

## NEW SPECIES AND NEW RECORDS OF LICHENICOLOUS FUNGUS *PYRENIDIUM* FROM INDIA

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The present paper interprets a new species and a new record of the lichenicolous fungus *Pyrenidium* from India. The new species *P. dimelaenae* Y. Joshi was found on the thallus of saxicolous lichen species *Dimelaena oreina* (Ach.) Norman and is characterised by globose to subglobose black perithecia with light greenish blue tint in ostiolar channel. The new species shares many morphological characters with other *Pyrenidium* species but differs in its number of spores and hosts. In addition, two new records, i.e. *Lichenostigma dimelaenae* Calat. et Hafellner and *P. borbonicum* Huanraluek, Ertz et K. D. Hyde are also being reported from India for the first time.

Key words: Dacampiaceae, *Dimelaena*, Himalaya, *Lichenostigma*, Pyrenidiaceae, *Sticta*

### INTRODUCTION

The lichenicolous fungus *Pyrenidium* introduced by Nylander (1865) belonging to family Pyrenidiaceae Zahlbr. (Huanraluek *et al.* 2019) is mainly characterised by dark brown perithecioid ascomata with pseudoparaphyses and distinct periphyses; usually 3-septate, smooth, dark brown ascospores with the end cells often hyaline to subhyaline, melanised septa, and the blue-green pigment often located in upper peridial cells and upper cells of the hamathecial filaments (Hawksworth 1983, 1986, Knudsen and Kocourková 2010, Matzer 1996, Navarro-Rosinés and Roux 2007).

The genus having a cosmopolitan distribution is found on lichen thalli, occurring on various substrates, such as bark, rocks, soil, bryophytes or living leaves (Aptroot 2014, Hawksworth 1980, 1983, Knudsen and Kocourková 2010, Matzer 1996, Navarro-Rosinés and Roux 2007) and is represented by 12 legitimate binomials across the world, *viz.* *Pyrenidium actinellum* Nyl., *P. aggregatum* Knudsen et Kocourk., *P. borbonicum* Huanraluek, Ertz et K. D. Hyde, *P. coccineum* Aptroot, *P. cryptotheciae* Matzer, *P. hetairizans* (Leight.) D. Hawksw., *P. hypotrachyna* Y. Joshi, *P. macrosporum* Motiej., Zhurb., Suija et Kantvilas, *P. octosporum* Looman, *P. santessonii* Lücking, *P. sporopodiorum* Matzer and *P. zamiae* (Müll. Arg.) Matzer (Diederich *et al.* 2018, Huanraluek *et al.* 2019, Index Fungorum 2020, Joshi *et al.* 2018) excluding two species – *Pyrenidium hyalosporum* Alstrup, D. Hawksw. et R. Sant. (Navarro-Rosinés and

Roux 2007) which was synonymised under *Zwackhiomacromyces hyalosporus* (Alstrup, D. Hawksw. et R. Sant.) Etayo et F. Berger by Berger and Zimmermann (2016) and *Pyrenidium ucrainicum* S. Y. Kondr., Lőkös et Hur, which is probably a synonym of *Didymocyrtis ramalinae* (Roberge ex Desm.) Ertz, Diederich et Hafellner (Ertz *et al.* 2015).

In the present study I am describing a new species of *Pyrenidium* from India colonising thallus of *Dimelaena oreina*, thus raising the number of species to 13 across the world. Since the paper mainly deals with *Pyrenidium*, hence the new record *P. borbonicum* colonising thallus of *Sticta* is described in brief, while *Lichenostigma dimelaenae* colonising thallus of *Dimelaena oreina* is merely reported in the text.

## MATERIALS AND METHODS

The study is based on specimens deposited in the herbarium of LWG including personal herbarium of Dr D. D. Awasthi (AWAS). Macroscopical examination was carried out using a stereo-zoom dissecting microscope (Olympus SZ61). Microscopical studies of hand-made sections were carried out in water, 10% KOH (K), Lugol's iodine, directly (I) or after 10% KOH pre-treatment (K/I) using a Olympus BX53 compound microscope equipped with Olympus differential interference contrast optics. Measurements were taken from water mounts and are indicated as (minimum–)(X–SD)–X–(X+SD)(–maximum), where X is the arithmetic mean and SD the corresponding standard deviation, followed by the number of measurements (n). Values in italics (e.g., *–107.31–*) are arithmetic means.

## RESULTS AND DISCUSSION

### *Pyrenidium borbonicum* Huanraluek, Ertz et K. D. Hyde (Mycosphere 10(1): 645. 2019)

Ascomata perithecia, in groups immersed in the host-thallus, 55–109 × 57–127 μm, subglobose to broadly ovoid. Peridium 14–21 μm wide, brown to dark brown. Hymenium not interspersed. Hamathecial filaments numerous, composed of pseudoparaphyses, richly branched. Asci 60–70 × 10–11 μm, 8-spored, narrowly ellipsoid, ocular chamber not distinct, KI–. Ascospores 19–20 × 5–6 μm, biseriate, partially overlapping, hyaline to dark brown at maturity, K+ turning black, often pale brown in the spore tips, narrowly ellipsoid, (1–)3-septate, sometimes slightly curved toward the ends, constricted at the septa, without a gelatinous sheath. Conidiomata not seen.

Till date the species is reported from only two localities in India – Tamil Nadu and West Bengal, colonising various species of lichen genus *Sticta*. It

seems to be a rare species since it has not been collected since 1959. Presence of necrotic patches and dead hyphal tissue in the thallus, revealed it to be a parasitic species.

Specimens examined: INDIA. Tamil Nadu, Madurai district, Shambaganur-Kodai-kanal, along heving's path, alt. 1,828–1,981 m, on thallus of *Sticta weigelii* colonising over stone with mosses, coll.: G. Foreau and D. D. Awasthi (4296), 22 December 1959 (LWG-AWAS 12961); Palni Hills, Sirudumkanal Shola, alt. 1,908 m, on thallus of *Sticta weigelii* colonising soil, coll.: G. Foreau (4558), 31 December 1959 (LWG-AWAS 129756). – West Bengal, Darjeeling district, Tiger hills, alt. 2,438 m, on thallus of *Sticta lingulata* colonising bark, coll.: D. D. Awasthi (3120), 10 October 1954 (LWG-AWAS 12965).

*Pyrenidium dimelaenae* Y. Joshi, spec. nova

(Fig. 1)

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*Similar to Pyrenidium zamiae in having somewhat similar ascospore size (15–22 × 4–6 μm) but differs in having 4(–6)-spored asci, smaller perithecia ((54.0–)76.66–106.0–135.34(–154.0) × (54.0–)79.35–107.31–135.27(–154.0) μm) and different host viz. Dimelaena oreina.*

Type: India. Uttarakhand, Chamoli district, way to Niti, 10 km before Niti, alt. 3,118 m, on thallus of *Dimelaena oreina* colonising rocks, 20 August 2007, D. K. Upreti and S. Nayaka, 07-010293 (Holotype: LWG-12335; Isotype: RUBL).

Ascomata perithecia, growing on the thallus of *Dimelaena oreina*, sessile to semi-immersed, scattered, solitary or 2–4 contiguous, black, globose to subglobose, (54.0–)76.66–106.0–135.34(–154.0) × (54.0–)79.35–107.31–135.27(–154.0) μm (n = 35), with light greenish blue tint in ostiolar channel, ostiole central, with pore-like opening. Peridium thick-walled, composed of several layers of brown to dark brown isodiametric cells, inner layers comprising of hyaline cells, (5.0–)7.0–10.0(–20.0) μm wide (n = 35), often thicker in ostiole region, 18.0–35.0(–50.0) μm. Hymenium not interspersed, hyaline, I–, KI–. Hamathecial filaments numerous, persistent, composed of pseudoparaphyses, 1–2 μm diam., richly branched and anastomosing, developing between the asci. Paraphyses 1–2 μm wide, with light greenish blue tint in ostiole region, apical cell not enlarged. Asci (53.97–)60–62.70–71.43(–83.0) × (9.0–)10.37–12.52–14.67(–17.0) μm (n = 35), 4(–6)-spored, fissitunicate, subcylindrical, shortly stipitate, apically rounded with indistinct ocular chamber, I–, KI+ red. Ascospores uniseriate to irregularly overlapping, oblong to ellipsoidal, rounded or obtuse at the apex, hyaline to pale brown in immature state, reddish brown to dark brown in mature state, K+ turning black, 3-septate, constricted at the septa, septa melanised, tips or rarely whole end cells subhyaline, the two inner cells

somewhat larger than the end cells and often with a single or two oil drops, with perispore, (15.0–)15.44–16.41–17.38(–19.0) × (5.0–)5.33–6.75–8.17(–10.0) μm (n = 35). Conidiomata not seen.

Host: On thallus of *Dimelaena oreina*.

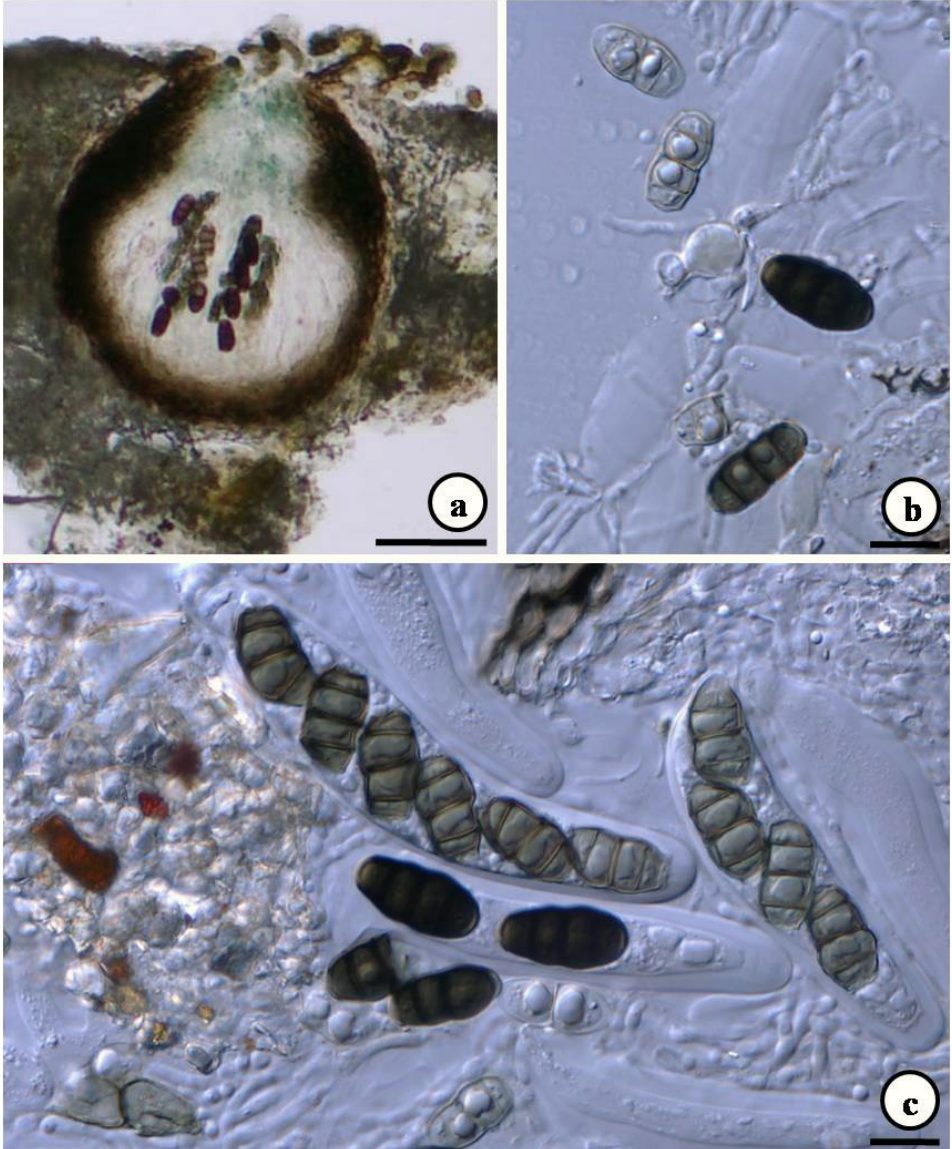


Fig. 1. *Pyrenidium dimelaenae* (holotype). **a** = vertical section through perithecia showing green colouration in ostiolar neck (bar = 55 μm); **b** = hyaline to pale brown to dark brown ascospores (bar = 10 μm); **c** = asci with 4–6 ascospores (bar = 10 μm)

**Etymology:** The epithet is named after the genus *Dimelaena*, which is associated with the lichenicolous fungus.

**Ecology and distribution:** Till date the species is reported from the type locality, where it is growing along with *Lichenostigma dimelaenae* and inhabiting the thallus of *Dimelaena oreina* colonising rocks. Since no damage is observed on the thallus, it is regarded as a commensalistic species. *Lichenostigma dimelaenae* is also reported for the first time from Indian subcontinent.

**Taxonomic remarks:** The members of lichen genus *Dimelaena* are species rich in connections with lichenicolous lichens (15 species, *viz.* *Acarospora anatolica* H. Magn., *A. invadens* H. Magn., *A. jenisejensis* H. Magn., *A. microcarpa* (Nyl.) Weddell, *A. nashii* K. Knudsen, *A. succedens* H. Magn., *A. superans* H. Magn., *Buellia imshaugii* Hafellner, *Dimelaena lichenicola* K. Knudsen, *Erichansenia epithallina* (Lyngé) S. Y. Kondr., Kärnefelt et A. Thell, *Lecidella dimelaenophila* Hertel, *Miriqidica verrucariicola* (B. D. Ryan) K. Knudsen et Kocourk., *Monerolechia californica* (H. Magn.) Elix, *Rhizocarpon dimelaena* Timdal, *R. renneri* Poelt), as compared to lichenicolous fungi (5 species, *viz.* *Arthonia hawksworthii* Halıcı, *Endococcus oreinae* Hafellner, *Lichenostigma dimelaenae* Calat. et Hafellner, *Muellerella ventosicola* (Mudd) D. Hawksw., *Polycoccum evae* Calat. et V. J. Rico).

The new taxon, which is colonising the thallus of *Dimelaena oreina* and characterised by numerous globose to subglobose black perithecia with light greenish blue tint in ostiolar channel, asci 4(–6)-spored and 3-septate ascospores [(15.0–)15.44–16.41–17.38(–19.0) × (5.0–)5.33–6.75–8.17(–10.0) μm]. The species might be confused with *Pyrenidium actinellum*, *P. cryptotheciae*, *P. macrosporum* and *P. zamiae*, which however, not only differ in having variation in number of spores within asci, different hosts, but to some extent also bear vegetative hyphae. *P. actinellum* used to colonise members of cyanolichens (*Scytinium* and *Solorina*) have 4-spored asci and bigger spores (19–27 × 7–9 μm (Doilom *et al.* 2018); 18–26 × 7.5–11 μm and 20–25 × 6–11 μm (Huanraluek *et al.* 2019)). *P. cryptotheciae* which used to colonise *Cryptothecia candida* has 8-spored asci and smaller ascospores 9–13 × 4–6 μm. As the name indicates, *P. macrosporum* differs from all known *Pyrenidium* species (including the new taxon) in having very large ascospores (32.0–)42.5–51.1(–55.3) × (12.5–)14.5–17.1(–18.0) μm and different host (*Parasiphula*). *P. zamiae* having somewhat similar ascospore size (15–22 × 4–6 μm) differs in having 6–8-spored asci, bigger perithecia (100–170 × 100–150 μm) and different host *viz.* *Porina*.

Till date, the genus in India is represented by 4 species (*Pyrenidium actinellum*, *P. borbonicum*, *P. dimelaenae* and *P. hypotrachynae*) colonising various corticolous, saxicolous, and more rarely terricolous lichens (Joshi *et al.* 2016, 2018, Zhurbenko 2013). Of these 4 species, 2 are strictly saxicolous, while 2 species share similar habitat (Table 1). As far as their distribution in India is

Table 1  
Distribution of lichenicolous genus *Pyrenidium* in India

S. no.	Species	Host(s)	Lichen habitat	Distribution in India	Reference
1	<i>P. actinellum</i>	<i>Diploschistes</i> sp., <i>Peltigera canina</i> , <i>P. elisabethae</i> , <i>P. praetextata</i> (thallus)	corticolous, saxicolous, terricolous	Jammu & Kashmir, Uttarakhand	Zhurbenko (2013), Joshi <i>et al.</i> (2016)
2	<i>P. borbonicum</i>	<i>Sticta lingulata</i> , <i>S. weigelii</i> (thallus)	corticolous, saxicolous, terricolous	Tamil Nadu, West Bengal	present manuscript
3	<i>P. dimelaenae</i>	<i>Dimelaena oreina</i> (thallus)	saxicolous	Uttarakhand	present manuscript
4	<i>P. hypotrachynae</i>	<i>Hypotrachyna coorgiana</i> (thallus)	saxicolous	Kerala	Joshi <i>et al.</i> (2018)

considered, 2 species are reported from temperate regions (*P. actinellum* and *P. dimelaenae*), while 2 are reported from tropical regions (*P. borbonicum* and *P. hypotrachynae*) (Table 1).

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