

New records of lichens (Lichenized *Ascomycota*) from India with novel habitat preferencesRajesh Bajpai^{1,2*}, Ramya Ranjan Paul², Chandra Prakash Singh³, Anzar A. Khuroo⁴ and Dalip Kumar Upreti²¹*Environment, Agriculture and Education Society, Bareilly-234001, India*²*Plant Diversity Systematics and Herbarium Division, CSIR-National Botanical Research Institute, Lucknow-226001, Uttar Pradesh, India.*³*AED//BPSG/EPISA, Space Applications Centre-ISRO, Ahmedabad, India*⁴*Centre for Biodiversity & Taxonomy, Department of Botany, University of Kashmir, Srinagar-190006, India*

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ABSTRACT

The present paper reports seven species of lichens for the first time from India. These include *Cryptothecia aleurinoidea* Aptroot & Wolsley, *Cryptothecia genuflexa* (Müll. Arg.) R. Sant., *Cryptothecia scribitella* (Nyl.) Makhija & Patw., *Diorygma upretii* Sipman, *Distothelia rubrostoma* (Aptroot) Aptroot & Lüicking, *Umbilicaria leiocarpa* DC., and *Verrucaria adelminienii* Zschacke. The species are appended here with brief description, distribution, ecology and specimen examined details. Most of the species prefer to grow on tree bark.

Keywords: *Ascomycota*, Biodiversity, Lichenized fungi, Taxonomy, India

INTRODUCTION

Lichens are one of the important constituents of the global biodiversity. They dominate the terrestrial ecosystem and are the noticeable components of coastal, alpine and forest ecosystems. Despite intense efforts in exploration and survey during the last six decades, the information about lichens from different floristic provinces of India is poor as many areas are still unexplored for lichen diversity. But our understanding of the lichens for the country has been noticeably advanced in day by day. Sinha *et al.* (2018) prepared checklist of Indian lichens which documented 2,714 species of lichens belonging to 324 genera and 78 families reported from the country. Recently, Mao *et al.* (2021) documented 2,961 species from India which is approximately 14% of the world known lichen species. The above observations indicate that the number of lichen taxa being added to the Indian biota has increased exponentially in the recent years. While inventorying different lichen rich regions of India, the authors encountered several interesting specimens of lichens. Of these, seven species represent new records to India.

MATERIAL AND METHODS

The study is based on the examination of more than 450 specimens of lichen genera *Cryptothecia* and *Diorygma* preserved in CSIR-National Botanical Research Institute herbarium (LWG) together with freshly collected specimens from different parts of India. The specimens were identified by studying their morpho-anatomy under a stereo-zoom (Leica EZ4) and compound microscope (Leica DM2500) following routine lichenological techniques and identification keys (Awasthi 1991, 2007; Kantvilas and Elix, 1994; Jagadeesh Ram and Sinha, 2016). Thin hand-cut sections of the thalli and fruiting bodies were mounted in water, Lugol's iodine and lactophenol cotton blue (LCB). The chemistry was studied through spot tests and thin layer chromatography (solvent system A) was performed following Orange *et al.* (2001).

NEW RECORDS**Family: *Arthoniaceae*****1. *Cryptothecia aleurinoidea* Aptroot & Wolsley Fig. 1A**

Thallus corticolous, crustose, whitish, thin, rough, upto 8 cm across and upto 50µm thick, with or without white hypothallus, ascigerous areas (asci) whitish, rounded to irregular, inconspicuous, slightly raised, upto 80-150 µm in size, appear as back dot, 8-spored, ascospores muriform 40-45 x 19-25 µm.

Chemistry: Thallus and ascigerous areas K-, C, KC, Pd, UV+ whitish. TLC: 2'O methylmicrophyllinic acid.

Distribution and ecological notes: The species is earlier known from north Thailand (Wolsely and Aptroot, 2009). The species prefers to grow is and on the smooth bark of tree mostly at lower attitudes and humid environment. *C. aleurinoidea* is a new record to India.

Specimens examined: Kerala, Palghat district: Siruvani alt. 850 m, on bark, 16-11-2006, Haridas B, 06-009506, 06-010798 (LWG), Thrissur district, Vazhachal range, alt. 300 m, on bark, 27-09-2006, Haridas B, 06-009507, 06-009703/A, 06-009865 (LWG).

2. *Cryptothecia genuflexa* (Müll. Arg.) R. Sant. Fig. 1B

Thallus corticolous, crustose, whitish, thin, smooth, effuse, upto 80 µm thick, pale brownish at the peripheral regions, hypothallus poorly develop whitish, ascigerous areas (asci) white concolorous with thallus, asci 8-spored, ascospores muriform 100-120 x 25-30 µm.

Chemistry: Thallus and ascigerous areas K+ red, C, KC+ yellow, Pd+ yellow, I-, UV. TLC: Traces of norstictic acid.

Distribution and ecological notes: Earlier, *C. genuflexa* was reported from Usambara Mountains of northeastern Tanzania in tropical East Africa, and lectotype studied by Makhija and Patwardhan (1985). It is a new record for India. The species is prefers to grow around moist and high humid environment, and preferring the rough bark of trees.

Specimens examined: Assam, Dima Hasau district: Umrangso from 6 miles, towards Kopili, 02 km from Kopili road, alt 618 m, on bark, 07-03-2017, Upreti DK & Party, 17-03356 (LWG).

3. *Cryptothecia scriblitella* (Nyl.) Makhija & Patw. **Fig 1C**

Thallus corticolous, crustose, ashy grey to yellowish, effuse, upto 5 cm across, hypothallus whitish, thick, ascigerous areas (asci) white, rounded to orbicular upto 1.0-1.5 mm across, slightly raised above the thallus, asci 8 spored, ascospores muriform 60-90 x 35-40 μm .

Chemistry: Thallus and ascigerous areas K, C, KC, P+ yellow, UV. TLC: Divaricatic acid.

Distribution and ecological notes: Earlier, Makhija and Patwardhan (1985) studied the lectotype of *C. scriblitella* species from Republic of New Granda, Colombia. It is reported as new record to India. The species is distributed between 100 to 1500 m altitudes in all type of environmental conditions and widely distributed in Tropical and Subtropical areas of the country.

Specimens examined: Bihar, Paschim Champaran district: Don hills, Gadhi west compart, on bark, 20-02-1995, Upreti DK & Tandon J, 213251, 213252 (LWG); Himachal Pradesh, Sirmaur district: Poanta sahib khara researve forest, on Mallotus bark, 25-06-2000, Chattejee and party, 20-65448 (LWG); Karnataka, Hassan district: near Sakleshpur, Sambhalli, alt 900 mt, on bark, 01-05-1979, Awasthi DD & Party, 79-0361 (LWG); Kerala, Kollam district: on way to Kuri, 3 miles from Kottarakara, on bark, 26-11-1973, Singh KP, 73-0219, Wayanad district: Nemon, near Mary Matha college, on bark, 18-05-2006, Haridas B, 06-0010780 (LWG); Madhya Pradesh, Shahdol district: Amarkantak, Jwaleshwar 12 km from Amarkantak town, alt 1200 mt, on bark, 30-01-1980, Upreti DK & Mishra UC, 80-0550 (LWG); West Bengal, Darjeeling district: Ranjeet valley, near bridge, alt 700 mt, on bark, 08-03-1967, Awasthi DD & Agarwal MR, 67-0195, Kalimpong, Munsong, near Inspection Gunglow, alt 1200 mt, on bark, 09-03-1967, Awasthi DD & Agarwal MR, 67-0245/K (LWG).

Family: Graphidaceae

4. *Diorygma upretii* Sipman

Fig. 1D

Thallus corticolous, crustose, yellowish white in colour, about 10 cm in diam., thick, ecorticate or with thin pseudocortex, filled with crystals, whitish and without algae below; surface matt, rugulose, warts expending to pustules ca 0.2-0.3 mm wide. Ascocarps slightly raised, stellate about 2 mm diam., with raised, granular thalline margin, disc exposed, 0.1-0.4 mm wide, brown pruinose; paraphyses unbranched, ascospores 1 per acsus, muriform 125-135x30-35 μm . Chemistry: Thallus K+ yellow, C, KC+ yellow, P+ red. TLC: Norstictic, protocetraric, salazinic acids.

Distribution and ecological notes: Earlier *D. upretii* was reported from Singapore by Sipman (2018) and found

growing on tree trunks and twigs of *Libocedrus*, *Maniltoa*, *Eugenia* and *Juniperus*. In India, it is reported for first time. The species prefers to grow on smooth bark trees of high humid areas at lower altitudes.

Specimens examined: Kerala, Quilon district: Tenmalai area on way to Aryankava, 25-11-1973, Singh K.P., on bark, 73-0159 (AWAS-LWG).

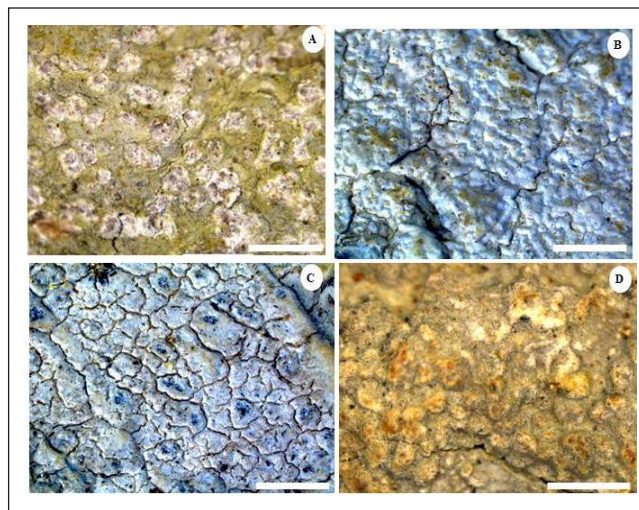


Fig 1: A. *Cryptothecia aleurinoidea* Aptroot & Wolseley, B. *Cryptothecia genuflexa* (Müll. Arg.) R. Sant., C. *Cryptothecia scriblitella* (Nyl.) Makhija & Patw. (scales: 1 mm in all), D. *Diorygma upretii* Sipman, (scales 0.5 mm)

Family: Trypetheliaceae

5. *Distothelia rubrostoma* (Aptroot) Aptroot & Lücking **Fig. 2A**

Thallus corticolous, crustose, yellowish grey to pinkish, prothallus absent. Ascomata single, with fringe, 1.0-1.3mm wide and 0.2-0.6mm high, young ostiole with red, K⁺ purple anthraquinone. Wall completely carbonized, to 80 μm thick. Asci 150 x 20 μm . Ascospores 23-29x11-14 μm , with equal locules, with rounded ends, walls much thickened with a halter-shaped endo-spore formation, verruculose. Pycnidia 60-100 μm wide; conidia bacilliform, simple, hyaline, 6-8x0.3-0.5 μm .

Chemistry: Thallus K⁺ yellow light, C, KC, P. Anthraquinones present in TLC

Distribution and ecological notes: The species is Neotropical in distribution and earlier it has been reported from Dominican Republic and Guadeloupe (Aptroot and Lücking, 2016). Earlier this species known as *Bogoriella rubrostoma* by Hongsanan *et al.* (2020). But not earlier reported from India, hence it is a new record for the country. The species prefers to grow on rough bark of trees like *Simarouba glauca* at lower altitudes.

Specimens examined: Odisha, Mayurbhanj district, Bahalda, on bark, 24-01-2019, Ramya Ranjan Paul 19-035623 (LWG).

Family: Umbilicariaceae**6. *Umbilicaria leiocarpa* DC. Fig. 2 B&C**

Thallus saxicolous, foliose, peltate, umbilicate, continuous 3.0-5.0 mm in diam., diffuse, effuse, cracked, fissured, fractured, rimose, areolate, squamulate; upper surface grey to brown, pruinose; lobes 20-25 mm width, lower surface brown-blackish, pinkish, rhizomorph poorly developed; ascomata: well developed apothecoid 1.0 to 1.5 mm diameter gyrose, stipitate, stalked disc, flat, flattened, expanded, epruinose. Ascospores 8-per asci; 12.0-14.5 x 4.0-5.0µm; ellipsoidal; septa absent.

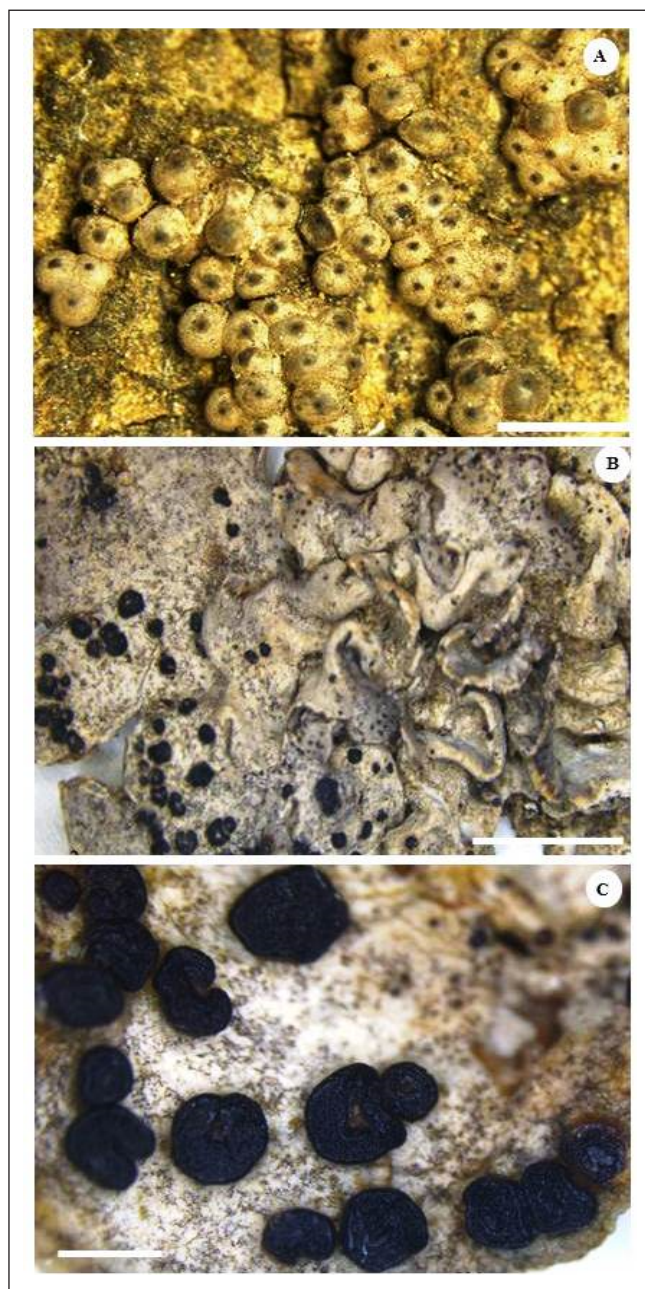


Fig. 2: A. *Distothelia rubrostoma* (Aptroot) Aptroot & Lücking (scales 0.5 mm), B. *Umbilicaria leiocarpa* DC., thallus (1.0mm), C. Apothecia (500µm)

Chemistry: Thallus K+ yellow, C, P, KC TLC: norstictic acid.

Distribution and ecological notes: Earlier, the species was reported from Africa and America (Hestmark, 2017). The species prefers to grow on exposed siliceous rock at high altitudes of Himalaya. The species reported for the first time from India.

Specimens examined: Jammu and Kashmir, Baramulla district, Gulmarg valley, Aparwat, Khilanmarg, GUL 2 site, altitude 3600mt, (N 34°01'53.00", E74°20'49.00") on rock, 04-08-2021, Bajpai R, 021-039841, accession no 58677/17-12-2021; Bajpai R, 021-039844 on rock, accession no 58674/17-12-2021.

Family: Verrucariaceae**7. *Verrucaria adelminienii* Zschacke Fig. 3 A&B**

Thallus terricolous, crustose, irregularly rimose with delicate cracks, less than 0.1 mm thick white sometimes greenish white, dull, subfarinose; prothallus absent. Perithecia: semi-immersed, hemispherically prominent; exciple: sub-globose, 0.22-0.26 mm wide, pale brown to blackish; involucrellum: completely enveloping the exciple, 30-50 µm thick, brown-black, at the base somewhat paler and ± patchily pigmented. Perithecia 0.13-0.40 mm in diam., immersed, clavate, asci 8-

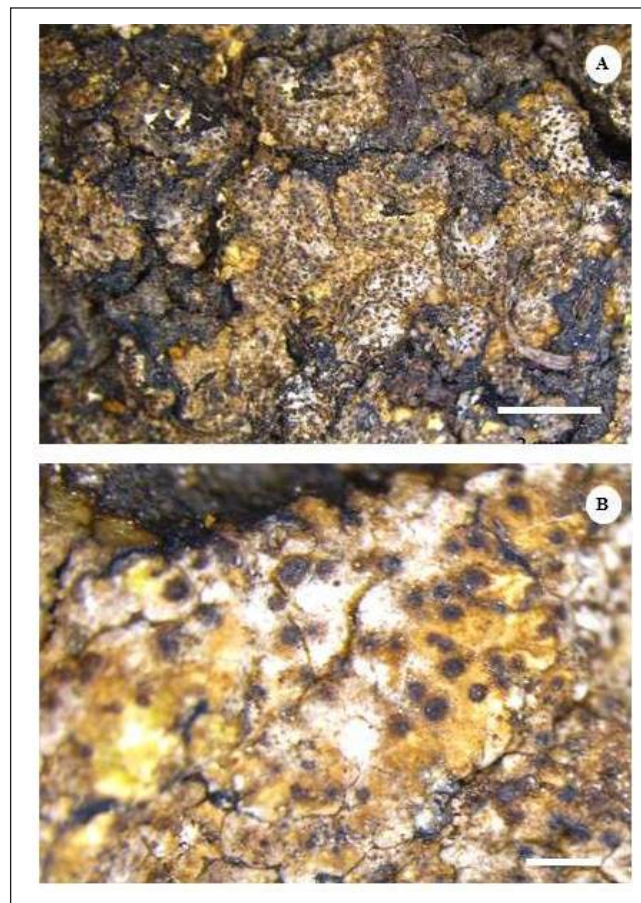


Fig. 3: A. *Verrucaria adelminienii* Zschacke, thallus (1.0mm), B. Perithecia (500µm)

spored; ascospores hyaline, simple, ellipsoid, 20-23 x 5-6 μm .

Chemistry: Thallus K, C, KC, P, TLC: No chemicals.

Distribution and ecological notes: The species is semi-endolithic to thinly epilithic, on soil, limestone and sometime on calciferous sandstone, distributed in Europe and western North America, Sonoran distribution (California, Santa Rosa Island) Nash *et al* (2007). In India, the species is reported for the first time. The species prefers to grow on soil, mostly in shady or partially shady areas.

Specimens examined: Jammu and Kashmir, Baramulla district, Gulmarg valley, Aparwat, Khilanmarg, below treeline (BT-300 mt) site, altitude 3321mt, (N 34°02'08.96", E74°21'03.07") on soil, 05-08-2021, Bajpai R, 021-039838, accession no 58629/17-12-2021.

It is well known that lichens have specific requirements for their habitats. They can occur on a range of substrates, each substrate must have the individual components in the precise amount that growing lichen necessities. These requirements are basically water, air, light, and substrates. The finding show that the species of *Cryptothecia*, *Diorygma* and *Distothelia* prefers to grow on rough bark and twigs mostly at coastle area of India. However, umbilicaria and verrucaria are mostly found growing over rocks at temperate to alpine area.

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