

New Records of Lichenicolous Fungi Inhabiting *Cladonia* from India

Akhilesh Kumar Maurya^{a, b}, Gaurav K. Mishra^{a, b, *}, Siljo Joseph^c, and Dalip K. Upreti^a

^a Lichenology Laboratory, Plant Diversity, Systematics and Herbarium Division, CSIR-National Botanical Research Institute, Lucknow, 226001, India

^b Academy of Scientific and Innovative Research (AcSIR), CSIR-HRDC Campus, Kamla Nehru Nagar, Ghaziabad Uttar Pradesh, 201002, India

^c Forest Botany Department, Forest Ecology and Biodiversity Conservation Division, KSCSTE-Kerala Forest Research Institute, Peechi, Thrissur, Kerala, 680653 India

*e-mail: gmishrak@gmail.com

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Abstract—Two species of lichenicolous fungi viz. *Didymocyrtis cladoniicola* (Diederich, Kocourk. and Etayo) Ertz and Diederich, and *Epicladonia simplex* D. Hawksw., inhabiting *Cladonia* species are discovered as new records for India, besides four species known earlier from India. *Cladonia*, a dimorphic genus is one of the most suitable hosts for the fungal spores to colonize easily for the growth of lichenicolous fungi. The brief taxonomic descriptions of species, distribution and illustrations are provided to facilitate their identification.

Keywords: Ascomycetes, diversity, secondary fungi, lichen parasites, taxonomy

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INTRODUCTION

Lichenicolous fungi (LF) represent a highly specialized and successful group of organisms that live exclusively on lichens, most commonly as host-specific parasites, but also as broad-spectrum pathogens, saprotrophs or commensals. A total of 2319 species of LF are described Worldwide, representing 2219 species of Ascomycetes and 100 species of Basidiomycetes falling under 55 orders, 115 families and 397 genera (Diederich et al., 2018). However, Indian LF are poorly studied although these are considered as an unexplored treasure of interesting and novel species. So far, only 230 species of LF inhabiting various lichen genera are known from the country (Joshi, 2018). Genus *Cladonia* comprising about 58 species in India (Singh and Sinha, 2010; Sinha et al., 2018) out of about 500 species known in the world (Wijayawardene et al., 2022) is an important host organism for many LF. In India, four species viz. *Bachmanniomyces punctum* (A. Massal) Diederich and Pino-Bodas, *Roselliniella cladoniae* (Anzi) Matzer and Hafellner, *Sphaerellothecium cladoniae* (Alstrup and Zhurb.) Hafellner and *Tremella cladoniae* Diederich and M.S. Christ. are reported (Joshi, 2018; Joshi et al., 2018), so far against 93 species of LF known globally. While studying some collections of genus *Cladonia* for LF made from Himalayan regions of Union Territory of Jammu and Kashmir and state of Uttarakhand, following two interesting species are reported as new records for Indian fungal biota that are briefly

described and illustrated along with their distribution at global level.

MATERIALS AND METHODS

The specimens were carefully observed under the stereo zoom microscope (Leica Journal Pre-proof S8APO). The hand-cut sections of the sporulating bodies were prepared and studied under a compound microscope (Leica DM500). The photographs were taken with the attached camera (EC3) of the microscope. The measurements were taken in a water mount and K solution (10% KOH). The length, breadth, and length/breadth ratio (l/b) of ascospores were given as (min–) { \bar{x} –SD}–{ x + SD} (max–) where “min” and “max” are uttermost values, \bar{x} represent the arithmetic mean, SD represent standard deviation, followed by the number of measurements (n). The taxonomic keys available in literature (Ihlen and Wedin, 2008; Hawksworth et al., 2010) were consulted for the identification. The investigated specimens are deposited in the LWG herbarium of CSIR-National Botanical Research Institute, Lucknow.

RESULTS

Taxonomy

Didymocyrtis cladoniicola (Diederich, Kocourk. and Etayo) Ertz and Diederich, *Fungal Diversity* 74: 67 (2015). (Figs. 1a– 1d).

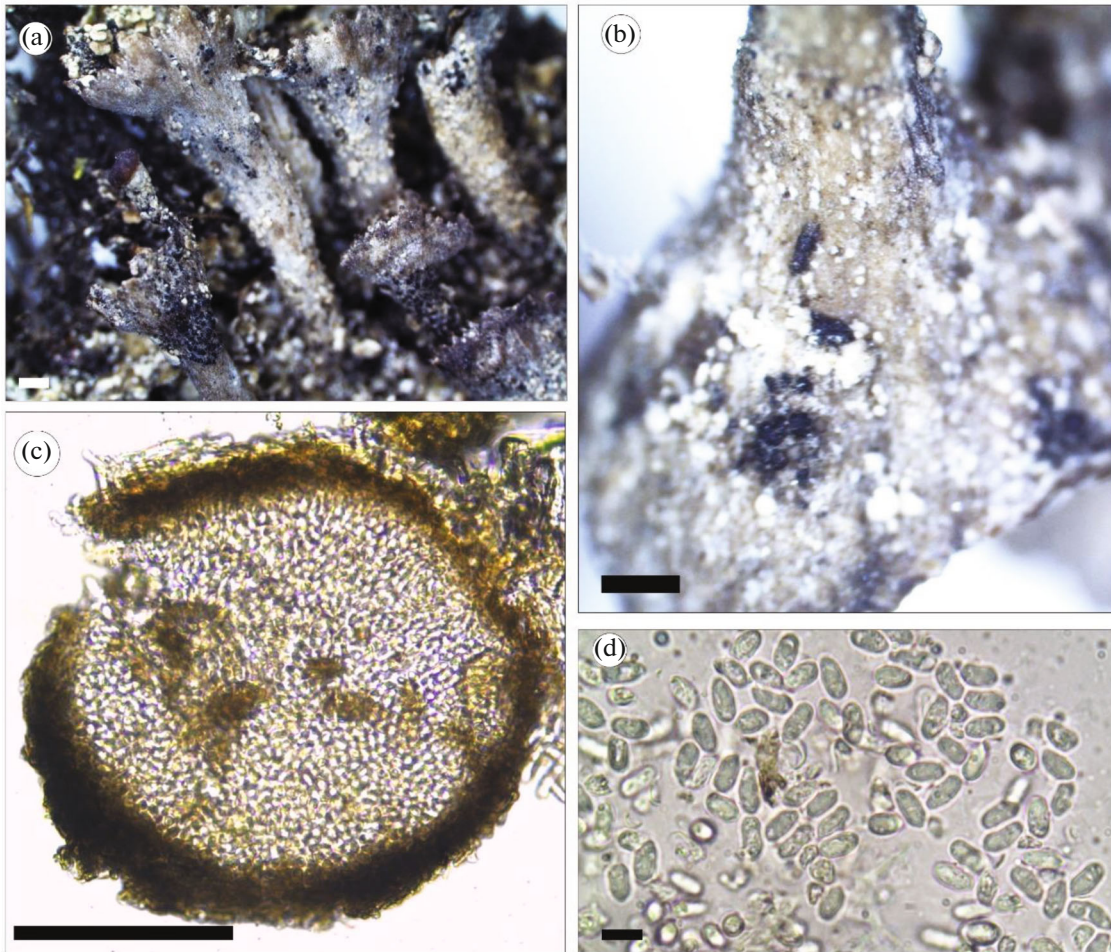


Fig. 1. (a, b) Habitat of *Didymocyrtis cladoniicola*, (c) cross section of pycnidia, (d) conidia. Scale: (a) 600 μm , (b) 200 μm , (c) 50 μm , (d) 5 μm .

Description. Conidiomata in the form of pycnidia, erumpent or immersed in host thallus (podetia), black, aggregated, subspherical to pyriform, 50–100 μm diam.; the outer wall of pycnidia is brown and the inner wall is lined by conidiogenous cells; single conidiogenous produced a higher number of conidia. Conidia hyaline, ellipsoid, the wall is smooth, (2.9–) 3.64–6.24 (–6.9) \times (2.2–) 2.52–3.26 (–3.5) μm , $l/b = 1.31–1.97$ ($n = 20$).

Host. *Cladonia pyxidata* (L.) Hoffm. from Uttarakhand.

Distribution. Previously this species was known from Europe (Belgium, Czech Republic, France, Germany, Spain, Ukraine), Africa (Canary Islands), and North America (USA: Minnesota; Greenland) (Zhurbenko and Pino-Bodas, 2017).

Notes. *D. cladoniicola* is closely related to *Didymocyrtis epiphyscia* Ertz and Diederich, which has slightly bigger pycnidia (50–) 100–150 μm diam. It has unexpectedly low host specificity with aggressive parasitic

nature that is supposed to kill the host (Ertz et al., 2015).

Specimen examined. INDIA: Uttarakhand, Uttarakashi district, Govind Wildlife Sanctuary, Har ki Dun near forest guest house, on soil, September 22, 2013, G.K. Mishra 13-020161 (LWG).

Epicladonia simplex D. Hawksw., Bull. Brit. Mus. Nat. Hist., Bot. 9 (1): 19 (1981). (Figs. 2a and 2b).

Description. Conidiomata pycnidia, forming gall on primary thallus (squamule), brown to black, single, scattered, 40–200 μm diam.; pycnidia wall brown; conidiogenous cells occasionally with up to 4 annellations. Conidia hyaline, aseptate, smooth-walled, oblong to fusiform, (5.01–) 5.75–7.49 (–8.34) \times (2.07) 2.08–2.80 (–3.42) μm , $l/b = 1.72–3.5$ ($n = 15$).

Host. *Cladonia coniocraea* (Flörke) Spreng., from Uttarakhand.

Distribution. Previously this species was reported from Finland, Russia, Krasnoyarsk Territory, the Republic of Buryatia, and the Sakhalin Region (Zhurbenko and Pino-Bodas, 2017).

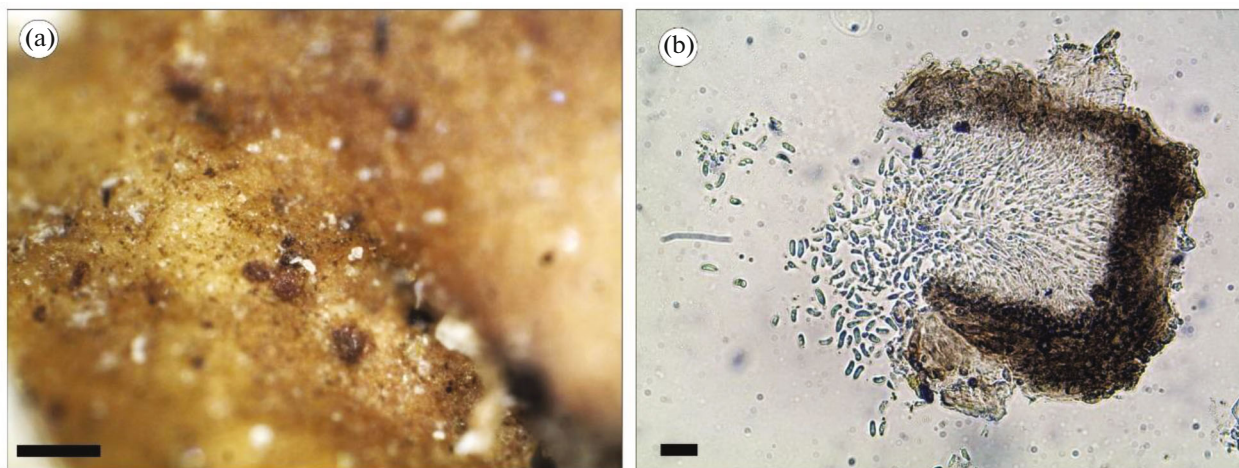


Fig. 2. (a) Habitat of *Epicladonia simplex* D. Hawksw, (b) cross section of pycnidia and conidia. Scale: (a) 100 μm , (b) 10 μm .

Notes. *E. simplex* is more similar to *E. lapponica* Ihlen, in having similar subcylindrical to ampulliform conidiogenous cells but the latter species differs in having larger conidiomata (200–) 300–600 μm and smaller conidia (7.5–11 \times 3–3.5 μm).

Specimen examined. **INDIA: Uttarakhand,** Chamoli district, Badrinath, 30°44'32.5" N 79°29'50.7" E, alt. 3181 m, on soil, October 12, 2013, H. Rai, R. Khare and S. Gupta 13-021115 (LWG).

SIGNIFICANT STATEMENT

The work is mainly focused on fungal taxonomy. The present study will enhance the understanding of fungal biota of India. These fungi can also be used for screening against various activities such as antimicrobial, antioxidant, anticancer etc.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This work does not contain any studies involving human and animal subjects.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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