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Phylogenetic placement of the lichenicolous, anamorphic genus *Lichenodiplis* and its connection to *Muellerella*-like teleomorphs

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ABSTRACT

Lichenicolous fungi are a specialized group of taxa which inhabit lichens and develop diverse degrees of specificity and parasitic behaviour towards their hosts. They are recognized only by their phenotypic symptoms and sexual or asexual spore-producing structures on the lichen thalli. Only recently, molecular data and culture dependent approaches have helped in uncovering the species diversity and in verifying the phylogenetic position and anamorph–teleomorph relationships of some taxa. Here, we studied the phylogenetic placement of representative taxa of two lichenicolous genera, the coelomycete *Lichenodiplis* and the ascomycete *Muellerella*. We obtained molecular data for three nuclear and mitochondrial loci (28S, 18S, and 16S), both from fresh collected specimens and culture isolates. Our multilocus phylogeny places *Lichenodiplis* and *Muellerella* samples in one monophyletic, fully supported clade, sister to *Epibryon* (Epibryaceae) in Chaetothyriales (Eurotiomycetes). Morphological analyses of axenically cultured fungi show the formation of conidiomata and conidiospores in both *Lichenodiplis* and *Muellerella* isolates. We suggest that the species *Lichenodiplis lecanorae* and *Muellerella atricola* represent, respectively, the anamorphic and teleomorphic stages of the same fungus and discuss their relationships with the other fungal families in Chaetothyriomycetidae.

Introduction

Morphological similarities between dothidealean and chaetothyrialean fungi have in the past led to the systematic misplacement of several groups. More recently, molecular data have helped verify the phylogenetic position of many taxa, and these have been transferred between the two classes Dothideomycetes and Eurotiomycetes (Gueidan *et al.* 2014; Wijayawardene *et al.* 2014). The availability of molecular data have also made possible the assemblage of multiple loci datasets, resulting in the reappraisal of phylogenetic placements and relationships for a great number of species at different taxonomic levels (e.g. Gueidan *et al.* 2008, 2011, 2014; Schoch *et al.* 2009; Hyde *et al.* 2013), including anamorphic fungi. These fungi have also been studied by culture isolation approaches, which has improved our understanding of

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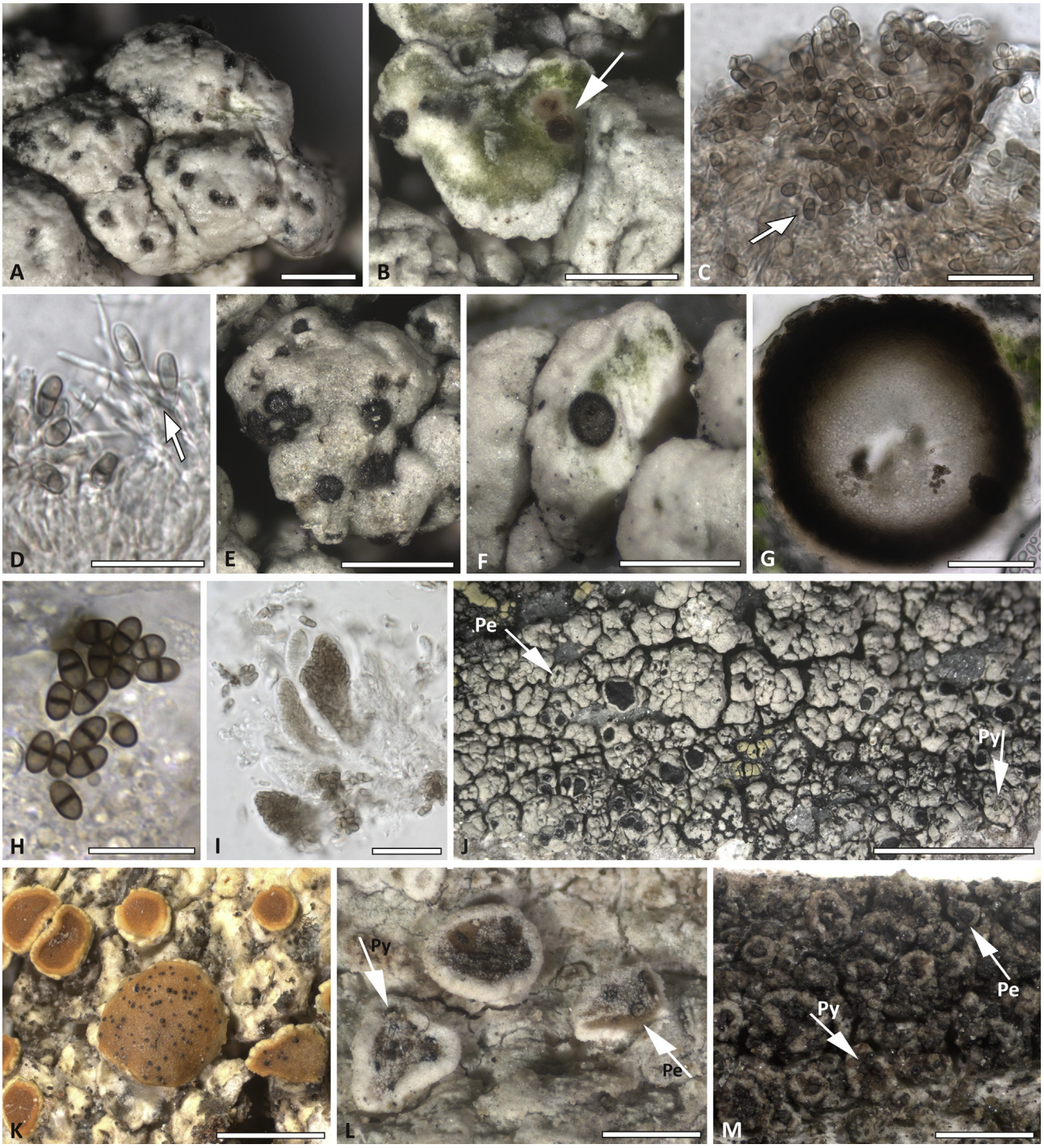

Fig 1 – **Habitus of the lichenicolous *Lichenodiplis lecanorae* (A–D) and *Muellerella atricola* (E–I) on the host *Tephromela atra* and co-occurence of *Lichenodiplis* pycnidia (Py) and *Muellerella* perithecia (Pe) on diverse lichen hosts (J–M); sample ID are reported in square brackets '[ ]'. –*Lichenodiplis lecanorae*: (A) pycnidia on host thallus [Muggia 0297-13], (B) section of a pycnidium in thallus [Muggia 002-13], (C) pycnidium section and conidiospores [Muggia 002-13], (D) conidiospores and conidiogenous hyphae [Muggia 002-13]. –*Muellerella atricola*: (E) perithecia on host thallus [Muggia 001-13], (F) section of a perithecium on the thallus [Muggia 001-13], (G) perithecium section [Muggia 002-13], (H) ascospores, (I) asci and ascospores, squash section [Muggia 002-13]. (J) perithecia of *M. atricola* and pycnidia of *L. lecanorae* on *T. atra* [Muggia 001-13]. (K) infection of *L. lecanorae* on *Caloplaca flavorubescens* [GZU 34-2012], black pycnidia on the apothecium disk (the rare perithecia not shown here). (L) infection of *L. lecanorae* on *Lecanora* sp. and rare perithecia of *Muellerella* in the same hymenium [Ertz 13635, BR]. (M) infection of *L. lecanorae* on *Lecanora* sp. and perithecia of *M. lichenicola* on adjacent apothecia [Ertz 8852, BR]. Scale bars: K = 1 mm; A, B, E, F, L, M = 0.5 mm; G = 60 μm; C, D, I = 20 μm; H = 10 μm.**