on the upper side. Spores oval shaped, 2-3 µm in length. Primary photobiont is present. Chemical test showed positive result.

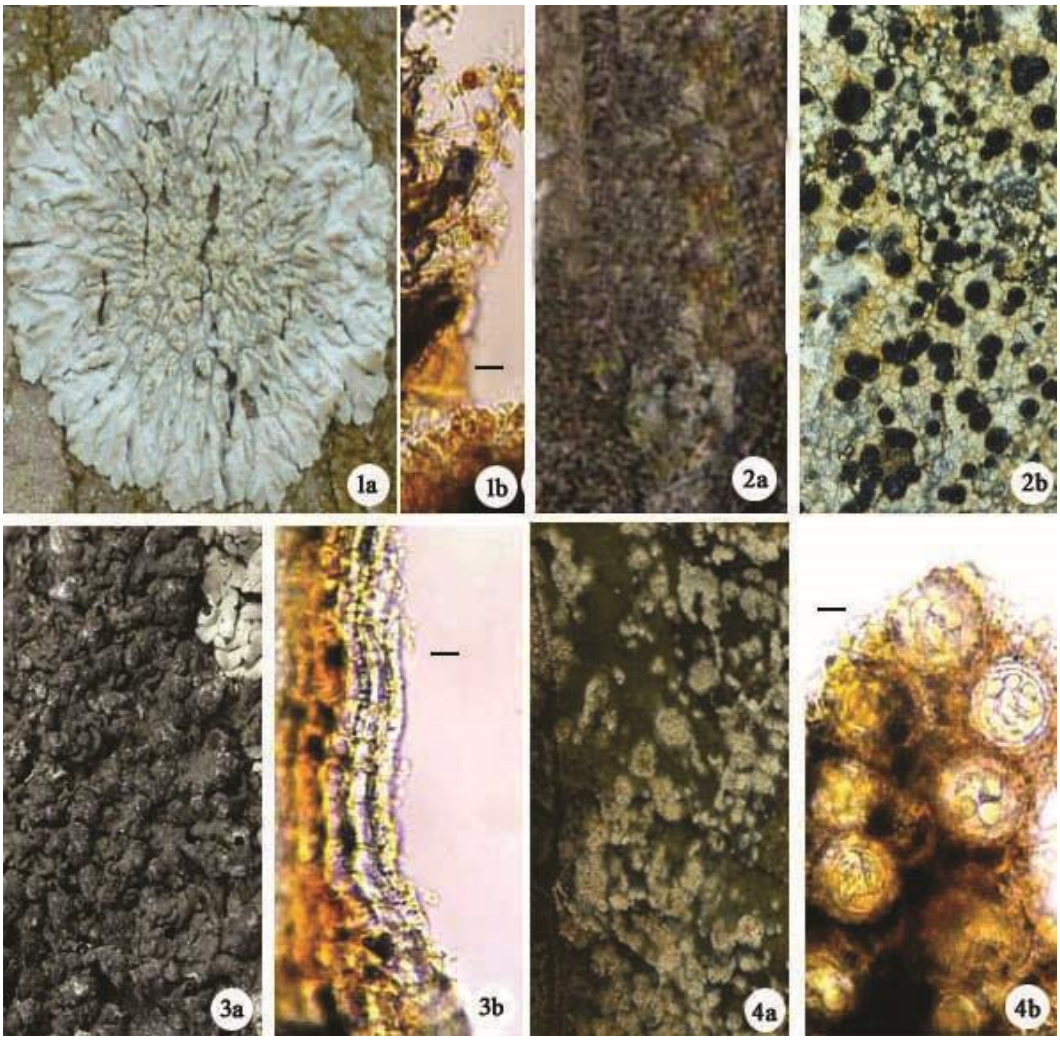

Plate 2. Figs 1-4: 1. *Dirinaria leopoldii* (Stein) D. D. Awasthi (1a: Thallus, 1b: T.S. of the thallus); 2. *Echinoplaca campanulata* Kalb & Vězda (2a: Thallus, 2b: Enlarge view); 3. *Metamelanea umbonata* Henssen (3a: Thallus, 3b: T.S. of the thallus); 4. *Pyrgillus javanicus* (Mont. & Bosch) Nyl. (4a: Thallus, 4b: T.S. of the thallus). Scale=10 µm.

Specimen examined: Recorded on Dhaki Jam (*Syzygium grande*) from North Block of Khadimnagar National Park, Sylhet, AAK-74, 07th April 2022.

7. **Metamelanea umbonata** Henssen (Family-Lichinaceae) **(Pl. 2, Figs 3a-b)**

(Schultz, 2008; Woods and Coppins, 2012)

Synonym: *Metamelanea umbonata* Henssen,

Thallus crustose, substrate bark, cork, plant surface, brownish to black, surface gray to greenish white, glossy, areolate, up to 5 cm wide patches, more or less angular, lobule-like outgrowths, densely arranged photobiont cells surrounded by loose hyphae. Apothecia adnate, dark reddish brown margin, well-developed, epithecium brown, hymenium colourless to brownish, K/I+ blue; asci 8-spored, long-cylindrical-clavate, thin-walled, without internal amyloid structures. Ascospores 1-celled, hyaline, broadly ellipsoid, 10-12 x 7-8 µm, thin walled. Photobiont cyanobacterial Chroococcoid, densely aggregated brownish gelatinous sheaths.

Specimen examined: Recorded on Tea (*Camellia sinensis*) from North Block of Khadimnagar National Park, Sylhet, AAK-Kaium 45, 10th April 2021.

8. Pyrgillus javanicus (Mont. & Bosch) Nyl. (Family-Pyrenulaceae) **(Pl. 2, Figs 4a-b)**

(Singh and Singh, 2012)

Thallus crustose, corticolous, found on bark, trunk, and cork, white-yellowish grey, continuous, smooth to cracked, loose. Thallus shape is definite, hyaline pigmentation is found. Very thick layer formation has been observed. Ascomata scattered, sessile, generally conical with truncate or rounded apices, thick margin; asci not seen, ascospores dark brown, ellipsoid, 3-septate, thick-walled, 10–12 × 4–6 µm. Photobiont trentepohlioid.

Specimen examined: Mostly grows in tea plants. Recorded on Tea (*Camellia sinensis*) from North Block of Khadimnagar National Park, Sylhet, AAK-27, 08th April 2021.

9. Ramboldia blastidiata Kantvilas & Elix (Family-Ramboldiaceae) **(Pl. 3, Figs 1a-b)**

(Kantvilas and Elix, 2007)

Crustose thallus, mostly found on bark, trunk, and twigs; pale greyish to greenish, olive-green to olive-brown, reddish-brown. The outer layer has a creamy whitish rim; occurring mostly on rock and rarely on wood. Thallus shape is definite (4-5inch in diameter). Photobiont cells 5–15 µm wide, green pigmentation. Very thick layer formation has been observed. Apothecia round to irregularly rhomboidal, solitary, bright red-brown or dark brown, basally constricted; margin very thin, asci 30–35 × 14–16 µm. Ascospores ellipsoidal to fusiform-ellipsoidal, simple, septate, 8.0–10.0 × 3.0–5.0 µm. Apothecial ascoma is observed. Pycnidia not seen. Chemical test showed K+ yellow to red, P+ yellow.

Specimen examined: Recorded on Jack fruit (*Artocarpus heterophyllus*) from North Block of Khadimnagar National Park, Sylhet, AAK-145, 08th November 2022.

10. Trypethelium ochroleucum (Eschw.) Nyl. (Family-Trypetheliaceae) **(Pl. 3, Figs 2a-b)**

(Nylander, 1869; Kerr, 2014)

Synonyms: *Verrucaria ochroleuca* Eschw.**,** *Astrothelium phlyctaena* (Fée) Aptroot & Lücking

Thallus greyish green, smooth, found on the bark. The thallus is crustose type, continuous, upper surface gray to greenish, thallus shape is definite (width is 3-4 inch), very moderately thick layer formation observed, upper surface smooth, red pigmentation observed. Perithecial ascoma has been detected. Ascomata largely immersed, ascospores 3-septate, oval shaped spore, width is

10-12 µm and length is 22-25 µm, primary photobiont present. Secondary metabolites secretion observed. Chemical test showed K– result.

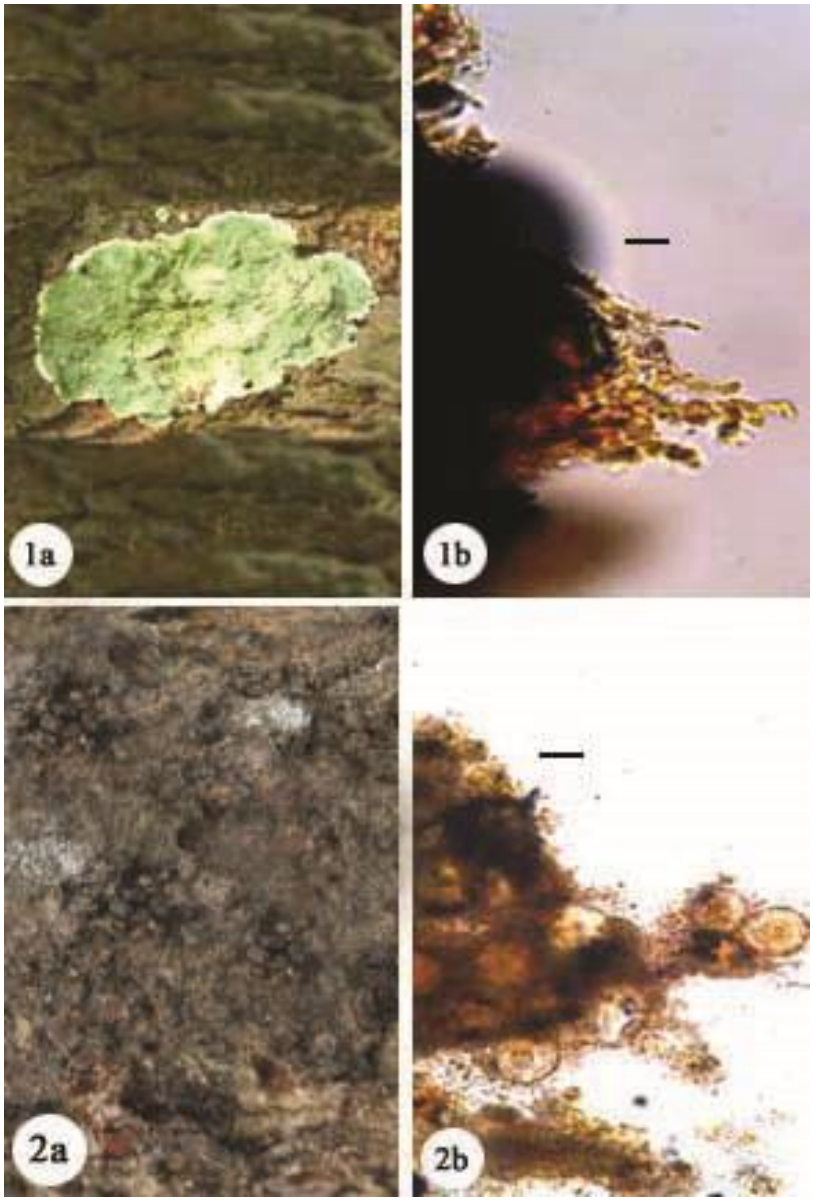

Plate 3. Figs 1-2: 1. *Ramboldia blastidiata* Kantvilas & Elix (1a: Thallus, 1b: T.S. of the thallus); 2.*Trypethelium ochroleucum* (Eschw.) Nyl. (2a: Thallus, 2b: T.S. of the thallus). Scale=10 µm.

Specimen examined: Recorded on Jarul (*Lagerstroemia speciosa*) from North Block of Khadimnagar National Park, Sylhet, AAK-11, 05th January 2021.

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