MICROFUNGI ASSOCIATED WITH PTERIDOPHYTES IN SOUTHWESTERN CHINA

JINGYI ZHANG

DOCTOR OF PHILOSOPHY
IN
BIOLOGICAL SCIENCE

SCHOOL OF SCIENCE
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THIS DISSERTATION IS A PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN BIOLOGICAL SCIENCE

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ABSTRACT

Pteridophytes (ferns and their allies) constitute a vital component of global plant flora， playing significant ecological roles while providing essential resources for food, medicine, horticulture, agriculture, industry, and environmental management. As the oldest vascular plants, pteridophytes possess a wealth of ancestral characteristics relevant to plant evolution. Their associated fungi are considered to play a crucial role in facilitating plant colonization, offering unique insights into fungai and fungal symbiosis. However, this important ecological niche has long been overlooked, and there is a lack of comprehensive worldwide fungal checklists and global-scale reviews on fungi associated with pteridophytes.

This study provides a comprehensive exploration of fungi associated with ferns and their allies from a global perspective, encompassing three main components. The first component of this study is the compilation of a checklist of fungi associated with pteridophytes worldwide and their classification, based on the USDA Systematic Mycology and relevant research. A total of 1,648 fungal species, including 348 undetermined species, belonging to 611 genera, 240 families, 100 orders, 34 classes, and 11 phyla are listed. Two interesting and important fungal groups: (1) 36 genera with likely fern host-specificity (*Asterocalycella*, *Carrismyces*, *Completoria*, *Dangeardiella*, *Desmella*, *Equiseticola*, *Exoteliospora*, *Griggsia*, *Hyalopsora*, *Hysteropeltella*, *Lachnopsis*, *Massalongina*, *Melaniella*, *Milesina*, *Mixia*, *Nothodactylaria*, *Ophiodiaporthe*, *Paratrimmatostroma*, *Phacidina*, *Placothyrium*, *Platycarpa*, *Pleurothyrium*, *Poculopsis*, *Polycladium*, *Polycyclina*, *Polycyclus*, *Ptechetelium*,

Radiciseta, *Repetobasidiellum*, *Rhagadolobiopsis*, *Rommelaarsia*, *Scolecoleotia*, *Uncol*, *Uredinopsis*, *Woldmaria* and *Zymochalara*), and (2) the ten highest occurrence frequencies of fungal genera (*Cercospora*, *Hyalopsora*, *Lachnum*, *Milesina*, *Phaeosphaeria*, *Pseudocercospora*, *Ramularia*, *Taphrina*, *Uredinopsis* and *Uredo*) are discussed, providing generic notes and re-drawn photo plates.

Additionally, based on morphological and phylogenetic analyses, we identified 124 species within Ascomycota associated with pteridophytes collected from southwestern China, comprising 59 saprobic and 65 endophytic species. Among the saprobic species, we identify 59 species distributed in four classes, 11 orders, 22 families, and 38 genera. This includes the introduction of one new family, Xenoberkleasmiaceae, six new genera (*Cyatheomyces*, *Microlepicola*, *Muriformyces*, *Pseudopalawanella*, *Synnematouspora* and *Xenopleopunctum*), 38 new species, and 21 new records. Furthermore, five new combinations are also introduced: *Muriformyces micronesiacum* (≡ *B. micronesiacum*), *M. nigroapicale* (≡ *B. nigroapicale*), *Xenoberkleasmium pandani* (*B. pandani*), *X. crunisia* (*B. crunisia*), *X. typhae* (≡ *B. typhae*). *Tainosphaeria phialogeniculata* is synonymized under *T. jonesii* based on conspecific phylogenetic relationship and similar morphology, while *Periconia elaeidis* and *P. verrucosa* are synonymized under *P. cookei*.

The last part is about exploring culturable endophytic fungi isolated from *Dicranopteris* spp. in Guizhou province, southwestern China. Based on the evidence from both morphology and phylogeny, 93 strains represting 65 endophytic fungi associated with three *Dicranopteris* species (medicinal ferns) in Guizhou, China have been identified in four classes, 18 orders, 29 families and 39 genera. As a result, a new family, *Massicellisporaceae*, three new genera *viz. Massicellispora*, *Miniglobosispora* and *Pseudopopulomyces*, 29 new species and 36 new records are introduced. In addition, several species are re-evaluated; *Diaporthe hainanensis* and *D. harriottiae* are synonymized under *D. arecae*, *Colletotrichum juglandis* is synonymized as *C. simulanticitri*, while *C. gracile*, *C. oblongisporum*, and *C. nullisetosum* are combined into a single species as *C. jiangxiense*, and *Cashiella sticheri* was transferred to *Pezicula* as *P. sticheri* based on morphological and phylogenetic evidence.

The historical background, significance, numbers, diversity, lifestyle and lifestyle switching, host-specificity or preference, and host jumping of fungi associated with pteridophytes have also been discussed and reviewed. This study provides foundational data for future ecological and evolutionary research on fungi associated with pteridophytes, enhancing our understanding of their ecological roles and potential applications.

Keywords: 84 New Taxa, Checklist, Dothideomycetes, Ferns, Phylogeny, Sordariomycetes, Taxonomy

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ABBREVIATIONS AND SYMBOLS

com.	combination
diam.	diameter
e.g.	for example
et al.	and others
h	hours
gen.	genus/genera
ibid.	ibidem
min	minute
ml	maximum likelihood support
mm	millimetre
nov.	novum (Latin for new thing)
pp	posterior probabilities
sp.	species
spp.	species (plural)
viz.	that is
vs.	versus
$\bar{x}$	average
°C	degree centigrade
µm	micrometer
µl	microliter
%	percent

CHAPTER 1

INTRODUCTION

1.1 Background of Pteridophytes

1.1.1 Definition, Taxonomic, Distribution

Pteridophytes, a transitional group of plants between non-tracheophytes and spermatophytes, comprise two distinct evolutionary lineages: ferns and their allies (lycophytes) (Smith et al., 2006; Christenhusz & Byng, 2016; PPG, 2016). These are also known as free-sporing, spore-bearing, or seed-free vascular plants (Smith et al,. 2006; PPG, 2016; Ojha & Devkota, 2021). Pteridophytes are ancient vascular plants with independent gametophyte and sporophyte phases, with their ancestors dating back to the Devonian period of the mid-Paleozoic era (410–355 million years ago), showing a direct relationship with the evolution of the most primitive vascular plants (Rothwell, 1996; Dudani et al., 2014; Xue & Hao, 2014; Rimington et al., 2015; Guatimosim et al., 2016a). Due to the complexity of classification, the number of families, genera, and species of ferns and lycophytes in China has been unsettled (Smith et al., 2006; Moran, 2008; Chapman, 2009; Chang et al., 2011; Christenhusz & Byng, 2016; PPG, 2016; Zhou et al., 2016; Baskaran et al., 2018a; Coritico & Amoroso ,2020). A modern comprehensive classification for extant lycophytes and ferns was provided by PPG (2016), which was recognized by subsequent studies. PPG (2016) established the Pteridophyte Phylogeny Group (PPG) and accepted approximately 12,000 species into 337 genera, 51 families, and 14 orders. In a recent study, Balkrishna et al. (2019) reviewed the pteridophyte classification proposed by previous studies, and provided an updated pteridophyte classification into four divisions, six classes, 13 subclass, 22 orders, 29 families, and less than 300 genera. These plants are distributed worldwide in a variety of habitats including aquatic (such as *Azolla* sp., *Marsilea* sp.), climbers (such as *Lygodium* sp.), epiphytes (such as *Oleandra* sp., *Vittaria*

sp., *Drynaria* sp.), lithophytes (such as *Woodsia* sp.), terrestrial (such as *Cyathea* sp., *Angiopteris* sp.). They are most abundant in tropical and moist temperate regions (Page, 1979; Khuller, 2000; Singh et al., 2010; Thakur & Rajbhandary, 2018; Khoja et al., 2022).

1.1.2 Ecological Value

Pteridophytes are widely recognized as symbols of abundant biodiversity found in almost every part of the earth (Goswami et al., 2016). They serve as ecological filters, playing crucial roles in forest regeneration and are important components of tropical and temperate forests (George & Bazzaz, 1999; Mehltreter et al., 2010; Khoja et al., 2022). Pteridophytes also contribute to the formation of rugged carpet flora and concealed vegetation, playing essential roles in ecosystem processes in both the forest canopy and understory habitats (Page, 1979; George & Bazzaz, 1999; Ranil et al., 2005; Mehltreter et al., 2010; Goswami et al., 2016; Thakur & Rajbhandary, 2018). In addition to their indispensable ecological roles, pteridophytes also make significant contributions in various fields such as food, medicine, industry, agriculture, horticulture, and environmental management, with especially wide-ranging involvement in food, traditional medicine, and ornamentation (Benjamin & Manickam, 2007; Sarker & Hossain, 2009; Singh et al., 2010; Ojha & Devkota, 2021; Ranil & Bussmann, 2021).

1.1.3 Edible, Aesthetic, Medicinal and Other Values

Due to their high nutritional content, pteridophytes as part of vegetable consumption are becoming increasingly popular worldwide, creating significant value (Lu, 2007; Chettri et al., 2018; Ojha & Devkota, 2021; Yang et al., 2021). For example, the most popular edible fern, *Pteridium aquilinum* var. *latiusculum* is consumed by over a billion people annually in China and Nepal, with an annual production value reaching hundreds of millions of dollars (Nwosu, 2002; Liu et al., 2012; Ojha & Devkota, 2021). Presently, research is focusing on the edible value of ferns (Lu, 2007; Mehltreter, 2010; Singh et al., 2010; Chettri et al., 2018). For instance, Liu et al. (2012) reported an ethnobotanical inventory of 52 traditionally edible ferns in China, Chettri et al. (2018) analyzed six edible ferns, finding their nutritional components to be higher than some commonly used

commercial vegetables. Some of these pteridophytes are also used in preparation of ethnic foods such as fermented foods and pickles (Ojha & Devkota, 2021). Furthermore, these edible pteridophytes serve as good sources of proteins, vitamins C, iron, crude fiber and minerals, contributing to overcoming nutritional deficiencies, especially in hilly regions (Chang et al., 2007; Mehltreter, 2010; Chettri et al., 2018). Starch extracted from *Pteridium aquilinum* var. *latiusculum* has even become a major staple food substitute during famine periods, providing evidence that in the context of climate change, the consumption of ferns can diversify the human food basket (Zhang, 2007; Liu et al., 2012; Chettri et al., 2018).

Ferns and fern-allies are aesthetically attractive due to their immense diversity in plant appearance, spore morphology, and foliage patterns and colors (Ranil et al., 2005; Ranil & Bussmann, 2021; Mondal et al., 2023). They represent potential aesthetic assets and have been utilized for horticultural and other decorative purposes throughout a long history (Singh et al., 2010; Singh & Johari, 2018; Ranil & Bussmann, 2021). The variety of ornamental ferns is abundant, such as *Adiantum* spp., *Blechnum* spp., *Cyathea* spp., *Nephrolepis* spp., and *Platicerum* spp. (Ranil et al., 2005; Ranil et al., 2015). The floriculture industry with these pteridophytes and their nurseries has seen significant development to meet the market requirement, reaching a value of millions of dollars (Singh et al., 2010; Mondal et al., 2023). This has not only promoted the development of the pteridophytes market but has also helped improve the local population's economic status, playing a significant role in poverty alleviation globally (Ranil et al., 2005; Singh et al., 2010; Ranil et al., 2015; Singh & Johari, 2018).

Many pteridophytes have medicinal value and can be used for alternative treatments of various human diseases (Benjamin & Manickam, 2007; Singh et al., 2010; Goswami et al., 2016; Ojha & Devkota, 2021). For example, leaves of *Adiantum philippense* are used to cure fever, cough, asthma, leprosy, and hair loss; whole plants of *Blechnum orientale* are used in anathematic and typhoid treatments (Baskaran et al., 2018b). Studies have demonstrated the excellent adaptability of fern plants and their allies to different environmental conditions, resulting in the production of a rich variety of

phytochemicals or secondary metabolites such as flavonoids, steroids, alkaloids, phenols, terpenoid compounds, multiple amino acids and fatty acids, as well as some unique metabolites (Singh et al., 2010; Srivastava & Paul, 2016; Baskaran et al., 2018b; Zaman et al., 2019). Traditionally used for human health and medicine, especially for their antioxidant, anti-diabetic, anticancer, antiviral, anti-inflammatory, wound healing, antibacterial, and anti-Alzheimer's activities (Chang et al., 2007; Liu et al., 2012; Srivastava & Paul, 2016; Baskaran et al., 2018b). Three main secondary metabolites produced by ferns and fern-allies, namely terpenoids, alkaloids, and phenylpropanoid compounds and related phenolic compounds, have gained attention as potential sources of new drugs (Anishmon & Thomas, 2005; Goswami et al., 2016; Srivastava & Paul, 2016; Wani et al., 2016). In addition, many pteridophytes (such as Pteridaceae, Polypodiaceae and Adiantaceae) with potential active compounds and good prospects have been identified, serving as potential genetic resources to combat many diseases, yielding tremendous economic value and enormous benefits to human society (Singh et al., 2010; Srivastava & Paul, 2016; Baskaran et al., 2018b; Ojha & Devkota, 2021). The medicinal use of these plants, particularly in homeopathy and Ayurvedic medicine, has generated billions of dollars in revenue worldwide (Singh et al., 2010; Goswami et al., 2016). Further systematic research on the greater medicinal potential of fern plants is expected to make progress in the development of life-saving drugs (Anishmon & Thomas, 2005; Benjamin & Manickam, 2007; Singh et al., 2010; Goswami et al., 2016; Srivastava & Paul, 2016; Wani et al., 2016; Ojha & Devkota, 2021).

Certain pteridophytes have significant applications as raw materials in industrial production. For instance, *Lycopodium* powder is utilized as a release agent in the metallurgical industry, while *Azolla* and *Equisetum* are employed as biofertilizers in agricultural production (Toba, 1975); the fronds of *Gleichenia gigantea* are utilized for fuel and mulching purposes (Joshi & Joshi, 2008). Additionally, pteridophytes can act as ecological indicators, reflecting the soil and climate characteristics, and exhibiting high

sensitivity to external environments, particularly in forestry production (Della & Falkenberg, 2019). Pteridophytes, a transitional group of

1.2 Background on Fungi Associated with Pteridophytes

Studies on fungi associated with pteridophytes have revealed many interesting and unique taxa, some of which were new to science (Kirschner et al., 2019; Zhang et al., 2021, 2023). Pteridophytes are considered as good substrates for many fungi including mycorrhiza fungi that form symbiotic relationships in the roots, endophytes that colonize the internal tissues of healthy plants, pathogens that cause disease, epiphytes on fronds and stems, and saprobic decomposers on all parts of dead and dying plants (Stevenson, 1945; Mehltreter, 2010; Del Olmo-Ruiz & Arnold, 2014; Kirschner et al., 2019).

1.2.1 History

Initial research associated with fungi on pteridophyes almost exclusively focused on fern rust fungi (Fraser, 1912; Arthur, 1924a; Bell, 1924; Faull, 1947). However, some studies documented a few records of fungi on ferns (Stevens & Dalbey, 1919; Seymour, 1929; Cash, 1938). Sjamsuridzal et al. (1999) suggested reconsidering the hypothesis that fern rust fungi are the origin of all rust fungi, as phylogenetic evidence from 18S rDNA sequence analysis indicated that fern rust fungi are not primitive phylogenetically. The first overview of parasitic fungi on ferns was probably provided by Stevenson (1945), focusing on fungal groups including three common fern rust genera (*Hyalopsora*, *Milesia* and *Uredinopsis*), the striking genus *Taphrina*, the tar-spot taxon, and certain other pathogens. Later, Bennell and Henderson (1985) reviewed the major groups of parasitic fungi on pteridophytes, with a focus on rust fungi and their relationship with fern hosts, discussing their potential contributions to the classification and systematic evolution of the hosts. Gilbertson and Hemmes (1997) conducted a primary investigation into mainly saprobic fungi across various systematic groups on tree ferns. Later, Helfer (2006) simply investigated the distribution and frequency of parasitic microfungi on ferns and fern allies,

focusing on the significance of fern rusts. Helfer (2006) listed the 20 most common genera of microfungi found on ferns and fern allies, and the 20 pteridophyte genera most commonly colonized by microfungi (Helfer, 2006). Mehltreter (2010) reviewed the interactions of antagonistic, neutral, and mutualistic relationships between ferns, lycophytes and fungi, discussing endophytes, saprobes, pathogens and mycorrhizae associated with ferns. This is the most recent overview of saprobic, parasitic and symbiotic fungi associated with pteridophytes (Mehltreter, 2010). Kirschner and Liu (2014) provided a concise review of parasitic fungi associated with live ferns, along with new species and findings from Taiwan. Kirschner et al. (2019) updated and conducted a comprehensive review of parasitic fungi associated with living ferns in Taiwan, discussing the chances and challenges of investigating fungi on ferns in Taiwan. They also provided an updated checklist of approximately 60 species associated with Taiwanese pteridophytes, revealing that around 90% of fern-associated fungi remain undiscovered and unidentified (Kirschner et al., 2019). Seifollahi et al. (2023) discussed pathogenic fungal genera associated with ferns and fern-allies in northern Thailand, adding new species and records. Antonovics (2020) inferred that ferns exhibit higher resistance to fungal pathogens as compared to angiosperm species, as they tend to harbor fewer pathogenic species; however, the physiological or molecular processes underlying this result remain unclear.

1.2.2 Dominant Group

Ascomycota and Basidiomycota are the main fungal groups on most plants and this is also the case with pteridophytes, with fern rusts forming the majority of the latter (Helfer, 2006; Cummins & Hiratsuka, 2003b; Aime & McTaggart, 2021; Wang et al., 2021). Among Ascomycota, more studies focused on mycosphaerellaceous taxa and their corresponding cercosporoid asexual morphs (Braun, 2004; Aptroot & Crous, 2006; Kirschner & Chen, 2007; Braun et al., 2013; Kirschner & Liu, 2014; Kirschner & Wang, 2015; Guatimosim et al., 2016a; Medel-Ortiz et al., 2020; Antonovics, 2023). Holm and Holm (1978) commented on 16 pteridicolous ascomycetes of new or noteworthy species in Sweden based on morphology. Braun (2004) recorded species of the cercosporoid

Periconiella on ferns worldwide. Aptroot and Crous (2006) clarified the conspectus of *Mycosphaerella* and its anamorphs, encompassing over 30 taxa associated with ferns and fern-allies. Medel-Ortiz et al. (2020) provided an updated checklist of 25 ascomycete fungi on fern hosts recorded from Mexico. Studies investigated the mycota associated with pteridophytes in Brazil, specifically focusing on the cercosporoid and related fungi found in frond spots of various pteridophyte specimens (Braun et al., 2013; Guatimosim et al., 2016a). Another morphological and phylogenetic-based investigation in Brazil focused on lachnoid and chalara-like fungi on ferns (Guatimosim et al., 2016b). Notably, a systematic study of the fungi (endophytes, saprophytes and pathogens) of bracken (*Pteridium aquilinum*) was provided in temperate regions, as well as a checklist of fungal species recorded on decomposing petioles of bracken (Frankland, 1966, 1969, 1976; Godfrey, 1974; Petrini, 1992; Fisher, 1996). The most thoroughly studied fern species for fungi is bracken.

1.2.3 Evolutionary Significance

Due to the significant role of ferns in the early evolution of terrestrial plants (Zhao, 2000; Brundrett, 2002; Zhang et al., 2004; Ogura-Tsujita et al., 2019), the study of mycorrhizal fungi in ferns has always been a focused area of research (Hepden, 1960; Fisher, 1996; Zhao, 2000; Zhang et al., 2004; Zubek et al., 2010; Pressel et al., 2016). Mycorrhizal symbiosis is commonly believed to have enabled plants to colonize terrestrial habitats (Strullu-Derrien & Strullu, 2007). The mycorrhizas of pteridophytes found in the fossil rhizomes of *Asteroxylon* and *Rhynia* from the Devonian to Carboniferous periods in the Paleozoic era are considered the earliest arbuscular mycorrhiza, suggesting that Glomeromycotina associations are ancestral mycorrhizal symbiosis (Remy et al., 1994; Taylor et al., 1995). The phenomenon of mycorrhizal symbiosis is widely considered a major innovation that drove the plant-terrestrial process 460–480 MYA (Bonfante & Genre, 2008; Pressel et al., 2016). The proportion of arbuscular mycorrhizal pteridophytes out of 256 pteridophyte species in Yunnan, southwest China, was determined to be less than that in angiosperms, revealing the evolutionary trend in Filicineae from constantly mycorrhizal to facultative mycorrhizal and finally to nonmycorrhizal plants, strongly supporting the

hypothesis of the mycotrophic origin of land plants (Pirozynski & Malloch, 1975; Zhao, 2000). Pressel et al. (2016) critically reviewed the current understanding of pteridophyte fungal associations, emphasizing the nature and biology of the interactions between pteridophytes and their fungal symbionts, which are significant for elucidating key events in early land plant evolution and the evolutionary history of mycorrhizal (Mehltreter, 2010). A study by Muthukumar and Prabha (2013) showed the widespread extent and type of arbuscular mycorrhizal (AM) and septate endophytic (SE) fungal associations in lycophytes and ferns on different substrates from southern India, emphasizing the importance of these associations in the establishment and survival of these plants (Mehltreter, 2010; Zubek et al., 2010). The arbuscular mycorrhizal (AM) symbiosis with Glomeromycota has long been considered an ancient and widespread form of symbiosis until recent studies shown that pteridophytes form symbiotic relationships with both Mucoromycotina and Glomeromycota, indicating that Mucoromycotina are also ancestral symbionts (Remy et al., 1994; Taylor et al., 1995; Strullu-Derrien et al., 2014; Rimington et al., 2015; Ogura-Tsujita et al., 2019). This elevates our understanding of the origin and evolution of fungal symbiosis in vascular plants to a new height (Strullu-Derrien et al., 2014; Rimington et al., 2015; Ogura-Tsujita et al., 2019). However, research in this area has mainly focused on the occurrence and evolutionary significance of arbuscular mycorrhizal fungi in ferns and allies, with relatively little research on the composition of AM fungal species in the rooting-zone soils of pteridophytes (Hepden, 1960; Zhao, 2000; Zhang et al., 2004; Kessler et al., 2014; Pressel et al., 2016). A brief review of the study of mycorrhizal fungi associated with pteridophytes have been provided (Hepden, 1960; Zhao, 2000; Khade & Rodrigues, 2002; Mehltreter, 2010; Pressel et al., 2016). Despite the considerable attention given to the mycorrhizal associations of pteridophytes, their status remains unclear (Zhao, 2000; Mehltreter, 2010; Kessler et al., 2014; Pressel et al., 2016).

This study offers valuable insights into the evolutionary dynamics and ecological implications of these fungal interactions with pteridophytes, connecting the scientific community with a global understanding of these phenomena.

1.3 Research Gaps

1.3.1 Certain ecological niches of pteridophytes associated fungi are crucial to understand fungal phylogeny and evolution, yet they remain largely overlooked.

1.3.2 The fungal diversity associated with pteridophytes is poorly studied in Chin.

1.3.3 No comprehensive worldwide checklist of fungi associated with pteridophytes, nor sufficient data on their geographical distribution.

1.3.4 Few global-scale reviews exist on fungi related to pteridophytes, limiting our broader understanding of their ecological and evolutionary significance.

1.4 Objectives

1.4.1 To investigate fungi-associated with pteridophytes in southwestern China, using both morphological and molecular approaches.

1.4.2 To review current knowledge and host associations of fungi related to pteridophytes.

1.4.3 To compile a checklist of fungi associated with pteridophytes and document their geographical distribution

1.5 Expected Outcome

1.5.1 This study is expected to describe new taxa and investigate the diversity of microfungi on pteridohytes in southwestern China.

1.5.2 This study is expected to review fungi on pteridophytes from a global prespective.

1.5.3 This study is expected to provide a checklist of fungi on pteridophytes.

1.6 Thesis Outline

This thesis comprises five chapters.

Chapter 1 is a general introduction, providing an overview of the host pteridophytes and their associated fungi. It comprehensively discusses the reasons and significance of selecting pteridophytes as hosts for fungal research, and points are addressed regarding the research history, current status, and advantageous groups of pteridophyte fungi, as well as their significance and evolutionary. The research gaps, objectives, expected outcome and thesis outline are listed.

Chapter 2 provides a detailed checklist of fungi occurring on pteridophytes worldwide and their classification, regarding their taxonomic positions, host, host family, geographical distribution and references. We provides notes and re-drawn photo plates for selected fungal genera, showcasing host-specificity at the genus level and the highest occurrence frequencies of fungal genera.

Chapter 3 provides the morpho-molecular systematics of saprobic fungi associated with pteridophyte in southern China. In this chapter, we describe 59 species collected from various ferns. Based on morphological comparisons and multigene phylogenetic analyses, we introduce one new family, six new genera, 38 new species, 21 new records, and five new combinations.

Chapter 4 provides the morpho-molecular systematics of endophytic fungi associated with *Dicranopteris* spp. (Medicial ferns) in China. In this chapter, we describe 65 species collected from three *Dicranopteris* sspecies. Based on morphological comparisons and multigene phylogenetic analyses, we introduce one new family, three new genera, 29 new species, 36 new records, and one new combinations.

Chapter 5 provides an overall conclusion with disscuing the diversity, distribution, numbers, liftstyle and host-juming of fungi associated with pteridophytes, highlights, the research advantages, future work and publications.

CHAPTER 2

GLOBAL CHECKLIST OF PTERIDOPHYTES-ASSOCIATED FUNGI FROM PREVIOUS STUDIE, ALONG WITH NOTES AND REDRAWN PLATES ON SELECTED FUNGAL GENERA

2.1 Introduction

Until now, there have been no comprehensive global statistics on the numbers and distribution of fungi associated with ferns and their allies worldwide. Only limited statistical information has been documented for specific regions, particular pteridophyte hosts, or for certain fungal groups. For example, approximately 60 species have been found on ferns in Taiwan, China (Kirschner et al., 2019); investigations on saprobic fungi on tree ferns have been carried out in some areas (Stevens & Dalbey, 1919; Dingley, 1972; Gilbertson & Hemmes, 1997; Ruiz & Heredia, 2000; Medel et al., 2010); Comprehensive fungal community studies on Pteridium aquilinum were done in the UK (Petrini, 1992; Frankland, 1966, 1969, 1976; Farr et al., 2021); and studies on the numbers and taxa of fern rust fungi have been performed (Bell, 1924; Berndt et al., 1994; Helfer, 2006; Smith, 2015).

2.2 Methods

The checklist of fungi associated with pteridophytes was obtained based on the USDA Systematic Mycology (Farr et al., 2021) and relevant literature. This checklist follows the current classification schemes including the databases of MycoBank (http://www. mycobank.org), Species Fungorum (https://www.speciesfungorum.org), and recent publications, mostly from review papers published in the last few years (He et al., 2019; Hyde et al., 2020b; Hongsanan et al., 2020a, 2020b; Wijayawardene et al.,

2022, 2024).

In the fungal-host dataset, we searched for fungal records related to hosts of ferns and fern-allies by inputting the host genus name. The names are based on 568 pteridophyte genera listed on “The Plant List” website (Appendix: 568 genera records from 35 fern families accepted in pteridophytes on The Plant List). It is inevitable that many of the 568 genera are synonyms, as there are currently approximately 300 widely accepted host genera in pteridophytes, as confirmed during host surveys (PPG, 2016; Balkrishna et al., 2019). However, to maximize the collection of pteridophytes-related fungal records, we selected a wider range of 568 host genus names recorded in “The Plant List” for searching in USDA Systematic Mycology. Due to the complexity of classification, the number of ferns and their allies has been changing, and the scientific names are often heteronymized. We recorded fungal host scientific names as accurately as possible according to the original literature, and the families of the hosts were processed according to website of “The Plant List” http://www.theplantlist.org/browse/P/, Accession, 3 July 2022; Kalwij, 2012) and related literature.

2.3 Result Part 1: Checklist and Classification

Based on the USDA Systematic Mycology, and relevant literature, over 6000 records were found from previous studies. These records represent 1,648 species (including 348 unidentified species) with associated metadata (i.e., hosts, host family, geographical distribution and citations), listed in the checklist (Table 2.1). These 1,648 species are distributed across 611 genera, 240 families, 100 orders, 34 classes and 11 phyla (Table 2.2).

Table 2.1 Checklist of fungi associated with pteridophytes worldwide from previous studies

No.	Species	Host	Distribution	Reference
1	*Absidia caerulea*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
2	*Absidia cylindrospora*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976), Petrini (1992)
3	*Acanthophiobolus helicosporus*	*Equisetum sylvaticum* (Equisetaceae)	Sweden	Eriksson (2014)
4	*Acaulospora laevis*	*Pteridium esculentum* (Dennstaedtiaceae)	New Zealand	Gadgil (2005)
5	*Achlya caroliniana*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
6	*Achlya debaryana*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
7	*Achlya papillosa*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
8	*Achlya rodrigueziana*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
9	*Acremonium alternatum*	*Neottopteris nidus* (Aspleniaceae)	China	Jiang et al. (2016)
10	*Acremonium boreale*	*Equisetum arvense* (Equisetaceae)	Canada	Ginns (1986)
11	*Acremonium exiguum*	*Dicksonia antarctica* (Dicksoniaceae)	Sri Lanka	Gams (1975)
12	*Acremonium felinum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
13	*Acremonium murorum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
14	*Acremonium nigricans*	*Cyathea arborea* (Cyatheaceae)	Cuba	Delgado-Rodriguez and Mena-Portales (2004)
15	*Acremonium* sp.1	*Equisetum pratense* (Equisetaceae)	Poland	Ruszkiewicz-Michalska et al. (2012)
16	*Acremonium* sp2.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)
17	*Acremonium* sp.3	*Pteris* sp. (Pteridaceae)	India	Kumaresan et al. (2013)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
18	*Acrodictys bambusicola*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
19	*Acrospermum maxoni*	*Polypodium induens* (Polypodiaceae)	Dominican Republic, Haiti, Panama	Ciferri (1961), Farr et al. (2021)
20	*Acrospermum urceolatum*	*Selaginella arizonica* (Selaginellaceae), *Selaginella hansenii* (Selaginellaceae), *Selaginella mutica* var. *limitanea* (Selaginellaceae), *Selaginella rupestris* (Selaginellaceae), *Selaginella* sp. (Selaginellaceae)	United States	Farr and Horner (1968), Shaw (1973), Farr et al. (2021)
21	*Acrotheca* sp.1	*Selaginella pilifera* var. *pringlei* (Selaginellaceae)	United States	Farr and Horner (1968)
22	*Acrotheca* sp.2	*Selaginella oregana* (Selaginellaceae)	United States	Farr and Horner (1968)
23	*Actinopelte* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
24	*Agroathelia rolfsii*	*Asplenium nidus* (Aspleniaceae), *Angiopteris evecta* (Marattiaceae), *Davallia* sp. (Davalliaceae), *Marattia salicina* (Marattiaceae), *Platycerium bifurcatum* (Polypodiaceae)	Australia, United States	Alfieri et al. (1984), Rugg and Summerell (1993)
25	*Alatospora acuminata*	*Equisetum* sp. (Equisetaceae)	India	Sati and Belwal (2005)
26	*Albosynnema filicicola*	*Cyathea arborea* (Cyatheaceae)	France	Sherwood (1974)
27	*Allantophomopsis lycopodina*	*Lycopodium complanatum* (Lycopodiaceae)	Austria	Carris (1990)
28	*Allophylaria campanuliformis*	*Athyrium distentifolium* (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Pteridium* sp. (Dennstaedtiaceae)	Germany, Sweden, United Kingdom	Eriksson (2014), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
29	*Alternaria brassicae*	*Neottopteris nidus* (Aspleniaceae)	China	Jiang et al. (2016)
30	*Alternaria longissima*	*Marsilea quadrifolia* (Marsileaceae)	India	Deighton (1968)
31	*Alternaria padwickii*	*Marsilea quadrifoliata* (Marsileaceae)	India	Sarbhoy et al. (1975)
32	*Alternaria polypodii*	*Nephrolepis biserrata* (Davalliaceae), *Polypodium* sp. (Polypodiaceae)	Canada, West Indies	Farr et al. (2021)
33	*Alternaria* sp.	*Asplenium nidus* (Aspleniaceae)	United States	Alfieri et al. (1984)
34	*Alternaria* sp.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)
35	*Alternaria* sp.	*Davallia trichomanoides* f. *barbata* (Davalliaceae)	United States	Alfieri et al. (1984)
36	*Alternaria* sp.	*Nephrolepis* sp. (Davalliaceae)	United States	Alfieri et al. (1984)
37	*Alternaria* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Alfieri et al. (1984)
38	*Alternaria* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Farr et al. (2021)
39	*Alternaria* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
40	*Alternaria* sp.	*Cyrtomium falcatum* (Dryopteridaceae)	United States	Alfieri et al. (1984)
41	*Alternaria* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	Caribbean	Farr et al. (2021), Minter et al. (2001)
42	*Alternaria* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
43	*Alternaria* sp.	*Platycerium bifurcatum* (Polypodiaceae)	Venezuela	Farr et al. (2021)
44	*Alternaria* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Farr et al. (2021)
45	*Alternaria* sp.	*Ceratopteris thalictroides* (Pteridaceae)	United States	Farr et al. (2021)
46	*Alternaria* sp.	*Selaginella rupestris* (Selaginellaceae)	United States	Farr and Horner (1968)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
47	*Alternaria* sp.	*Pteris* sp. (Pteridaceae)	United States	Farr et al. (2021)
48	*Amarenomyces dactylidi*	Fern	China	Phookamsak et al. (2019)
49	*Amniculicola longissima*	Pteridophytes	India	Sati and Belwal (2005)
50	*Amphinema byssoides*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Selaginella apoda* (Selaginellaceae)	Germany, Scandinavia, United States	Farr et al. (2021), Hjortstam and Larsson (1997)
51	*Anguillospora crassa*	*Equisetum* sp. (Equisetaceae)	India	Sati and Belwal (2005)
52	*Angulospora aquatica*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
53	*Antennaria semiovata*	*Dryopteris* sp. (Dryopteridaceae)	United Kingdom	Cannon et al. (1985)
54	*Antennatula sp.*	*Elaphoglossum* sp. (Lomariopsidaceae)	Caribbean	Farr et al. (2021), Minter et al. (2001)
55	*Anthracocystis heteropogonicola*	*Lygodium japonicum* (Schizaeaceae)	United States	Rush et al. (2020)
56	*Aphanobasidium bourdotii*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
57	*Aphanobasidium filicinum*	*Osmunda cinnamomea* (Osmundaceae), *Polystichum munitum* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada, Portugal, Scandinavia, United States	Farr et al. (2021)
58	*Aphanomyces irregularis*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
59	*Apiospora sphaerosperma*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
60	*Arachniotus terrestris*	*Psilotum flaccidum* (Psilotaceae)	India	Pande (2008)
61	Arachnopezizaceae *cf. Arachnopeziza*	*Alsophila firma* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)
62	*Armillaria mellea*	*Alsophila australis* (Cyatheaceae), *Dicksonia antarctica* (Dicksoniaceae)	United States	Anonymous (1960), French (1989)
63	*Arnium apiculatum*	*Equisetum* sp. (Equisetaceae)	United States	Shearer et al. (1980)
64	*Arthrobotrys megalosporus*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
65	*Aschersonia cubensis*	*Pteris* sp. (Pteridaceae)	West Indies	Farr et al. (2021), Minter et al. (2001)
66	*Aschersonia eugeniae*	*Polypodium myriocarpum* (Polypodiaceae)	Philippines	Teodoro (1937)
67	*Aschersonia goldiana*	*Adiantum* sp. (Adiantaceae)	Puerto Rico, United States (Virgin Islands)	Farr et al. (2021), Stevenson (1975)
68	*Aschersonia incrassata*	*Adiantum* sp. (Adiantaceae)	West Indies	Minter et al. (2001)
69	*Aschersonia philippinensis*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
70	*Aschersonia* sp.	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
71	*Ascochyta equiseti*	*Equisetum arvense* (Equisetaceae), *Equisetum laevigatum* (Equisetaceae), *Equisetum limosum* (Equisetaceae), *Equisetum fluviatile* (Equisetaceae), *Equisetum ramosissimum* (Equisetaceae), *Equisetum sylvaticum* (Equisetaceae), *Equisetum telmateia* var. *braunii* (Equisetaceae)	Czechoslovakia, Germany, Portugal, Russia, Switzerland, United Kingdom, United States	Greene (1968), Farr et al. (2021)
72	*Ascochyta osmundae*	*Osmunda claytoniana* (Osmundaceae)	United States	Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
73	*Ascochyta osmundicola*	*Osmunda claytoniana* (Osmundaceae)	United States (Wisconsin)	Punithalingam (1988)
74	*Ascochyta pteridis*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland), United States	Webb and Lindow (1987), Farr et al. (2021)
75	*Ascochyta selaginellae*	*Selaginella helvetica* (Selaginellaceae)	Italy	Punithalingam (1988)
76	*Ascochyta sp.*	*Pteridium aquilinum* (Dennstaedtiaceae)	Germany	Farr et al. (2021)
77	*Ascocoryne sarcoides*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
78	*Ascocoryne sp.*	*Cyathea* sp. (Cyatheaceae)	West Indies	Farr et al. (2021)
79	*Aspergillus flavus*	*Adiantum* sp. (Adiantaceae)	India	Kumaresan et al. (2013)
80	*Aspergillus fumigatus*	*Pteridiurn aquilinum* (Dennstaedtiaceae	United Kingdom	Frankland (1976)
81	*Aspergillus niger*	*Adiantum* sp. (Adiantaceae), *Gleichenia linearis* (Gleicheniaceae)	India	Kumaresan et al. (2013)
82	*Aspergillus* sp.	*Adiantum* sp. (Adiantaceae)	India	Kumaresan et al. (2013)
83	*Aspergillus* sp.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)
84	*Aspergillus* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
85	*Aspergillus terreus*	*Pteris* sp. (Pteridaceae)	India	Kumaresan et al. (2013)
86	*Asteridiella selaginellae*	*Selaginella pilifera* var. *pringlei* (Selaginellaceae)	Mexico	Katumoto and Hosagoudar (1989)
87	*Asterina aspidii*	*Cyrtomium fortunei* (Dryopteridaceae), *Cyrtomium fortunei* var. *clivicola* (Dryopteridaceae)	Japan	Ken (1975), Katsumoto (1979), Farr et al. (2021)
88	*Asterina cyathearum*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
89	*Asterina* sp.	*Cibotium* sp. (Dicksoniaceae)	United States	Raabe et al. (1981)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
90	*Asterocalycella mirabilis*	*Alsophila spinulosa* (Cyatheaceae), Sphaeropteris *lepifera* (Cyatheaceae), *Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province)	Kirschner et al. (2019)
91	*Asterostroma spinososporum*	*Blotiella pubescens* (Dennstaedtiaceae)	France (Reunion)	Boidin et al. (1997)
92	*Athelia acrospora*	*Dryopteris carthusiana* (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
93	*Athelia arachnoidea*	*Cibotium* sp. (Dicksoniaceae)	United States	Raabe et al. (1981)
94	*Athelia arachnoidea* var. *arachnoidea*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson et al. (2002)
95	*Athelia binucleospora*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
96	*Athelia cibotii*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997), Gilbertson et al. (2002)
97	*Athelia epiphylla*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
98	*Athelia fibulata*	*Athyrium filix-femina* (Woodsiaceae)	Germany, Scandinavia	Schmid-Heckel (1988), Hjortstam and Larsson (1997)
99	*Athelia pyriformis*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae), *Dryopteris dilatata* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Denmark, Scandinavia, United States	Gilbertson and Hemmes (1997), Hjortstam and Larsson (1997), Gilbertson et al. (2002)
100	*Athelia sibirica*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
101	*Athelia* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
102	*Athelopsis galzinii*	*Aspidium* sp. (Dryopteridaceae), *Blechnum spicant* (Blechnaceae)	France (Reunion), Portugal	Boidin and Gilles (1986), Cardoso et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
103	*Athelopsis lembospora*	*Athyrium distentifolium* (Woodsiaceae), *Athyrium filix-femina* (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Germany, Scandinavia	Hjortstam and Larsson (1997), Farr et al. (2021)
104	*Athelopsis subinconspicua*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
105	*Atkinsonella hypoxylon*	*Oleandra* sp. (Oleandraceae)	Brazil	Hanlin (1992)
106	*Atractilina parasitica*	*Adiantum latifolium* (Adiantaceae)	West Indies	Minter et al. (2001)
107	*Aureobasidium pullulans*	*Pteridium aquilinum* (Dennstaedtiaceae), *Psilotum nudum* (Psilotaceae)	United Kingdom	Frankland (1976), Petrini (1992), Atsatt and Whiteside (2014)
108	*Aureobasidium* sp.	*Adiantum* sp. (Adiantaceae), Gleichenia *linearis* (Gleicheniaceae), *Pteris* sp. (Pteridaceae)	India	Kumaresan et al. (2013)
109	*Balaniopsis africana*	*Cyathea* sp. (Cyatheaceae)	Kenya	Kirk (1985)
110	*Balaniopsis kirkii*	*Cyathea* sp. (Cyatheaceae)	Kenya	Whitton et al. (2002a)
111	*Basidiodendron eyrei*	*Athyrium distentifolium* (Woodsiaceae)	Germany	Schmid-Heckel (1988)
112	*Berkeleyomyces basicola*	*Equisetum arvense* (Equisetaceae)	Canada	Ginns (1986)
113	*Bifusella anomala*	*Dicranopteris dichotoma* (Gleicheniaceae)	China	Lin (1994)
114	*Bionectria ochroleuca*	*Sphaeropteris lepifera* (Cyatheaceae)	China (Taiwan Province)	Guu et al. (2010)
115	*Bioscypha cyatheae*	*Cyathea* sp. (Cyatheaceae)	Costa Rica	Wu and Diao (2023)
116	*Bioscypha pteridicola*	*Cnemidaria uleana* var. *abitaguensis* (Cyatheaceae)	Colombia	Samuels and Rogerson (1990)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
117	*Bipolaris sacchari*	*Lygodium japonicum* (Schizaeaceae), *Lygodium microphyllum* (Schizaeaceae)	United States	Elliott and Rayamajhi (2005)
118	*Bisporella pteridicola*	*Alsophila firma* (Cyatheaceae), An unidentified fern, *Cyathea bicrenata* (Cyatheaceae), *Pecluma alfredii* (Polypodiaceae), *Sphaeropteris horrida* (Cyatheaceae), *Thelypteris* sp. (Thelypteridaceae)	China (Guangdong Province), Mexico	Zhuang et al. (2017), Medel-Ortiz et al. (2020), Farr et al. (2021)
119	*Bloxamiella cyatheicola*	*Cyathea atrovirens* (Cyatheaceae), *Cyathea delgadii* (Cyatheaceae)	Brazil	Guatimosim et al. (2016b), Wu and Diao (2023)
120	*Boeremia exigua*	*Nephrolepis cordifolia* (Davalliaceae)	New Zealand	Gadgil (2005)
121	*Botryobasidium ampullatum*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae), *Cibotium hawaiense* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
122	*Botryobasidium isabellinum*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
123	*Botryobasidium laeve*	*Dryopteris filix-mas* (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
124	*Botryobasidium subcoronatum*	*Dryopteris dilatata* (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
125	*Botryobasidium vagum*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Scandinavia	Hjortstam and Larsson (1997)
126	*Botryosphaeria dothidea*	*Lemmaphyllum microphyllum* (Polypodiaceae)	China	Li et al. (2024a)
127	*Botryosphaeria ramosa*	*Lemmaphyllum microphyllum* (Polypodiaceae)	China	Li et al. (2024a)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
128	*Botryodiplodia* sp.	*Pteris* sp. (Pteridaceae), *Selaginella* sp (Selaginellaceae)	India	Kumaresan et al. (2013)
129	*Botryosphaeria* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
130	*Botryosphaeria* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Sweden	Alfieri et al. (1984)
131	*Botryosporium pulchrum*	*Selaginella* sp. (Selaginellaceae)	United States	Farr and Horner (1968)
132	*Botryotinia* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
133	*Botrytis cinerea*	*Alsophila australis* (Cyatheaceae), *Adiantum capillus-veneris* (Adiantaceae), *Adiantum* sp. (Adiantaceae), *Athyrium* sp. (Woodsiaceae), *Cyrtomium falcatum* (Dryopteridaceae), *Cyrtomium* sp. (Dryopteridaceae), *Doryopteris pedata* (Adiantaceae), *Davallia* sp. (Davalliaceae), *Davallia trichomanoides* f. *barbata* (Davalliaceae), *Nephrolepis* sp. (Davalliaceae), *Nephrolepis exaltata* (Davalliaceae), *Pteridiurn aquilinum* (Dennstaedtiaceae), *Pteris ensiformis* (Pteridaceae)	Australia, China, New Zealand, United Kingdom, United States	Frankland (1976), Alfieri et al. (1984), Pennycook (1989), Farr et al. (2021)
134	*Botrytis* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
135	*Bourdotia kipukaensis*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
136	*Brunneochlamydosporium cibotii*	*Cibotium schiedei* (Dicksoniaceae)	Netherlands	Giraldo and Crous (2019)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
137	*Brunneochlamydosporium macroclavatum*	*Salvinia auriculata* (Salviniaceae)	India	Giraldo and Crous (2019)
138	*Bulbillomyces farinosus*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Kirk and Spooner (1984)
139	*Burenia athyrii*	*Athyrium filix-femina* (Woodsiaceae)	United Kingdom	Farr et al. (2021)
140	*Byssoloma subdiscordans*	*Polystichum* sp. (Dryopteridaceae)	China (Taiwan Province)	Kirschner et al. (2019)
141	*Caeoma superficialis*	*Blechnum* sp. (Blechnaceae), *Blechnum volubile* (Blechnaceae)	Brazil, Paraguay	Farr (1973), Mendes et al. (1998)
142	*Calidion cenicafeae*	*Polypodium adnatum* (Polypodiaceae)	Colombia	Salazar-Yepes and Buriticá Céspedes (2008)
143	*Calidion dumontii*	*Thelypteris* sp. (Thelypteridaceae)	Colombia	Buriticá (1978)
144	*Calidion lindsaeae*	*Lindsaea lancea* (Dennstaedtiaceae), *Lindsaea ulei* (Dennstaedtiaceae), *Polypodium brasiliense* (Polypodiaceae)	Brazil, Venezuela	Hennen et al. (1982), Chardón and Toro (1934), Farr et al. (2021)
145	*Calonectria hurae*	*Rumohra adiantiformis* (Dryopteridaceae)	Brazil, USA	Lombard et al. (2016a)
146	*Calonectria ilicicola*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Crous (2002)
147	*Calonectria indusiata*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Crous (2002)
148	*Calonectria kyotensis*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Crous (2002)
149	*Calonectria morganii*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Crous (2002)
150	*Calonectria pteridis*	*Arachniodes adiantiformis* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Nephrolepis exaltata* (Davalliaceae), *Nephrolepis* sp. (Davalliaceae), Rumohra *adiantiformis* (Dryopteridaceae)	Brazil, United States, West Indies	Stevenson (1945), Crous (2002), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
151	*Calonectria reteaudii*	*Asplenium* sp. (Aspleniaceae), *Davallia* sp. (Davalliaceae)	Australia, Solomon Islands	Crous (2002)
152	*Calonectria rumohrae*	*Adiantum* sp. (Adiantaceae), *Rumohra* adiantiformis (Dryopteridaceae)	Brazil, Netherlands, Panama	El-Gholl et al. (1997), Crous (2002), Lombard et al. (2016a)
153	*Calonectria spathulata*	*Pteridium* sp. (Dennstaedtiaceae)	Brazil	Crous (2002)
154	*Calophoma clematidina*	*Selaginella* sp. (Selaginellaceae)	Netherlands	Woudenberg et al. (2009)
155	*Calycellina osmundae*	*Osmunda* sp. (Osmundaceae)	United States	Lowen and Dumont (1984)
156	*Calycellina sadleriae*	*Sadleria* sp. (Blechnaceae)	United States	Lowen and Dumont (1984)
157	*Camarographium stephensii*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Pakistan, United Kingdom, Yugoslavia (Serbia and Montenegro)	Sutton (1980), Dennis (1986), Ahmad et al. (1997)
158	*Camarosporium pteridis*	*Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae)	United States	Greene (1964)
159	*Camposporium lycopodiellae*	*Lycopodiella inundata* (Lycopodiaceae)	Germany	Crous et al. (2018)
160	*Campylospora purvula*	Pteridophytes	India	Sati and Belwal (2005)
161	*Capnocybe fraserae*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	Hughes (1966)
162	*Capnofrasera dendryphioides*	*Hymenophyllum* sp. (Hymenophyllaceae)	New Zealand	Gadgil (2005)
163	*Capnophialophora fraserae*	Elaphoglossum sp. (Lomariopsidaceae)	West Indies	Minter et al. (2001)
164	*Capronia polyspora*	*Lycopodium selago* (Lycopodiaceae)	Norway	Holm and Holm (1994)
165	*Carrismyces proliferatus*	*Cyathea* sp. (Cyatheaceae)	Mexico	Castañeda Ruiz and Heredia (2000)
166	*Cashiella sticheri*	*Sticherus cunninghamii* (Gleicheniaceae)	New Zealand	Gadgil (2005)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
167	*Cephaloscypha mairei*	*Blechnum spicant* (Blechnaceae), *Polystichum lonchitis* (Dryopteridaceae)	Germany, United Kingdom (England and Scotland)	Schmid-Heckel (1988), Farr et al. (2021)
168	*Cephalosporium* sp.	*Alsophila australis* (Cyatheaceae)	United States	Alfieri et al. (1984)
169	*Cephalosporium* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
170	*Ceramothyrium linnaeae*	*Equisetum fluviatile* (Equisetaceae), *Lycopodium annotinum* (Lycopodiaceae)	Sweden	Eriksson (2014), Constantinescu et al. (1989)
171	*Ceramothyrium lycopodii*	*Lycopodium annotinum* (Lycopodiaceae)	Sweden	Constantinescu et al. (1989)
172	*Ceratobasidium cornigerum*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
173	*Ceratorhiza decidua*	*Adiantum pedatum* (Adiantaceae), *Adiantum* sp. (Adiantaceae), *Onoclea struthiopteris* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	United States	Greene (1950), Anonymous (1960)
174	*Ceratosporella ponapensis*	*Cyathea alsophila* (Cyatheaceae)	Micronesia	Matsushima (1981)
175	*Cercospora abacopteridis*	*Abacopteris urophylla* (Thelypteridaceae)	Singapore	Crous and Braun (2003)
176	*Cercospora adianticola*	*Adiantum venustum* (Adiantaceae)	India	Braun et al. (2013)
177	*Cercospora adiantigena*	*Adiantum philippense* (Adiantaceae), *Doryopteris ludens* (Adiantaceae)	Tanzania	Crous and Braun (2003)
178	*Cercospora angiopteridis*	*Angiopteris evecta* (Marattiaceae)	Indonesia	Boedijn (1961), Braun (2001)
179	*Cercospora apii*	*Adiantum venustum* (Adiantaceae), *Dryopteris polypodioides* (Dryopteridaceae), *Pleopeltis membranacea* (Polypodiaceae), *Polypodium punctatum* (Polypodiaceae)	China, Cuba, India	Crous and Braun (2003), Braun and Urtiaga (2013)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
180	*Cercospora arachniodis*	*Arachniodes* sp. (Dryopteridaceae)	China	Zhuang (2005)
181	*Cercospora athyrii*	*Athyrium esculentum* (Woodsiaceae), *Diplazium esculentum* (Woodsiaceae)	Philippines	Chupp (1954), Crous and Braun (2003), Braun et al. (2013)
182	*Cercospora camptosori*	*Asplenium radicans* (Aspleniaceae), *Camptosorus rhizophyllus* (Aspleniaceae), *Dryopteris* sp. (Dryopteridaceae)	United States	Chupp (1954), Braun et al. (2013), Anonymous (1960)
183	*Cercospora cheilanthis*	*Aleuritopteris farinosa* (Adiantaceae), *Cheilanthes farinosa* (Adiantaceae)	India	Chowdhry et al. (1983), Crous and Braun (2003), Braun et al. (2013)
184	*Cercospora christellae*	*Christella parasitica* (Thelypteridaceae)	Thailand	To-Anun et al. (2010)
185	*Cercospora coniogrammes*	*Coniogramme japonica* (Adiantaceae), *Hypolepis mitis* (Dennstaedtiaceae), *Macrothelypteris torresiana* (Thelypteridaceae)	Australia, Brazil	Groenewald et al. (2013), Guatimosim et al. (2016a)
186	*Cercospora cyclosori*	*Cyclosorus acuminatus* (Thelypteridaceae), *Cyclosorus* sp. (Thelypteridaceae), *Pteris biaurita* (Pteridaceae), *Pteris* sp. (Pteridaceae)	China (Taiwan Province), India, Thailand	Hsieh and Goh (1990), Kamal (2010), To-Anun et al. (2011), Kirschner et al. (2019), Sinha et al. (2022)
187	*Cercospora davalliae*	*Davallia tenuifolia* (Davalliaceae)	India	Sarbhoy et al. (1975)
188	*Cercospora dharwarensis*	*Lygodium flexuosum* (Schizaeaceae)	India	Crous and Braun (2003)
189	*Cercospora diplaziicola*	*Diplazium esculentum* (Woodsiaceae)	India, Laos, Thailand	Crous and Braun (2003), Braun et al. (2013)
190	*Cercospora dryopteridis*	*Dryopteris polypodioides* (Dryopteridaceae)	China	Braun et al. (2013)
191	*Cercospora filicum*	*Nephrodium* sp. (Dryopteridaceae), *Polypodium* sp. (Polypodiaceae)	Brazil	Crous and Braun (2003)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
192	*Cercospora lygodiicola*	*Lygodium japonicum* (Schizaeaceae)	India	Lall et al. (1964)
193	*Cercospora marsileae*	*Marsilea quadrifolia* (Marsileaceae)	India, Myanmar	Braun et al. (2013)
194	*Cercospora microsorii*	*Microsorum membranaceum* (Polypodiaceae)	India	Kumar (1981)
195	*Cercospora plagiogyriae*	*Plagiogyria euphlebia* (Plagiogyriaceae)	China (Taiwan Province)	Crous and Braun (2003), Kamal (2010)
196	*Cercospora platycerii*	*Platycerium bifurcatum* (Polypodiaceae), *Platycerium grande* (Polypodiaceae), *Platycerium* sp. (Polypodiaceae), *Platycerium wallichii* (Polypodiaceae)	Thailand, United States	To-Anun et al. (2011), Braun et al. (2013)
197	*Cercospora pleopeltidis*	*Microsorum membranaceum* (Polypodiaceae)	India	Braun et al. (2013)
198	*Cercospora pteridicola*	*Pteris aquilina* (Pteridaceae)	Spain	Braun et al. (2013)
199	*Cercospora pteridigena*	*Adiantum philippense* [*lunulatum*] (Adiantaceae), *Adiantum venustum* (Adiantaceae)	India	Braun et al. (2013)
200	*Cercospora samambaiae*	*Thelypteris dentata* (Thelypteridaceae)	Brazil	Guatimosim et al. (2016a)
201	*Cercospora selaginellarum*	*Selaginella apoda* (Selaginellaceae), *Selaginella denticulata* (Selaginellaceae), *Selaginella helvetica* (Selaginellaceae), *Selaginella kraussiana* (Selaginellaceae)	France, United States	Farr and Horner (1968), Braun et al. (2013)
202	*Cercospora* sp.	*Pityrogramma calomelanos* (Adiantaceae)	United States	Alfieri et al. (1984)
203	*Cercospora* sp.	*Asplenium* sp. (Aspleniaceae)	United States	Anonymous (1960)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
204	*Cercospora* sp.	*Asplenium bulbiferum* (Aspleniaceae)	United States	French (1989)
205	*Cercospora* sp.	*Phyllitis scolopendrium* (Aspleniaceae)	United States	French (1989)
206	*Cercospora* sp.	*Sadleria cyatheoides* (Blechnaceae)	United States	French (1989)
207	*Cercospora* sp.	*Cyathea delgadii* (Cyatheaceae)	Brazil	Guatimosim et al. (2016a)
208	*Cercospora* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Anonymous (1960)
209	*Cercospora* sp.	*Sphenomeris chusana* (Dennstaedtiaceae)	United States	Raabe et al. (1981)
210	*Cercospora* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	United States	French (1989)
211	*Cercospora* sp.	*Tectaria heracleifolia* (Dryopteridaceae)	United States	Alfieri et al. (1984)
212	*Cercospora* sp.	*Angiopteris longifolia* (Marattiaceae)	Cook Islands	Dingley et al. (1981)
213	*Cercospora* sp.	Alsophila sp. (Cyatheaceae)	United States	Alfieri et al. (1984)
214	*Cercospora* sp.	*Cyrtomium falcatum* (Dryopteridaceae)	United States	Alfieri et al. (1984), French (1989)
215	*Cercospora* sp.	*Marsilea minuta* (Marsileaceae)	India	Farr et al. (2021)
216	*Cercospora* sp.	*Platycerium grande* (Polypodiaceae)	United States	Raabe et al. (1981)
217	*Cercospora* sp.	*Polypodium phyllitidis* (Polypodiaceae)	United States	Alfieri et al. (1984)
218	*Cercospora* sp.	*Polypodium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
219	*Cercospora* sp.	*Polypodium* sp. (Polypodiaceae)	Mauritius	Orieux and Felix (1968)
220	*Cercospora* sp.	*Polypodium punctatum* (Polypodiaceae)	Cuba	Urtiaga (1986)
221	*Cercospora* sp.	*Polypodium punctatum f. cristatum* (Polypodiaceae)	Cuba	Urtiaga (1986)
222	*Cercospora* sp.	*Acrostichum aureum* (Pteridaceae)	United States	Alfieri et al. (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
223	*Cercospora* sp.	*Selaginella* sp. (Selaginellaceae)	United States	Alfieri et al. (1984)
224	*Cercospora* sp.	*Macrothelypteris torresiana* (Thelypteridaceae)	Brazil	Guatimosim et al. (2016a)
225	*Cercospora* sp.	*Thelypteris dentata* (Thelypteridaceae)	Brazil	Guatimosim et al. (2016a)
226	*Cercospora* sp.	*Lygodium volubile* (Schizaeaceae)	Brazil	Guatimosim et al. (2016a)
227	*Cercospora* sp.	*Pteris deflexa* (Pteridaceae)	Brazil	Guatimosim et al. (2016a)
228	*Cercospora trismeriae*	*Pityrogramma* sp. (Adiantaceae)	Ecuador	Braun et al. (2013)
229	*Cercosporella equiseti*	*Equisetum laevigatum* (Equisetaceae), *Equisetum ramosissimum* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	Hungary, Italy, Kazakhstan, United States, Uzbekistan	Greene (1944), Braun (1995), Anonymous (1960)
230	*Cercosporella filicis-feminae*	*Athyrium filix-femina* (Woodsiaceae), *Onoclea struthiopteris* [*Struthiopteris germanica*] (Woodsiaceae)	Caucasus, Faeroe Islands, Germany, Latvia, Poland, Romania, United Kingdom	Braun (1988), Braun (1995), Mułenko et al. (2008)
231	*Cercosporella* sp.	*Woodwardia* sp. (Blechnaceae)	United States	French (1989)
232	*Cercosporella struthiopteridis*	*Onoclea struthiopteris* [*Struthiopteris germanica*] (Woodsiaceae)	Latvia	Braun (1993)
233	*Cetraspora armeniaca*	*Lycopodium* sp. (Lycopodiaceae)	Poland	Mułenko et al. (2008)
234	*Ceuthospora lycopodii*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae), *Lycopodium complanatum* (Lycopodiaceae), *Lycopodium obscurum* (Lycopodiaceae)	Denmark, United States	Nag Raj (1993), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
235	*Ceuthospora* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
236	*Chaetasbolisia falcata*	*Polystichum munitum* (Dryopteridaceae), *Polystichum* sp. (Dryopteridaceae), *Woodwardia radicans* (Blechnaceae)	United States	Miller and Bonar (1941), French (1989)
237	*Chaetomastia equiseti*	*Equisetum hyemale* (Equisetaceae)	United States	Barr (1989)
238	*Chaetospermum camelliae*	*Adiantum tenerum* (Adiantaceae)	Cuba	Nag Raj (1993)
239	*Chaetothyriopsis adianti*	*Adiantum tetraphyllum* f. acuminata (Adiantaceae)	Venezuela	Sydow (1930)
240	*Chaetothyrium javanicum*	*Blechnum orientale* (Blechnaceae)	China (Taiwan Province)	Anonymous (1979), Farr et al. (2021)
241	*Chalara cibotii*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Raabe et al. (1981)
242	*Chalara crassipes*	*Pteridium aquilinum* (Dennstaedtiaceae)	Germany	Guatimosim et al. (2016b)
243	*Chalara microspora*	*Microlepia marginata* (Dennstaedtiaceae)	China	Guo (1992)
244	*Chalara parvispora*	*Cyathea medullaris* (Cyatheaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	England, New Zealand	Nag Raj and Hughes (1974), Kirk (1983)
245	*Chalara phaeospora*	*Cyathea* sp. (Cyatheaceae)	Kenya	Kirk (1985)
246	*Chalara pteridina*	*Pteridium aquilinum* (Dennstaedtiaceae)	Australia, Austria, Germany, Poland, United Kingdom (Scotland)	Ellis (1971), Nag Raj and Kendrick (1975), Kirk and Spooner (1984), Mułenko et al. (2008)
247	*Chalara selaginellae*	*Selaginella arenicola* (Selaginellaceae), *Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae), *Selaginella rupestris* (Selaginellaceae)	United States	Farr and Horner (1968), Nag Raj and Kendrick (1975)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
248	*Chloridium atanagildae*	*Nephelea woodwardioides* (Cyatheaceae)	Cuba	Delgado-Rodriguez and Mena-Portales (2004)
249	*Chloridium* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
250	*Chlorociboria pteridicola*	*Dryopteris filix-mas* (Dryopteridaceae)	France	Dougoud and Ayel (2003)
251	*Chromosporium* sp.	*Cryptogramma acrostichoides* (Adiantaceae)	United States	Cooke (1955)
252	*Cilioplea nivalis*	*Selaginella asprella* (Selaginellaceae), *Selaginella bigelovii* (Selaginellaceae), *Selaginella densa* var. *scopulorum* (Selaginellaceae), *Selaginella watsonii* (Selaginellaceae)	United States	Farr and Horner (1968), Farr et al. (2021)
253	*Cistella crassipila*	*Pteridium* sp. (Dennstaedtiaceae)	United Kingdom	Cannon et al. (1985)
254	*Cistella hymenophylli*	*Hymenophyllum wilsonii* (Hymenophyllaceae)	United Kingdom (Scotland)	Spooner and Dennis (1985)
255	*Cistella minuta*	*Pteris cretica* (Pteridaceae)	India	Lowen and Dumont (1984)
256	*Cistella spicicola*	*Diphasiastrum complanatum* (Lycopodiaceae)	Finland	Bogale et al. (2010)
257	*Cladosporiella foliicola*	*Blechnum occidentale* (Blechnaceae)	Cuba	Braun et al. (2013)
258	*Cladosporium adianticola*	*Adiantum* sp. (Adiantaceae), *Adiantum tenerum* (Adiantaceae)	Cuba, West Indies	Castañeda (1987), Minter et al. (2001), Crous et al. (2006c)
259	*Cladosporium cyrtomii*	*Cyrtomium caryotideum* (Dryopteridaceae)	China	Zhang et al. (2003), Dugan et al. (2004)
260	*Cladosporium equiseti*	*Equisetum ramosum* (Equisetaceae)	Italy	Dugan et al. (2004)
261	*Cladosporium grumosum*	*Pteridium latiusculum* (Dennstaedtiaceae)	United States	Mix (1954b)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
262	*Cladosporium herbarum*	*Cystopteris fragilis* (Woodsiaceae), *Equisetum arvense* (Equisetaceae), *Pteridiurn aquilinum* (Dennstaedtiaceae)	Greenland, United Kingdom, United States	Conners (1967), Gilman and Archer (1929), Frankland (1976), Dugan et al. (2004) Farr et al. (2021)
263	*Cladosporium insectorum*	*Asplenium lineatum* (Aspleniaceae)	Spain	Dugan et al. (2004)
264	*Cladosporium macrocarpum*	*Equisetum ramosum* (Equisetaceae)	Italy	Bensch et al. (2012)
265	*Cladosporium neocheiropteridis*	*Neocheiropteris palmatopedata* (Polypodiaceae)	China	Liu et al. (2000)
266	*Cladosporium neottopteridis*	*Neottopteris nidus* (Aspleniaceae)	China	Liu et al. (2000)
267	*Cladosporium pseudocladosporioides*	*Pteridium aquilinum* (Dennstaedtiaceae)	Romania	Bensch et al. (2012)
268	*Cladosporium* sp.	*Adiantum tetraphyllum* (Adiantaceae)	Venezuela	Urtiaga (2004)
269	*Cladosporium* sp.	*Equisetum* sp. (Equisetaceae)	United States	Shaw (1973)
270	*Cladosporium* sp.	*Equisetum hyemale* (Equisetaceae)	Korea	Cho and Shin (2004)
271	*Cladosporium* sp.	*Equisetum pratense* (Equisetaceae)	Poland	Ruszkiewicz-Michalska et al. (2012)
272	*Cladosporium* sp.	*Osmunda regalis* (Osmundaceae)	Poland	Mułenko et al. (2008)
273	*Cladosporium* sp.	*Aglaomorpha meyeniana* (Polypodiaceae)	United States	Alfieri et al. (1984)
274	*Cladosporium* sp.	*Polypodium punctatum f. cristatum* (Polypodiaceae)	Cuba	Urtiaga (1986)
275	*Cladosporium* sp.	*Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae)	United States	Farr and Horner (1968)
276	*Cladosporium* sp.	*Gleichenia linearis* (Gleicheniaceae)	India	Kumaresan et al. (2013)
277	*Cladosporium* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
278	*Cladosporium tenuissimum*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
279	*Clasterosporium polypodii*	*Polypodium nanum* (Polypodiaceae)	Venezuela	Dennis (1970)
280	*Clathrospora diplospora*	*Equisetum arvense* (Equisetaceae)	Poland	Adamska (2001)
281	*Clavariopsis aquatica*	Pteridophytes	India	Sati and Belwal (2005)
282	*Clitopilus conchatus*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	McKenzie et al. (1992)
283	*Clitopilus fuligineus*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	McKenzie et al. (1992)
284	*Clonostachys candelabrum*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Kirk (1983)
285	*Clonostachys rosea*	*Psilotum nudum* (Psilotaceae), *Pteridiurn aquilinum* (Dennstaedtiaceae), *Sphaeropteris lepifera* (Cyatheaceae)	Canada, China (Taiwan), United Kingdom, United States	Frankland (1976), Ginns (1986), Kirschner et al. (2019), Farr et al. (2021)
286	*Clypeolina notogrammes*	*Coniogramme japonica* (Adiantaceae)	China	Tai (1979)
287	*Clypeolum hymenophylli*	*Hymenophyllum* sp. (Hymenophyllaceae)	Indonesia	Batista (1959)
288	*Clypeosphaerella sticheri*	*Sticherus bifidus* (Gleicheniaceae)	Brazil	Guatimosim et al. (2016a)
289	*Coccodiella polymorpha*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium menziesii* (Dicksoniaceae), *Cibotium* sp. (Dicksoniaceae), *Dicksonia* sp. (Dicksoniaceae)	United States	Anonymous (1960), Mardones et al. (2018)
290	*Coccomyces crystalligerus*	*Blechnum discolor* (Blechnaceae)	New Zealand	Johnston (1994)
291	*Coccomyces dentatus*	*Pteridium* sp. (Dennstaedtiaceae)	Brazil	Farr (1973)
292	*Coccostroma nudum*	*Cibotium chamissoi* (Dicksoniaceae), *Dicksonia* sp. (Dicksoniaceae)	South America, United States	von Arx (1954), Mardones et al. (2018)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
293	*Coenogonium botryosum*	*Adiantum* andicola (Adiantaceae), *Grammitis* sp. (Grammitidaceae)	Mexico	Medel-Ortiz et al. (2020)
294	*Colletotrichum falcatum*	*Selaginella* sp (Selaginellaceae)	India	Kumaresan et al. (2013)
295	*Colletotrichum acutatum*	*Rumohra adiantiformis* (Dryopteridaceae)	United States, West Indies	Minter et al. (2001), Guerber et al. (2003)
296	*Colletotrichum fructicola*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
297	*Colletotrichum gigasporum*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
298	*Colletotrichum gloeosporioides*	*Adiantum tenerum* (Adiantaceae), *Blechnum occidentale* (Blechnaceae), *Lygodium microphyllum* (Schizaeaceae), *Lygodium japonicum* (Schizaeaceae), *Nephrolepis exaltata* (Davalliaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Polypodium punctatum* (Polypodiaceae), *Polypodium* sp. (Polypodiaceae), *Rumohra adiantiformis* (Dryopteridaceae), *Tectaria heracleifolia* (Dryopteridaceae), *Thelypteris poiteana* (Thelypteridaceae)	Australia, Barbados, China, Cuba, Mauritius, Republic of Korea, United States, West Indies	Norse (1974), French (1989), Minter et al. (2001), Farr et al. (2021)
299	*Colletotrichum guizhouensis*	*Phlegmariurus phlegmaria* (Lycopodiaceae)	China	Jayawardena et al. (2016)
300	*Colletotrichum orchidearum*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
301	*Colletotrichum pandanicola*	*Cyclosorus* sp (Thelypteridaceae), *Nephrolepis cordifolia* (Davalliaceae), *Pteris ensiformis* (Pteridaceae)	Thailand	Seifollahi et al. (2023)
302	*Colletotrichum plurivorum*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)
303	*Colletotrichum polypodialium*	*Nephrolepis* sp. (Davalliaceae), *Phymatosorus* sp. (Polypodiaceae)	Thailand	Seifollahi et al. (2023)
304	*Colletotrichum* sp.	*Asplenium nidus* (Aspleniaceae)	United States	Alfieri et al. (1984)
305	*Colletotrichum* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Urtiaga (2004)
306	*Colletotrichum* sp.	*Dryopteris* sp. (Dryopteridaceae)	United States	Alfieri et al. (1984)
307	*Colletotrichum* sp.	*Platycerium* bifurcatum (Polypodiaceae)	United States	Alfieri et al. (1984)
308	*Colletotrichum* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
309	*Colletotrichum* sp.	*Polypodium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
310	*Colletotrichum* sp.	*Polypodium punctatum* (Polypodiaceae)	Cuba	Urtiaga (1986)
311	*Colletotrichum* sp.	*Polypodium punctatum f. cristatum* (Polypodiaceae)	Cuba	Urtiaga (1986)
312	*Colletotrichum* sp.	*Adiantum* sp. (Adiantaceae), *Gleichenia linearis* (Gleicheniaceae), *Lygodium flexuosum* (Schizaeaceae), *Pteris* sp. (Pteridaceae), *Selaginella* sp. (Selaginellaceae)	India	Kumaresan et al. (2013)
313	*Colletotrichum* sp.	*Lygodium flexuosum* (Schizaeaceae), *Pteris* sp. (Pteridaceae), *Selaginella* sp. (Selaginellaceae)	India	Kumaresan et al. (2013)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
314	*Colletotrichum truncatum*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)
315	*Collybia dorotheae*	*Cyathea* sp. (Cyatheaceae)	West Indies	Minter et al. (2001)
316	*Comatricha pulchella*	*Dryopteris filix-mas* (Dryopteridaceae)	Germany	Schmid-Heckel (1988)
317	*Comoclathris platysporioides*	*Selaginella hansenii* (Selaginellaceae), *Selaginella lepidophylla* (Selaginellaceae), *Selaginella mutica* (Selaginellaceae), *Selaginella mutica* var. *limitanea* (Selaginellaceae), *Selaginella oregana* (Selaginellaceae), *Selaginella pilifera* var. *pringlei* (Selaginellaceae), *Selaginella rupestris* (Selaginellaceae), *Selaginella underwoodii* (Selaginellaceae), *Selaginella utahensis* (Selaginellaceae), *Selaginella viridissima* (Selaginellaceae), *Selaginella weatherbiana* (Selaginellaceae), *Selaginella wrightii* (Selaginellaceae)	United States	Farr and Horner (1968), Anon (1972)
318	*Completoria complens*	*Asplenium* sp. (Aspleniaceae), *Cyrtomium falcatum* (Dryopteridaceae), *Pteris argyria* (Pteridaceae), *Pteris cretica* (Pteridaceae), *Pteris* sp. (Pteridaceae)	United Kingdom, United States	Anonymous (1960), Dennis (1986)
319	*Coniochaeta saccardoi*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	United Kingdom (Scotland)	Kirk and Spooner (1984), Cannon et al. (1985)
320	*Coniothyrium equiseti*	*Equisetum marinum* (Equisetaceae)	United Kingdom (Scotland)	Kirk and Spooner (1984)
321	*Coniothyrium fuckelii*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
322	*Coniothyrium rupestris*	*Selaginella rupestris* (Selaginellaceae)	United States	Farr and Horner (1968)
323	*Coniothyrium* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Urtiaga (2004)
324	*Conoplea geniculata*	*Lycopodium* sp. (Lycopodiaceae)	Canada	Ginns (1986)
325	*Coprotus trichosuri*	*Lophosoria vulpecula* (Dicksoniaceae)	New Zealand	McKenzie et al. (1992)
326	*Cordyceps farinosa*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
327	*Coronicium thymicola*	*Angiopteris* evecta (Marattiaceae), *Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997), Gilbertson et al. (2002)
328	*Corticirama berchtesgadensis*	*Athyrium distentifolium* (Woodsiaceae)	Germany	Schmid-Heckel (1988)
329	*Corticium confine*	*Dryopteris filix-mas* (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
330	*Corticium pteridophilum*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	McKenzie et al. (1992)
331	*Corynelia pteridicola*	*Campyloneurum phyllitidis* (Polypodiaceae), *Campyloneurum* sp. (Polypodiaceae)	Dominican Republic, Puerto Rico (USA)	Stevens (1917), Ciferri (1929)
332	*Corynespora cassiicola*	*Arachniodes aristata* (Davalliaceae), *Athyrium niponicum* (Dryopteridaceae), *Adiantum cuneatum* (Adiantaceae), *Adiantum tenerum* (Adiantaceae), *Davallia repens* (Davalliaceae),*Platycerium* spp. (Pteridaceae)	United States	Alfieri et al. (1984), Smith (2008)
333	*Corynespora* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Alfieri et al. (1984)
334	*Cribraria* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
335	*Cristinia gallica*	*Athyrium* sp. (Woodsiaceae)	Norway	Ryvarden et al. (2003)
336	*Cristinia mucida*	*Athyrium filix-femina* (Woodsiaceae)	Norway	Hjortstam and Larsson (1997)
337	*Crocicreas blechni*	*Blechnum punctulatum* (Blechnaceae)	South Africa	Raitviir and Schneller (2007)
338	*Crocicreas quinqueseptatum*	*Alsophila firma* (Cyatheaceae), *Cyathea bicrenata* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)
339	*Crocicreas sessilis*	*Cyathea divergens* var. *tuerckheimii* (Cyatheaceae)	Mexico	Samuels and Rogerson (1990)
340	*Crucellisporium selaginellae*	*Selaginella rupestris* (Selaginellaceae)	United States	Farr and Horner (1968)
341	*Crucibulum laeve*	*Pteridium aquilinum* (Dennstaedtiaceae)	Greece	Zervakis et al. (1998)
342	*Cryptodiscus andersonii*	*Pteris aquilina* (Pteridaceae)	United States	Cash (1952)
343	*Cryptodiscus anguillosporus*	*Lycopodium complanatum* (Lycopodiaceae)	Sweden	Eriksson (2014)
344	*Cryptomycella pteridis*	*Dryopteris cristata* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada, Poland, Russia, United States	Ginns (1986), Gasich et al. (1999), Mułenko et al. (2008)
345	*Cryptomycella* sp.	*Phymatosorus scolopendria* (Polypodiaceae)	Tonga	Dingley et al. (1981)
346	*Cryptomycella* sp.	*Phymatosorus* scolopendria (Polypodiaceae)	Niue	Dingley et al. (1981)
347	*Cryptomycina filicina*	*Osmunda cinnamomea* (Osmundaceae), *Osmunda regalis* (Osmundaceae), *Osmunda* sp. (Osmundaceae)	France, Sweden, United States	Fries (1815), Anonymous (1960), Goos (2010), Eriksson (2014)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
348	*Cryptomycina pteridis*	*Dryopteris marginalis* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *lanuginosum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pseudocaudatum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae), *Pteridium latiusculum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada, England, Germany, Russia, Sweden, United States	Stevenson (1945), Cooke (1949), Jorstad (1953), Anonymous (1960), Dennis (1978), Alfieri et al. (1984); Ginns (1986), French (1989), Eriksson (2014), Rudolph et al. (2018), Farr et al. (2021)
349	*Cryptostictis dryopteris*	*Dryopteris* sp. (Dryopteridaceae)	South Africa	Nag Raj (1993)
350	*Curvularia crepinii*	*Ophioglossum vulgatum* (Ophioglossaceae)	Poland, United States	Ellett (1989), Nag Raj (1993)
351	*Curvularia lunata*	*Pteris grandifolia* (Pteridaceae)	Thailand	Seifollahi et al. (2023)
352	*Curvularia* sp.	*Davallia trichomanoides* (Davalliaceae)	United States	Alfieri et al. (1984)
353	*Cyanodermella candida*	*Alsophila punctulata* (Cyatheaceae)	Mexico	Setchell (1924)
354	*Cyathicula cyathoidea*	*Athyrium distentifolium* (Woodsiaceae), *Equisetum variegatum* (Equisetaceae), *Lycopodium clavatum* (Lycopodiaceae), *Osmunda* sp. (Osmundaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae), *Pteris* aquilina (Pteridaceae)	England, France, Germany, Sweden, United States	Schmid-Heckel (1988), Eriksson (2014), Farr et al. (2021)
355	*Cyathicula* sp.	*Cyathea bicrenata* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
356	*Cyathicula urniformis*	*Dicksonia antarctica* (Dicksoniaceae)	Australia	Medel-Ortiz et al. (2020))
357	*Cyathicula alpina*	*Equisetum* sp. (Equisetaceae)	United States	Kanouse (1947)
358	*Cylindrocarpon ianthothele*	*Equisetum* sp. (Equisetaceae)	England	Booth (1966)
359	*Cylindrocarpon* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
360	*Cylindrocarpon* sp. *(C. ditissima group)*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
361	*Cylindrocephalum zhejiangense*	Fern	China (Zhejiang Province)	Wu and Diao (2023)
362	*Cylindrocladium clavatum*	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
363	*Cylindrocladium heptaseptatum*	Polystichum *adiantiforme* (Dryopteridaceae), *Rumohra adiantiformis* (Dryopteridaceae)	Brazil, United States	Alfieri et al. (1984), Mendes et al. (1998)
364	*Cylindrocladium* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
365	*Cylindrosporium aquilinum*	*Pteris aquilina* (Pteridaceae)	United States	Gilman and Archer (1929)
366	*Cylindrosporium* sp.	*Osmunda regalis* (Osmundaceae)	United States	Alfieri et al. (1984)
367	*Cyphella calostoma*	*Platycerium alcicorne* (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae)	Czech Republic (Czechoslovakia)	Pilát (1927), Batista and Ciferri (1962)
368	*Cyphella cyatheae*	*Cyathea spinulosa* (Cyatheaceae)	Japan	Kobayashi (2007)
369	*Cyphellophora filicis*	Fern	Thailand	Phookamsak et al. (2019)
370	*Cytospora* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
371	*Dactylaria* sp.	*Adiantum tenerum* (Adiantaceae)	West Indies	Minter et al. (2001)
372	*Dactylonectria ecuadorensis*	*Cyathea lasiosora* (Cyatheaceae)	Ecuador	Gordillo and Decock (2017)
373	*Dactylonectria polyphaga*	*Asplenium* sp. (Aspleniaceae)	Ecuador	Gordillo and Decock (2017)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
374	*Dangeardiella fusiformis*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae)	Sweden, United Kingdom (Scotland)	Kirk and Spooner (1984), Cannon et al. (1985), Eriksson (1992, 2014)
375	*Dangeardiella macrospora*	*Athyrium alpestre* (Woodsiaceae), *Athyrium distentifolium* (Woodsiaceae), *Athyrium filix-femina* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae)	Germany, Norway, Poland, Sweden	Schmid-Heckel (1988), Mułenko et al. (2008), Eriksson (1992, 2014), Thambugala et al. (2014)
376	*Dasyscyphella dryina*	*Alsophila firma* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)
377	*Dasyscyphus crassipes*	*Pteridium* sp. (Dennstaedtiaceae)	United Kingdom	Cannon et al. (1985)
378	*Dasyscyphus cyatheae*	*Cyathea caudata* (Cyatheaceae)	Philippines	Teodoro (1937)
379	*Dasyscyphus gleicheniae*	*Cibotium* sp. (Dicksoniaceae)	United States	Raabe et al. (1981)
380	*Dasyscyphus javanicus*	*Cibotium menziesii* (Dicksoniaceae)	United States	Raabe et al. (1981)
381	*Dasyscyphus merrillii*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
382	*Dasyscyphus pteridialis*	*Pteridium* sp. (Dennstaedtiaceae), *Pteris aquilina* (Pteridaceae)	United Kingdom	Graddon (1977)
383	*Deconica phyllogena*	*Athyrium distentifolium* (Woodsiaceae)	Germany	Schmid-Heckel (1988)
384	*Deigloria paraguayensis*	*Blechnum occidentale* (Blechnaceae)	Argentina, Paraguay	Farr et al. (2021)
385	*Dematioscypha dematiicola*	*Pteridiurn* aquilinum (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
386	*Dennisiella ekmanii*	*Dryopteris* sp. (Dryopteridaceae)	Brazil	Farr et al. (2021)
387	*Desarmillaria tabescens*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Alfieri et al. (1984), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
388	*Desmella aneimiae*	*Adiantum cristatum* (Adiantaceae), *Adiantum latifolium* (Adiantaceae), *Adiantum pedatum* (Adiantaceae), *Anemia hirsuta* (Schizaeaceae), *Anemia phyllitidis* (Schizaeaceae), *Anemia* sp. (Schizaeaceae), *Anemia tomentosa* (Schizaeaceae), *Anemia tomentosa* var. *fulva* (Schizaeaceae), *Athyrium lilloi* (Woodsiaceae), *Blechnum* sp. (Blechnaceae), *Cyathea surinamensis* (Cyatheaceae), Cyclosorus *dentatus* (Thelypteridaceae), *Cyclopeltis semicordata* (Lomariopsidaceae), Dennstaedtia *cicutaria* (Dennstaedtiaceae), *Dennstaedtia rubiginosa* (Dennstaedtiaceae), *Goniophlebium percussum* (Polypodiaceae), *Gymnogramma* sp. (Adiantaceae), *Hypolepis nuda* (Dennstaedtiaceae), *Hypolepis repens* (Dennstaedtiaceae), *Lomariopsis japurensis* (Lomariopsidaceae), *Nephrolepis biserrata* (Davalliaceae), *Nephrolepis exaltata* (Davalliaceae), *Nephrolepis hirsutula* (Davalliaceae), *Nephrolepis obliterata* (Davalliaceae), *Nephrolepis rivularis*	Australia, Argentina, Brazil, China, Colombia, Costa Rica, France, Guiana, Guyana, Jamaica, Mexico, Panama, United States, Venezuela, West Indies	Sydow (1919), Ono (2020), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		(Davalliaceae), *Nephrolepis* sp. (Davalliaceae), , *Pityrogramma calomelanos* (Adiantaceae), *Pityrogramma trifoliata* (Adiantaceae), *Polybotrya* osmundacea (Dryopteridaceae), *Polypodium* sp. (Polypodiaceae), *Pteris* deflexa (Pteridaceae), *Pteris* sp. (Pteridaceae), *Pteris podophylla* (Pteridaceae), *Thelypteris abrupta* (Thelypteridaceae), *Thelypteris hispidula* (Thelypteridaceae), *Thelypteris* opulenta (Thelypteridaceae), *Thelypteris poiteana* (Thelypteridaceae), *Thelypteris quadrangularis* (Thelypteridaceae), *Thelypteris rudis* (Thelypteridaceae), *Thelypteris* sp. (Thelypteridaceae), *Triplophyllum dicksonioides* (Dryopteridaceae)		
389	*Desmella gymnogrammes*	*Adiantum latifolium* (Adiantaceae), *Ceropteris calomelanos* (Adiantaceae), *Cyclopeltis semicordata* (Lomariopsidaceae), *Pityrogramma calomelanos* (Adiantaceae)	Cuba, Puerto Rico, Trinidad-Tobago, Venezuela, West Indies	Arthur (1917), Sydow (1919), Arthur (1922), Chardón and Toro (1934), Dennis (1970), Minter et al. (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
390	*Desmella lygodii*	*Lygodium flexuosum* (Schizaeaceae), *Lygodium japonicum* (Schizaeaceae), *Lygodium microphyllum* (Schizaeaceae), *Lygodium* polymorphum (Schizaeaceae), *Lygodium* sp. (Schizaeaceae), *Lygodium venustum* (Schizaeaceae), *Lygodium volubile* (Schizaeaceae)	Brazil, Colombia, El Salvador, French, Guyana, Haiti, Jamaica, Mexico, Trinidad-Tobago, United States, Venezuela	Hennen and McCain (1993), Berndt (2013), Ono et al. (2020), Okane et al. (2021)
391	*Desmella mbatobiensis*	Gymnogramma sp. (Adiantaceae), *Blechnum* sp. (Blechnaceae), *Blechnum volubile* (Blechnaceae), *Nephrolepis pendula* (Davalliaceae), *Pteris* sp.	Brazil, Colombia, Paraguay	Sydow (1919), Farr (1973), Hennen et al. (2005), Farr et al. (2021)
392	*Desmella superficialis*	*Adiantum cristatum* (Adiantaceae), *Adiantum latifolium* (Adiantaceae), *Adiantum pedatum* (Adiantaceae), *Anemia hirsuta* (Schizaeaceae), *Blechnum occidentale* (Blechnaceae), *Cyclopeltis semicordata* (Lomariopsidaceae), *Dennstaedtia ordinata* (Dennstaedtiaceae), *Dennstaedtia rubiginosa* (Dennstaedtiaceae), *Dryopteris dentata* (Dryopteridaceae), *Dryopteris lilloi* (Dryopteridaceae), *Dryopteris poiteana* (Dryopteridaceae), *Dryopteris subtetragona* (Dryopteridaceae),	Argentina, Dominican Republic, Ecuador, Jamaica, Puerto Rico, Trinidad-Tobago, United States, Venezuela, Virgin Islands	Sydow (1919), Stevenson (1975), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		Dryopteris tetragona var. *guadalupensis* (*Dryopteridaceae*), *Goniopteris guadalupensis* (Thelypteridaceae), *Hemitelia obscura* (Cyatheaceae), *Hypolepis repens* (Dennstaedtiaceae), *Nephrolepis exaltata* (Davalliaceae), *Orthiopteris domingensis* (Dennstaedtiaceae), *Pityrogramma calomelanos* (Adiantaceae), Tectaria *martinicensis* (Dryopteridaceae), *Thelypteris patens* (Thelypteridaceae), *Thelypteris tetragona* (Thelypteridaceae)		
393	*Diaporthe chiangraiensis*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
394	*Diaporthe delonicis*	*Pteris grandifolia* (Pteridaceae)	Thailand	Seifollahi et al. (2023)
395	*Diaporthe heveae*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
396	*Diaporthe tectonendophytica*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
397	*Diaporthopsis pantherina*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom ((England)	Fu et al. (2013)
398	*Dichotomopilus erectus*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
399	*Dictyocheirospora heptaspora*	*Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province)	Kirschner et al. (2019)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
400	*Diderma radiatum*	*Alsophila firma* (Cyatheaceae), *Cibotium* sp. (Dicksoniaceae), *Cyathea bicrenata* (Cyatheaceae), *Cyathea dealbata* (Cyatheaceae), *Dicksonia squarrosa* (Dicksoniaceae), *Polypodium* sp. (Polypodiaceae), *Sadleria* sp. (Blechnaceae) *Sphaeropteris horrida* (Cyatheaceae)	New Zealand, United States, United Kingdom	Raabe et al. (1981), Farr et al. (2021)
401	*Didymella hyphenis*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	United Kingdom (Scotland)	Foister (1961), Cannon et al. (1985)
402	*Didymella lophospora*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae), *Pteris aquilina* (Pteridaceae)	Bulgaria, Greece, Italy, United Kingdom	Farr (1973), Pantidou (1973), Saccardo (1978), Cannon et al. (1985), Fakirova (2004)
403	*Didymella prominula*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (*Dennstaedtiaceae*), *Pteris aquilina* (Pteridaceae)	Austria, Denmark, France, Germany, Italy, United Kingdom	Munk (1957), Pirozynski and Morgan-Jones (1968), Cannon et al. (1985), Schmid-Heckel (1988)
404	*Didymella pteridis*	*Pteris* sp. (Pteridaceae)	Netherlands	Chen et al. (2017)
405	*Didymella* sp.	*Pteris* sp. (Pteridaceae)	Netherlands	Chen et al. (2015)
406	*Didymella* sp.	*Equisetum sylvaticum* (Equisetaceae)	Sweden	Eriksson (1992)
407	*Didymosphaeria equiseti-hiemalis*	*Equisetum hyemale* (Equisetaceae)	Denmark, Sweden	Holm and Holm (1981), Eriksson (1992)
408	*Didymosphaeria futilis*	*Equisetum hyemale* (Equisetaceae)	Sweden	Eriksson (2014)
409	*Dimeriella polypodii*	*Polypodium montigenum* (Polypodiaceae), *Polypodium madrense* (Polypodiaceae)	Mexico	Samuels and Rogerson (1990)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
410	*Dimerosporium adianti-curvati*	*Adiantum curvatum* (Adiantaceae)	Brazil	Rehm (1907)
411	*Diplodia* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Urtiaga (2004)
412	*Diplodina equiseti*	*Equisetum limosum* (Equisetaceae), *Equisetum palustre* (Equisetaceae)	Germany, India	Sydow and Sydow (1905), Mathur (1979)
413	*Diplodina* sp.	*Adiantum latifolium* (Adiantaceae)	Cuba	Urtiaga (1986)
414	*Diplodina* sp.	*Adiantum latifolium* (Adiantaceae)	West Indies	Minter et al. (2001)
415	*Dischloridium laeense*	*Alsophila spinulosa* (Cyatheaceae), *Cyathea arborea* (Cyatheaceae), *Dicksonia antarctica* (Dicksoniaceae)	China (Taiwan Province), Cuba, United Kingdom (England)	Kirk (1986), Matsushima (1987), Delgado-Rodriguez and Mena-Portales (2004)
416	*Discosia artocreas*	*Gymnocarpium dryopteris* (Woodsiaceae)	Poland	Wołczańska et al. (2004)
417	*Discosia artocreas f. pteridis-aquilinae*	*Pteridium aquilinum* (Dennstaedtiaceae)	Italy	Saccardo (1878), Index Fungorum)
418	*Dothidasteroma dipteridis*	*Dipteris conjugata* (Dipteridaceae)	Philippines	Teodoro (1937)
419	*Dothidea flabella*	*Pteris* sp. (Pteridaceae)	United States	Cooke (1878)
420	*Dothidella basirufa*	*Asplenium dentatum* (Aspleniaceae)	Dominican Republic, Haiti	Ciferri (1961), Benjamin and Slot (1969)
421	*Dothidella portoricensis*	*Dicranopteris flexuosa* (Gleicheniaceae), *Gleichenia* sp. (Gleicheniaceae)	Colombia, Puerto Rico	Stevens (1920), Dennis (1970)
422	*Drechslera salviniae*	*Salvinia auriculata* (Salviniaceae)	Brazil	Alcorn (1991)
423	*Drechslera sp.*	*Adiantum* sp. (Adiantaceae)	India	Kumaresan et al. (2013)
424	*Durella macrospora*	*Sticherus palmatus* (Gleicheniaceae)	Mexico	Medel-Ortiz et al. (2020)
425	*Echidnodella africana*	*Dryopteris inaequalis* (Dryopteridaceae)	South Africa	Inácio and Cannon (2003)
426	*Echidnodella marattiae*	*Marattia* sp. (Marattiaceae)	Indonesia	Goos (1999)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
427	*Echidnodella nephrodii*	*Nephrodium heterophylla* (Dryopteridaceae)	Indonesia	Goos (1999)
428	*Echidnodes africana*	*Dryopteris inaequalis* (Dryopteridaceae)	South Africa	Doidge (1950)
429	*Echidnodes hypolepidis*	*Hypolepis sparsisora* (Dennstaedtiaceae)	South Africa	Goos (1999)
430	*Echidnodes sp.*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
431	*Echinosphaeria pteridis*	*Pteris vittata* (Pteridaceae)	India	Dhargalkar and Bhat (2009)
432	*Endoconospora sp.*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
433	*Endoperplexa enodulosa*	*Dryopteris* sp. (Dryopteridaceae), *Pteridium* sp. (Dennstaedtiaceae)	Belgium, England	Roberts (1999)
434	*Endophragmiella taxi*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
435	*Entoloma distinguens*	*Dicksonia fibrosa* (Dicksoniaceae)	New Zealand	McKenzie et al. (1992)
436	*Entoloma undatum*	*Pteridium aquilinum* (Dennstaedtiaceae)	Greece	Pantidou (1973)
437	*Entorrhiza isoetis*	*Isoetes lacustris* (Isoetaceae)	Denmark, USSR	Gutner (1941), Zundel (1953)
438	*Entomortierella jenkinii*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
439	*Entomortierella parvispora*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
440	*Entyloma nephrolepidis*	*Nephrolepis biserrata* (Davalliaceae)	Indonesia	Zundel (1953)
441	*Entyloma oleandrae*	*Oleandra articulata* (Oleandraceae)	South Africa	Zundel (1953)
442	*Entyloma sp.*	*Marsilea vestita* (Marsileaceae)	United States	Shaw (1973)
443	*Epicoccum nigrum*	*Equisetum hyemale* var. *robustum* (Equisetaceae), *Lycopodium obscurum* var. *dendroideum* (Lycopodiaceae), *Pteridiurn aquilinum* (Dennstaedtiaceae)	Canada, United Kingdom, United States	Frankland (1976), French (1989)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
444	*Epicoccum sp.*	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Urtiaga (2004)
445	*Epicoccum sp.*	*Equisetum hyemale* (Equisetaceae)	United States	Mix (1954b)
446	*Epithele hydnoides*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae), *Cibotium* sp. (Dicksoniaceae)	United States	Boquiren (1971), Gilbertson and Hemmes (1997), Gilbertson et al. (2002)
447	*Equiseticola fusispora*	*Equisetum* sp. (Equisetaceae)	Italy	Abd-Elsalam et al. (2016)
448	*Erythricium laetum*	*Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
449	*Euantennaria caulicola*	*Asplenium bulbiferum* (Aspleniaceae), *Dicksonia fibrosa* (Dicksoniaceae), *Hymenophyllum demissum* (Hymenophyllaceae), *Lygodium articulatum* (Schizaeaceae), *Phymatosorus diversifolius* (Polypodiaceae), *Phymatosorus scandens* (Polypodiaceae), *Sticherus cunninghamii* (Gleicheniaceae)	New Zealand	Pennycook (1989), Gadgil (2005)
450	*Euantennaria mucronata*	*Phymatosorus diversifolius* (Polypodiaceae)	New Zealand	Pennycook (1989), Gadgil (2005)
451	*Euantennaria pacifica*	*Hymenophyllum demissum* (Hymenophyllaceae), *Pteridium esculentum* (Dennstaedtiaceae)	New Zealand	Pennycook (1989), Gadgil (2005)
452	*Eudimeriolum cyathearum*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
453	*Eutypella canariensis*	*Pteridium* sp. (Dennstaedtiaceae)	Azores	Dennis et al. (1977)
454	*Exochalara longissima*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Rong and Gams (2000)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
455	*Exophiala sp.*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
456	*Exoteliospora osmundae*	*Osmunda cinnamomea* (Osmundaceae), *Osmunda regalis* (Osmundaceae), *Osmunda regalis* var. *spectabilis* (Osmundaceae)	North America, United States	Bauer et al. (1999)
457	*Exserohilum rostratum*	*Platycerium* sp. (Polypodiaceae)	United States	Farr et al. (2021)
458	*Farysia itapuensis*	*Cyrtomium falcatum* (Dryopteridaceae), *Nephrolepis exaltata* (Davalliaceae)	United States	Rush et al. (2020)
459	*Farysia magdalenana*	*Polypodium polypodioides* (Polypodiaceae)	United States	Rush et al. (2020)
460	*Farysia setubalensis*	*Dryopteris erythrosora* (Dryopteridaceae)	United States	Rush et al. (2020)
461	*Favolaschia peziziformis*	*Cyathea mertensiana* (Cyatheaceae)	Japan	Kobayashi (2007)
462	*Fellhanera bouteillei*	*Polystichum* sp. (Dryopteridaceae)	China (Taiwan Province)	Kirschner et al. (2019)
463	*Fibricium rude*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
464	*Fibulomyces mutabilis*	*Athyrium filix-femina* (Woodsiaceae), *Cibotium glaucum* (Dicksoniaceae)	Scandinavia, United States	Gilbertson and Hemmes (1997), Hjortstam and Larsson (1997)
465	*Flagelloscypha citrispora*	*Pteridium aquilinum* (Dennstaedtiaceae)	Canada	Ginns (1986)
466	*Flagelloscypha donkii*	*Dryopteris filix-mas* (Dryopteridaceae)	Germany	Schmid-Heckel (1988)
467	*Fouragea filicina*	*Dryopteris filix-mas* (Dryopteridaceae), Dryopteris sp. (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Thelypteris palustris* (Thelypteridaceae)	Germany, Pakistan, Sweden, United Kingdom	Ahmad (1978), Dennis (1981), Cannon et al. (1985), Ahmad et al. (1997)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
468	*Fumago vagans*	*Cystopteris fragilis* (Woodsiaceae), *Polypodium echinodes* (Polypodiaceae)	Greenland, Venezuela	Conners (1967), Urtiaga (2004)
469	*Funneliformis mosseae*	*Dryopteris filix-mas* (Dryopteridaceae)	Poland	Mułenko et al. (2008)
470	*Fusarium avenaceum*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976), Petrini (1992)
471	*Fusarium graminearum*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Starkey et al. (2007)
472	*Fusarium haematococcum*	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
473	*Fusarium ipomoeae*	*Pteris grandifolia* (Pteridaceae)	Thailand	Seifollahi et al. (2023)
474	*Fusarium lateritium*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Farr et al. (2021)
475	*Fusarium mindoanum*	*Dryopteris diplazioides* (Dryopteridaceae)	Ecuador	Petrak (1950a)
476	*Fusarium nirenbergiae*	*Asparagus setaceous* (Asparagaceae), *Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
477	*Fusarium oxysporum*	*Cyrtomium falcatum* (Dryopteridaceae), *Selaginella* sp. (Selaginellaceae)	United States	Alfieri et al. (1984), French (1989)
478	*Fusarium pallidoroseum*	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
479	*Fusarium* sp.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)
480	*Fusarium* sp.	*Pellaea rotundifolia* (Adiantaceae)	United States	Alfieri et al. (1984)
481	*Fusarium* sp.	*Asplenium nidus* (Aspleniaceae)	United States	Alfieri et al. (1984)
482	*Fusarium* sp.	*Asplenium* sp. (Aspleniaceae)	United States	Alfieri et al. (1984)
483	*Fusarium* sp.	*Alsophila australis* (Cyatheaceae)	United States	Alfieri et al. (1984)
484	*Fusarium* sp.	*Davallia trichomanoides* f. *barbata* (Davalliaceae)	United States	Alfieri et al. (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
485	*Fusarium* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Alfieri et al. (1984)
486	*Fusarium* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Urtiaga (2004)
487	*Fusarium* sp.	*Angiopteris evecta* (Marattiaceae)	India	Mali et al. (2016)
488	*Fusarium* sp.	*Botrychium lunaria* (Ophioglossaceae)	Poland	Mułenko et al. (2008)
489	*Fusarium* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
490	*Fusarium* sp.	Polypodium sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
491	*Fusarium* sp.	*Pteris* sp. (Pteridaceae)	United States	Alfieri et al. (1984)
492	*Fusarium* sp.	*Pteris ensiformis* (Pteridaceae)	United States	Alfieri et al. (1984)
493	*Fusarium* sp.	*Pteris* sp. (Pteridaceae)	India	Kumaresan et al. (2013)
494	*Fusarium sulawesiense*	*Asplenium nidus* (Aspleniaceae)	Thailand	Seifollahi et al. (2023)
495	*Fusarium thapsinum*	*Azolla microphylla* (Salviniaceae)	India	Dey et al. (2017)
496	*Fuscolachnum inopinatum*	*Lycopodium annotinum* (Lycopodiaceae)	Sweden	Eriksson (2014)
497	*Fuscolachnum pteridis*	*Athyrium distentifolium* (Woodsiaceae), *Athyrium* filix-*femina* (Woodsiaceae), *Lycopodium* sp. (Lycopodiaceae), *Onoclea sensibilis* (Woodsiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada, Germany, Sweden, United Kingdom, United States	Cannon et al. (1985), Ginns (1986), Schmid-Heckel (1988), Farr et al. (2021)
498	*Fuscoporia contigua*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson et al. (2002)
499	*Galerina decipiens*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson et al. (2002)
500	*Gamszarea kalimantanensis*	*Asplenium nidus* (Aspleniaceae)	Indonesia	Sukarno et al. (2009)
501	*Gibbera lycopodii*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Germany, Sweden	Schmid-Heckel (1988), Eriksson (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
502	*Gibbera rosae*	*Lycopodium annotinum* (Lycopodiaceae)	Sweden	Eriksson (2014)
503	*Gibbera selaginellae*	*Selaginella oregana* (Selaginellaceae)	United States	Farr and Horner (1968)
504	*Gibellulopsis nigrescens*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
505	*Glabrocyphella filicicola*	*Pteris* sp. (Pteridaceae)	England	Batista and Ciferri (1962)
506	*Gliomastix cerealis*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
507	*Globisporangium debaryanum*	*Adiantum* sp. (Adiantaceae)	New Zealand	Pennycook (1989)
508	*Globisporangium intermedium*	*Pteris cretica* (Pteridaceae), *Pteris* sp. (Pteridaceae)	United States	Anonymous (1960)
509	*Globisporangium polymastum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
510	*Globisporangium rostratum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
511	*Globisporangium splendens*	*Alsophila australis* (Cyatheaceae), *Adiantum* sp. (Adiantaceae), *Pteris ensiformis* (Pteridaceae), *Pteris* sp. (Pteridaceae)	United States	Alfieri et al. (1984), Farr et al. (2021)
512	*Gloeopeniophorella sacrata*	*Pteridium esculentum* (Dennstaedtiaceae)	New Zealand	Gadgil (2005)
513	*Gloeosporium obtegens*	*Pteridium aquilinum* (Dennstaedtiaceae)	United States	Zeller (1929)
514	*Gloeosporium osmundae*	*Osmunda cinnamomea* (Osmundaceae)	United States	Anonymous (1960)
515	*Gloeosporium pteridii*	*Pteris aquilina* (Pteridaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae)	United States	Farr et al. (2021)
516	*Gloeosporium sp.*	*Alsophila* sp. (Cyatheaceae)	United States	French (1989)
517	*Gloiothele citrina*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
518	*Glomerella nephrolepis*	*Nephrolepis exaltata* (Davalliaceae)	United States	Anonymous (1960)
519	*Glomerella sp.*	*Adiantum tenerum* (Adiantaceae)	United States	Alfieri et al. (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
520	*Glomerella sp.*	*Adiantum* sp. (Adiantaceae)	United States	Alfieri et al. (1984)
521	*Glomerella sp.*	*Polypodium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
522	*Gloniella adianti*	*Adiantum capillus-veneris* (Adiantaceae), *Adiantum* sp. (Adiantaceae), *Trichomanes* sp. (Hymenophyllaceae), *Trichomanes speciosum* (Hymenophyllaceae)	Ireland, United Kingdom	Farr et al. (2021)
523	*Gloniella antarctica*	*Grammitis magellanica* (Grammitidaceae)	Argentina, Chile	Farr (1973)
524	*Gnomonia artospora*	*Onoclea sensibilis* (Woodsiaceae)	Canada	Ginns (1986)
525	*Gorgoniceps boltonii*	*Equisetum* sp. (Equisetaceae)	United Kingdom	Farr et al. (2021)
526	*Graphyllium pentamerum*	*Lycopodium selago* (Lycopodiaceae)	Norway	Holm and Holm (1994)
527	*Griggsia cyathea*	*Cyathea arborea* (Cyatheaceae)	Puerto Rico	Stevens and Dalbey (1919), Thambugala et al. (2014)
528	*Guignardia adianti*	*Adiantum* sp. (Adiantaceae)	Sri Lanka	von Arx (1954)
529	*Gymnopus druceae*	*Sphaeropteris medullaris* (Cyatheaceae)	New Zealand	Pennycook (1989)
530	*Halbania cyathearum*	*Cyathea glabra* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae)	India, Indonesia	Hongsanan et al. (2014)
531	*Hamatocanthoscypha helicotricha*	*Cyathea bicrenata* (Cyatheaceae), *Sticherus palmatus* (Gleicheniaceae)	Mexico	Medel-Ortiz et al. (2020)
532	*Hamatocanthoscypha laricionis* var. *laricionis*	*Gleichenia japonica* (Gleicheniaceae), *Lycopodium* sp. (Lycopodiaceae)	Japan, Sweden	Hosoya and Tanaka (2007), Eriksson (2014)
533	*Helicobasidium holospirum*	*Aspidium marginale* (Dryopteridaceae), *Aspidium spinulosum* (Dryopteridaceae), *Dryopteris intermedia* (Dryopteridaceae)	Canada, United States	Mix (1954b), Ginns (1986)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
534	*Helicogloea lagerheimii*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
535	*Helicoma olivaceum*	*Dicksonia antarctica* (Dicksoniaceae)	Australia	Tsui and Berbee (2006)
536	*Helminthosporium cibotii*	*Cibotium* sp. (Dicksoniaceae)	United States	Anonymous (1960), Raabe et al. (1981)
537	*Helminthosporium gleicheniae*	*Dicranopteris linearis* (Gleicheniaceae), *Gleichenia dichotoma* (Gleicheniaceae)	United States	Raabe et al. (1981), Goos and Gowing (1992)
538	*Helminthosporium hawaiiense*	*Marsilea minuta* (Marsileaceae)	India	Farr et al. (2021)
539	*Helotium polystichi*	*Polystichum munitum* (Dryopteridaceae)	United States (California)	Cash (1958)
540	*Hemimycena reducta*	*Dicksonia* sp. (Dicksoniaceae)	New Zealand	Horak and Dejardin (1994)
541	*Hendersonia fuscispora*	*Selaginella asprella* (*Selaginellaceae*), *Selaginella* utahensis (Selaginellaceae)	United States	Farr and Horner (1968)
542	*Hendersonia pallidispora*	*Selaginella asprella* (Selaginellaceae)	United States	Farr and Horner (1968)
543	*Hendersonia sp.*	*Selaginella asprella* (Selaginellaceae)	United States (California)	Farr and Horner (1968)
544	*Hendersonia sp.*	*Selaginella underwoodii* (Selaginellaceae)	United States (Arizona)	Farr and Horner (1968)
545	*Hendersonia sp.*	*Selaginella underwoodii* (Selaginellaceae)	United States (Colorado)	Farr and Horner (1968)
546	*Heptameria arvensis*	*Equisetum arvense* (Equisetaceae)	United States	French (1989)
547	*Hermatomyces amphisporus*	*Cyathea* sp. (Cyatheaceae)	Mexico	Ruiz and Heredia (2000)
548	*Herpobasidium abnorme*	*Polystichum munitum* (Dryopteridaceae)	United States	Oberwinkler and Wells (1985)
549	*Herpobasidium australe*	Adiantum *silvaticum* (Adiantaceae), *Arthropteris beckleri* (Oleandraceae)	Australia	Oberwinkler and Bandoni (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
550	*Herpothallon rubrocinctum*	*Cyathea parvula* (Cyatheaceae)	West Indies	Minter et al. (2001)
551	*Herpotrichiella papuapteridis*	*Polystichum lineare* (Dryopteridaceae)	Papua New Guinea	Shaw (1984)
552	*Heterochaete verruculosa*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
553	*Heterosporium equiseti*	*Equisetum arvense* var. *boreale* (Equisetaceae), *Equisetum arvense* (Equisetaceae), *Equisetum* sylvaticum f. *multiramosum (Equisetaceae)*	United States	Greene (1950), David (1997)
554	*Heterosporium selaginellarum*	*Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae)	United States	Farr and Horner (1968)
555	*Hispidula dicksoniae*	*Dicksonia antarctica* (Dicksoniaceae)	Australia	Beaton and Weste (1977)
556	*Hobsonia gigaspora*	*Cibotium glaucum* (Dicksoniaceae), *Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
557	*Hormisciomyces sp.*	*Elaphoglossum* sp. (Lomariopsidaceae)	West Indies	Minter et al. (2001)
558	*Hyalopeziza rubefaciens*	*Diphasiastrum complanatum* (Lycopodiaceae)	Sweden	Eriksson (2014)
559	*Hyalopsora aculeata*	*Blechnum nipponicum* (Blechnaceae), *Blechnum spicant* var. *nipponicum* (Blechnaceae)	Japan, USSR	Kuprevich and Transchel (1957), Hiratsuka et al. (1992)
560	*Hyalopsora adianti-capilli-veneris*	*Adiantum capillus-veneris* (Adiantaceae)	Algeria, Azores, France, Greece, Iran, Italy, Morocco, Spain, United Kingdom, USSR	Kuprevich and Transchel (1957), Pantidou (1973), Gjærum and Sunding (1986), Henderson (2000)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
561	*Hyalopsora aspidiotus*	*Aspidium dryopteris* (Dryopteridaceae), *Dryopteris disjuncta* (Dryopteridaceae), *Dryopteris linnaeana* (Dryopteridaceae), *Dryopteris robertiana* (Dryopteridaceae), *Gymnocarpium disjunctum* (Woodsiaceae), *Gymnocarpium dryopteris* (Woodsiaceae), *Gymnocarpium jessoense* (Woodsiaceae), *Gymnocarpium robertianum* (Woodsiaceae), *Lastrea dryopteris* (Thelypteridaceae), *Polypodium dryopteris* (Polypodiaceae), *Phegopteris connectilis* (Thelypteridaceae)	Bulgaria, Canada, China (Bejing, Hebei, Jilin), Finland, Germany, Japan, Norway, Poland, Republic of Korea, Russia, United Kingdom, United States, USSR	Cash (1936), Anderson (1952), Kuprevich and Transchel (1957), Gjærum (1974), Ji et al. (2018)
562	*Hyalopsora cheilanthis*	*Ceropteris triangularis* (Adiantaceae), *Cheilanthes pringlei* (Adiantaceae), *Cryptogramma* sp. (Adiantaceae), *Cryptogramma stelleri* (Adiantaceae), *Notholaena sinuata* (Adiantaceae), *Notholaena* sp. (Adiantaceae), *Pellaea andromedifolia* (Adiantaceae), Pellaea *gracilis* (Adiantaceae), Pellaea *ternifolia* (Adiantaceae), *Pityrogramma triangularis* (Adiantaceae)	Argentina, Chile, Canada, United States, USSR	Blasdale (1919), Hiratsuka (1958), Gilbertson and McHenry (1969), Yohem et al. (1985)
563	*Hyalopsora cryptogrammes*	*Onychium japonicum* (Adiantaceae)	China (Taiwan Province), Japan, Philippines	Teodoro (1937), Hiratsuka et al. (1992), Kirschner et al. (2019)
564	*Hyalopsora deodikarii*	*Pteris quadriaurita* (Pteridaceae)	India (Maharashtra)	Anon (1972)
565	*Hyalopsora diplazii*	*Diplazium squamigerum* (Woodsiaceae)	Japan	Hiratsuka et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
566	*Hyalopsora filicum*	*Athyrium niponicum* (Woodsiaceae)	Japan	Farr et al. (2021)
567	*Hyalopsora hakodatensis*	*Athyrium acrostichoides* (Woodsiaceae), *Athyrium iseanum* (Woodsiaceae), *Athyrium pycnosorum* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Deparia orientalis* (Woodsiaceae), *Deparia pycnosora* (Woodsiaceae), *Diplazium maximum* (Woodsiaceae), *Diplazium mettenianum* (Woodsiaceae), *Dryopteris* sp. (Dryopteridaceae), *Lunathyrium* sp. (Woodsiaceae), *Osmunda* sp. (Osmundaceae), *Phegopteris decursive-pinnata* (Thelypteridaceae)	China (Fujian, Hainan, Yunnan, Taiwan and Tibet Province), Himalaya, Japan, Republic of Korea, USSR	Kuprevich and Transchel (1957), Tai (1979), Zhuang (1983), Zhuang and Wei (1994), Cho and Shin (2004), Ji et al. (2018), Hiratsuka et al. (1992), Kirschner et al. (2019), Okane et al. (2021)
568	*Hyalopsora japonica*	*Crypsinus veitchii* (Polypodiaceae), *Phymatopsis malacodon* (Polypodiaceae), *Phymatopsis stracheyi* (Polypodiaceae)	China, Himalaya, Japan	Hiratsuka et al. (1992), Zhuang and Wei (1994)
569	*Hyalopsora minispora*	*Blechnopsis orientalis* (Blechnaceae)	China	Wang et al. (2021)
570	*Hyalopsora neocheilanthis*	*Cheilanthes chusana* (Adiantaceae), *Cheilanthes pringlei* (Adiantaceae), *Cryptogramma* sp. (Adiantaceae), *Notholaena* sp.(Adiantaceae), *Pellaea* sp. (Adiantaceae), and *Pityrogramma* sp. (Adiantaceae)	China, South Africa, USA, Argentina, Chile, Pakistan and Ecuador	Kuprevich and Transchel (1957), Hiratsuka (1958), Wang et al. (2021)
571	*Hyalopsora nodispora*	Adiantum capillus-veneris (Adiantaceae)	Pakistan	Saba et al. (2012)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
572	*Hyalopsora obovata*	*Elaphoglossum chartaceum* (Lomariopsidaceae), *Elaphoglossum cuspidatum* (Lomariopsidaceae), *Elaphoglossum latifolium* (Lomariopsidaceae), *Elaphoglossum leptophyllum* (Lomariopsidaceae), *Elaphoglossum* sp. (Lomariopsidaceae)	Colombia, Jamaica	Dale (1955), Buriticá and Pardo-Cardona (1996)
573	*Hyalopsora orientalis*	*Adiantum* sp. (Adiantaceae)	India	Chona and Munjal (1955)
574	*Hyalopsora pasadenae*	*Gymnogramma triangularis*	USA	Sydow and Sydow (1903)
575	*Hyalopsora pellaeicola*	*Cryptogramma stelleri* (Adiantaceae), *Mildella nitidula* (Adiantaceae), *Pellaea andromedifolia* (Adiantaceae)	Pakistan, United States	Arthur (1906), Ahmad et al. (1997)
576	*Hyalopsora polypodii*	*Aleuritopteris kuhnii* var. *brandtii* (Adiantaceae), *Athyrium melanolepis* (Woodsiaceae), *Athyrium niponicum* (Woodsiaceae), *Athyrium iseanum* (Woodsiaceae), *Athyrium pterorachis* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Athyrium yokoscense* (Woodsiaceae), *Blechnum amabile* (Blechnaceae), *Blechnum orientale* (Blechnaceae), *Cryptogramma brunoniana* (*Adiantaceae*), *Cystopteris fragilis* subsp. *fragilis* (Woodsiaceae), *Cystopteris filix-fragilis* subsp. *fragilis* (Woodsiaceae), *Cystopteris alpina* (Woodsiaceae),	Argentina, Austria, Belgium, Bulgaria, Canada, China (Taiwan and others province), Denmark, Finland, Germany, Iceland, Iran, Japan, Morocco, Nepal, New Zealand, Norway, Pakistan, Poland, Romania, Spain, Sweden, Turkey, Ukraine, United Kingdom, United States, USS	Tai (1979), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		Cystopteris bulbifera (Woodsiaceae), *Cystopteris filix-fragilis* subsp. *fragilis* (Woodsiaceae), *Cystopteris pellucida* (Woodsiaceae), *Cystopteris* sp. (Woodsiaceae), *Cystopteris sudetica* (Woodsiaceae), *Deparia petersenii* (Woodsiaceae), *Deparia petersenii* subsp. *congrua* (Woodsiaceae), *Deparia* tenuifolia (Woodsiaceae), *Diplazium grammitoides* (Woodsiaceae), *Diplazium maximum* (Woodsiaceae), *Diplazium wichurae* (Woodsiaceae), *Diplazium oshimense* (Woodsiaceae), *Diplazium siroyamaense* (Woodsiaceae), *Lunathyrium* sp. (Woodsiaceae), *Matteuccia orientalis* (Woodsiaceae), *Protowoodsia manchuriensis* (Dennstaedtiaceae), *Woodsia glabella* (Woodsiaceae), *Woodsia obtusa* (Woodsiaceae), *Woodsia oregana* (Woodsiaceae), *Woodsia scopulina* (Woodsiaceae), *Lastrea glanduligera* (Thelypteridaceae), *Lastrea laxa* (Thelypteridaceae), *Filix fragilis* (Dryopteridaceae), *Leptogramma totta* (Thelypteridaceae),		

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		Lunathyrium sp. (Woodsiaceae), *Leptogramma mollissima* (Thelypteridaceae), *Cystopteris fragilis* (Woodsiaceae), *Cystopteris moupinensis* (Woodsiaceae), *Dryopteris decursive-pinnata* (Dryopteridaceae), *Phegopteris decursive-pinnata* (Thelypteridaceae), *Polypodium fragilis* (Polypodiaceae), *Polypodium malacodon* (Polypodiaceae), *Pseudophegopteris* sp. (Thelypteridaceae), *Woodwardia orientalis* (Blechnaceae)		
577	*Hyalopsora taiwaniana*	*Cystopteris moupinensis* (Woodsiaceae), *Cystopteris sphaerocarpa* (Woodsiaceae)	China (Taiwan Province)	Kirschner et al. (2019)
578	*Hyalopsora tibetica*	*Athyrium spinulosum* (Athyriaceae)	China	Wang et al. (2021)
579	*Hyalopsora waterlotii*	*Pellaea viridis* (Adiantaceae)	Madagascar	Legendre (1972)
580	*Hyalopsora yamadana*	*Coniogramme fraxinea* (Adiantaceae), *Coniogramme intermedia* (Adiantaceae), *Cyclosorus* sp. (Thelypteridaceae), *Coniogramme suprapilosa* (Adiantaceae)	China, Japan, USSR	Kuprevich and Transchel (1957), Hiratsuka et al. (1992), Zhuang (2001), Zhuang (2005)
581	*Hyalopsora yunnanensis*	*Phymatopsis conmixta* (Polypodiaceae)	China	Li (1986)
582	*Hyaloscypha flaveola*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Sweden, United Kingdom (England)	Dennis (1978), Cannon et al. (1985), Eriksson (2014)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
583	*Hyaloscypha fuckelii*	*Alsophila firma* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)
584	*Hyalopsora aspidiotus*	*Phegopteris dryopteris* (Thelypteridaceae), *Thelypteris dryopteris* (Thelypteridaceae)	Denmark, Finland, Germany, Norway, Poland, Romania, Sweden, United States	Farr et al. (2021)
585	*Hyalospora polypodii*	*Adiantum capillus-veneris* (Adiantaceae)	Pakistan	Ahmad et al. (1997)
586	*Hydnoporia tabacina*	*Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
587	*Hydropisphaera arenula*	*Equisetum hyemale* (Equisetaceae)	Denmark, Germany, Luxembourg	Farr et al. (2021)
588	*Hydropisphaera arenuloides*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	Farr et al. (2021)
589	*Hydropisphaera cyatheae*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	Gadgil (2005)
590	*Hydropisphaera sp.*	*Sphaeropteris lepifera* (Cyatheaceae)	China (Taiwan Province)	Guu et al. (2010)
591	*Hydropisphaera suffulta*	*Sphaeropteris lepifera* (Cyatheaceae)	China (Taiwan Province)	Guu et al. (2010)
592	*Hydropus sp.*	*Cyathea* sp. (Cyatheaceae)	West Indies	Minter et al. (2001)
593	*Hygrocybe hapuuae*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
594	*Hymenochaete sp.*	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
595	*Hymenochaete tomentelloidea*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
596	*Hymenopsis equiseti*	*Equisetum telmateia* (Equisetaceae)	Hungary	Nag Raj (1993)
597	*Hymenoscyphus filicinus*	*Adiantum lunulatum* (Adiantaceae), *Aspidium cicutarium* (Dryopteridaceae), *Aspidium filix-mas* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris linnaeana* (Dryopteridaceae), *Dryopteris phegopteris*	Austria, Canada, Finland, Germany, India, United Kingdom (Scotland), United States	Sarbhoy et al. (1975), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		(Dryopteridaceae), *Gymnocarpium robertianum* (Woodsiaceae), *Phegopteris dryopteris* (Thelypteridaceae)		
598	*Hymenoscyphus scutula*	*Dennstaedtia punctilobula* (Dennstaedtiaceae)	United States	Anonymous (1960)
599	*Hymenoscyphus selaginellae*	*Selaginella selaginoides* (Selaginellaceae)	Germany	Schmid-Heckel (1988)
600	*Hyphoderma cremeoalbum*	*Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
601	*Hyphoderma nudicephalum*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
602	*Hyphodontia alutaria*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
603	*Hyphodontia capitata*	*Cyathea borbonica* (Cyatheaceae)	France (Reunion)	Boidin and Gilles (1986)
604	*Hyphodontia pallidula*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
605	*Hyphodontiella hauerslevii*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
606	*Hyphodontiella multiseptata*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997), Farr et al. (2021)
607	*Hyphopolynema australe*	*Blechnum indicum* (Blechnaceae)	Australia	Sutton and Alcorn (1984)
608	*Hypochniciellum ovoideum*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris* sp. (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
609	*Hypochnicium geogenium*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
610	*Hypochnicium lundellii*	*Athyrium filix-femina* (Woodsiaceae)	Sweden	Stack (1980)
611	*Hypochnicium punctulatum*	*Angiopteris longifolia* (Marattiaceae), *Cibotium chamissoi* (Dicksoniaceae)	Cook Islands, United States	Gilbertson and Hemmes (1997), Dingley et al. (1981)
612	*Hypocrella andropogonis*	*Adiantum petiolatum* (Adiantaceae), *Adiantum* sp. (Adiantaceae)	Puerto Rico, Virgin Islands	Stevenson (1975)
613	*Hypocrella discoidea*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
614	*Hypocrella palmicola*	*Adiantum* sp. (Adiantaceae)	West Indies	Minter et al. (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
615	*Hypoderma equiseti*	*Equisetum hyemale* (Equisetaceae)	United States	Cash (1952)
616	*Hypoderma rubi*	*Pyrrosia petiolosa* (Polypodiaceae)	China	Farr et al. (2021)
617	*Hypoderma sticheri*	*Sticherus cunninghamii* (Gleicheniaceae)	New Zealand	McKenzie et al. (1992)
618	*Hypomyces samuelsii*	*Cyathea* sp. (Cyatheaceae)	West Indies	Põldmaa (2011)
619	*Hypsotheca maxima*	*Microgramma squamulosa* (Polypodiaceae), *Niphidium crassifolium* (Polypodiaceae), *Niphidium* sp. (Polypodiaceae), *Polypodium crassifolium* (Polypodiaceae), *Polypodium phyllitidis* (Polypodiaceae), *Polypodium punctatum* (Polypodiaceae), *Polypodium schomburgkianum* (Polypodiaceae), *Polypodium* sp. (Polypodiaceae)	Bolivia, Brazil, Cuba, Dominican Republic, Puerto Rico, Venezuela, Virgin Islands	Ciferri (1929), Ciferri (1961), Farr (1963), Dennis (1970), Stevenson (1975), Crous et al. (2019), Farr et al. (2021)
620	*Hysterium magnosporum*	*Athyrium americanum* (Woodsiaceae)	United States	Cooke (1955)
621	*Hysteropeltella moravica*	Athyrium *filix-femina* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Czech Republic, Sweden	Petrak (1923), Holm and Holm (1978), Eriksson (2014), Phookamsak et al. (2016)
622	*Ijuhya donianumnesis*	*Diplazium donianum* (Athyriaceae)	China	Li et al. (2024b)
623	*Ijuhya equiseti-hyemalis*	*Equisetum hyemale* (Equisetaceae)	Germany	Lechat and Baral (2008)
624	*Ijuhya interruptusnesis*	*Cyclosorus interruptus* (Thelypteridaceae)	China	Li et al. (2024b)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
625	*Ilyonectria coprosmae*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	Gadgil (2005)
626	*Ilyonectria destructans*	*Pteridium aquilinum* (Dennstaedtiaceae), *Rumohra adiantiformis* (Dryopteridaceae)	Argentina, United Kingdom	Frankland (1976), Petrini (1992)
627	*Incrupila aspidii*	*Dryopteris dilatata* (Dryopteridaceae), *Phegopteris connectilis* (Thelypteridaceae), *Polystichum aculeatum* (Dryopteridaceae), *Polystichum lonchitis* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Germany, Sweden, South Africa, United States	Sprague (1955), Schmid-Heckel (1988), Raitviir and Schneller (2007), Eriksson (2014)
628	*Incrustocalyptella hapuuae*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
629	*Inocyclus angularis*	*Pleopeltis astrolepis* (Polypodiaceae)	Brazil	Guatimosim et al. (2014)
630	*Inocyclus calotheus*	*Adiantum tetraphyllum* (Adiantaceae)	Venezuela	Dennis (1970)
631	*Inocyclus discoideus*	*Davallia* sp. (Davalliaceae)	Nepal	Balfour-Browne (1968)
632	*Iodosphaeria phyllophila*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	Senanayake et al. (2015)
633	*Irenina selaginellae*	*Selaginella doederleinii* (Selaginellaceae), *Selaginella springiana* (Selaginellaceae)	China (Taiwan Province)	Anon (1972), Katumoto and Hosagoudar (1989), Kirschner et al. (2019)
634	*Irenopsis cornuta*	*Dicksonia* sp. (Dicksoniaceae), *Lygodium polymorphum* (Schizaeaceae)	Brazil, Panama	Hansford (1955), Piepenbring (2006)
635	*Irenopsis ekmanii*	*Lygodium oligostachyum* (Schizaeaceae)	Dominican Republic	Ciferri (1961)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
636	*Irenopsis pteridicola*	*Adiantum latifolium* (Adiantaceae), *Adiantum petiolatum* (Adiantaceae), *Adiantum* sp. (Adiantaceae), *Anemia adiantifolia* (Schizaeaceae), *Anemia* sp. (Schizaeaceae), *Asplenium cristatum* (Aspleniaceae), *Lygodium polymorphum* (Schizaeaceae), *Lygodium radiatum* (Schizaeaceae), *Thelypteris grandis* (Thelypteridaceae)	Dominican Republic, Ecuador, Panama, Puerto Rico, Trinidad-Tobago, Virgin Islands, West Indies	Minter et al. (2001), Stevenson (1975), Farr et al. (2021)
637	*Irenopsis selaginellarum*	*Selaginella stolonifera* (Selaginellaceae), *Selaginella* sp. (Selaginellaceae)	Dominican Republic, Panama	Ciferri (1938), Kirschner et al. (2010)
638	*Isaria* sp.	*Goniopteris scutellatus* (Thelypteridaceae)	South Africa	Doidge (1950)
639	*Isaria* sp.	*Pteridiurn* aquilinum (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
640	*Jalapriya toruloides*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
641	*Janetia capnophila*	*Gleichenia cunninghami* (Gleicheniaceae)	New Zealand	Hughes (1983)
642	*Jennwenomyces navicularis*	*Cyathea* sp. (Cyatheaceae)	Mexico	Ruiz and Heredia (2000)
643	*Lachnella alboviolascens*	*Equisetum arvense* (Equisetaceae)	Canada	Ginns (1986)
644	*Lachnella dicranopteridis*	*Gleichenia pectinata* (Gleicheniaceae)	Puerto Rico, Virgin Islands	Stevenson (1975)
645	*Lachnella gleicheniae*	*Cibotium glaucum* (Dicksoniaceae), *Dicranopteris* sp. (Gleicheniaceae), *Gleichenia* sp. (Gleicheniaceae)	United States	Gilbertson and Hemmes (1997), Haines (1980), Raabe et al. (1981)
646	*Lachnella pteridicola*	*Pteridium aquilinum* (Dennstaedtiaceae)	United States	Kanouse (1947)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
647	*Lachnopsis catarinensis*	*Dicksonia sellowiana* (Dicksoniaceae)	Brazil	Guatimosim et al. (2016)
648	*Lachnopsis cf. pteridophylli*	Fern	China	Guatimosim et al. (2016)
649	*Lachnopsis dicksoniae*	*Dicksonia sellowiana* (Dicksoniaceae)	Brazil	Guatimosim et al. (2016)
650	*Lachnopsis* sp.	*Dicksonia* sp. (Dicksoniaceae)	Puerto Rico	Guatimosim et al. (2016)
651	*Lachnum capense*	*Pteridium aquilinum* (Dennstaedtiaceae)	South Africa	Raitviir and Schneller (2007)
652	*Lachnum blechnophilum*	*Blechnum* sp. (Blechnaceae)	Australia	Spooner (1987)
653	*Lachnum brevipilosum*	*Alsophila* firma (Cyatheaceae), *Cyathea bicrenata* (Cyatheaceae), Pteridium *aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Mexico, United Kingdom (Scotland)	Farr et al. (2021), Medel-Ortiz et al. (2020)
654	*Lachnum brevisporum*	*Plagiogyria tuberculata* var. *decresans* (Plagiogyriaceae)	Papua New Guinea	Spooner (1987)
655	*Lachnum fimbriiferum*	*Alsophila firma* (Cyatheaceae), *Cyathea bicrenata* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae), *Dicksonia sellowiana* (Dicksoniaceae)	Colombia, Cuba, Dominican Republic, Ecuador, Jamaica, Mexico, Venezuela, West Indies	Medel and Lorea-Hernandez (2008); Medel-Ortiz et al. (2020), Farr et al. (2021)
656	*Lachnum flavidulum*	*Alsophila spinulosa* (Cyatheaceae), *Cyathea borinquena* (Cyatheaceae), *Cyathea dryopteroides* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae)	West Indies, China (Taiwan Province)	Minter et al. (2001), Kirschner et al. (2019)
657	*Lachnum lanariceps*	*Cyathea contaminans* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae)	Japan, Malaysia	Razikin et al. (2014)
658	*Lachnum nudipes*	*Alsophila spinulosa* (Cyatheaceae), *Lophosoria quadripinnata* (Dicksoniaceae)	China (Taiwan Province), Mexico	Kirschner et al. (2019), Medel-Ortiz et al. (2020)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
659	*Lachnum oncospermatum*	*Alsophila spinulosa* (Cyatheaceae), *Cyathea contaminans* (Cyatheaceae), *Cyathea lepifera* (Cyatheaceae), *Cyathea spinulosa* (Cyatheaceae), *Dicksonia sellowiana* (Dicksoniaceae), *Hemitelia walkerae* (Cyatheaceae)	Australia, China (Taiwan Province), Indonesia, Japan, Malaysia, Mexico, Philippines, Sri Lanka,	Medel and Lorea-Hernandez (2008), Mehltreter (2010), Medel-Ortiz et al. (2020)
660	*Lachnum patulum*	*Pteridium aquilinum* (Dennstaedtiaceae)	Sweden	Eriksson (2014)
661	*Lachnum pinnicola*	*Dicksonia antarctica* (Dicksoniaceae)	Australia	Spooner (1987)
662	*Lachnum pteridicola*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	Anon (1972)
663	*Lachnum pteridophyllum*	*Cyathea* dealbata (Cyatheaceae), *Cyathea divergens* var. *tuerckheimii* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae), *Cyathea lepifera* (Cyatheaceae), *Cyathea* spinulosa (Cyatheaceae), *Dicksonia antarctica* (Dicksoniaceae), *Dicksonia* sp. (Dicksoniaceae), *Dicksonia sellowiana* (Dicksoniaceae), *Dryopteris* sp. (Dryopteridaceae), *Histiopteris incisa* (Dennstaedtiaceae), *Lophosoria quadripinnata* (Dicksoniaceae)	Australia (Tasmania), China (Taiwan Province), Colombia, Dominican Republic, Jamaica, Japan, Mexico, New Guinea, New Zealand, Panama, Peru, Puerto Rico, Venezuela	Spooner (1987), Kobayashi (2007), Guatimosim et al. (2016), Kirschner et al. (2019), Medel-Ortiz et al. (2020), Farr et al. (2021)
664	*Lachnum singerianum*	*Alsophila firma* (Cyatheaceae), *Dicksonia sellowiana* (Dicksoniaceae)	Bolivia, In the Andean region of Bolivia to Venezuela, China, Mexico, Jamaica	Medel and Lorea-Hernandez (2008), Medel-Ortiz et al. (2020)
665	*Lachnum* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
666	*Lachnum* sp.	*Cyathea* sp. (Cyatheaceae)	West Indies	Minter et al. (2001)
667	*Lachnum* sp.	*Equisetum hyemale* (Equisetaceae)	Japan	Hosoya et al. (2010)
668	*Lachnum* sp.	*Alsophila spinulosa* (Cyatheaceae)	China (Taiwan Province)	Kirschner et al. (2019)
669	*Lachnum tungurahuense*	*Pteridium* sp. (Dennstaedtiaceae)	Ecuador	Petrak (1950a)
670	*Lachnum ulei*	*Dicranopteris* sp. (Gleicheniaceae), *Gleichenia glauca* (Gleicheniaceae), *Gleichenia* longissima (Gleicheniaceae), *Gleichenia* pectinata (Gleicheniaceae), *Gleichenia* sp. (Gleicheniaceae), *Hicriopteris pinnata* (Gleicheniaceae)	Brazil, United States	Stevens (1925), Raabe et al. (1981), Hanlin (1992), Mendes et al. (1998)
671	*Lachnum varians*	*Adiantum andicola* (Adiantaceae), *Alsophila firma* (Cyatheaceae), *Adiantum andicola* (Adiantaceae), *Cyathea bicrenata* (Cyatheaceae), *Cyathea divergens* var. *tuerckheimii* (Cyatheaceae), *Cyathea* lepifera (Cyatheaceae), *Cyathea spinulosa* (Cyatheaceae), *Dicksonia antarctica* (Dicksoniaceae), *Pteris wallichiana* (Pteridaceae)	Australia, Brazil, United States (Hawaii), New Guinea, Japan, Mexico, New Zealand, South America, The Caribbean	Spooner (1987), Hosoya and Tanaka (2007), Kobayashi (2007), Hosoya et al. (2010), Farr et al. (2021)
672	*Lachnum virgineum*	*Phlebodium aureum* (Polypodiaceae)	Mexico	Medel-Ortiz et al. (2020)
673	*Lachnum washingtonense*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Sweden, United States	Dennis (1963), Holm et al. (1990)
674	*Lactocollybia cycadicola*	*Cyathea spinulosa* (Cyatheaceae)	Japan	Kobayashi (2007)
675	*Laetinaevia blechni*	*Blechnum serrulatum* (Blechnaceae)	Brazil	Hanlin (1992), Mendes et al. (1998)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
676	*Lamproderma arcyrioides*	*Matteuccia struthiopteris* (Woodsiaceae)	Western Siberia	Vlasenko and Vlasenko (2013)
677	*Lamproderma* sp.	*Dryopteris filix-mas* (Dryopteridaceae)	Germany	Schmid-Heckel (1988)
678	*Lanzia cremea*	*Cibotium* sp. (Dicksoniaceae), *Dicranopteris* sp. (Gleicheniaceae), *Gleichenia* sp. (Gleicheniaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Polystichum squarrosum* (Dryopteridaceae)	India, United States	Raabe et al. (1981), Cash (1936), Sarbhoy et al. (1975), Index Fungorum
679	*Lasiobelonium nidulus*	*Onoclea sensibilis* (Woodsiaceae)	United States	Haines (1974)
680	*Lasiodiplodia mahajangana*	*Lemmaphyllum microphyllum* (Polypodiaceae)	China	Li et al. (2024a)
681	*Lasiodiplodia pseudotheobromae*	*Pteridium aquilinum* (Dennstaedtiaceae)	China	Dou (2017)
682	*Lasiodiplodia thailandica*	*Asplenium nidus* (Aspleniaceae), *Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
683	*Lasiodiplodia theobromae*	*Stenochlaena tenuifolia* (Blechnaceae)	United States	Miller (1991)
684	*Lasionectriopsis pteridii*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
685	*Lecanicillium saksenae*	*Asplenium nidus* (Aspleniaceae)	Indonesia	Sukarno et al. (2009)
686	*Leiosphaerella lycopodina*	*Diphasiastrum complanatum* (Lycopodiaceae), *Diphasiastrum* sp. (Lycopodiaceae), *Diphasium complanatum* (Lycopodiaceae), *Lycopodium annotinum* (Lycopodiaceae), *Lycopodium buttersii* (Lycopodiaceae),	Austria, Canada, Poland, Sweden, United Kingdom (Scotland), United States	Barr (1964), Eriksson (1992), Mułenko et al. (2008), Jaklitsch and Voglmayr (2012), Mułenko et al. (2008), Eriksson (2014), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		Lycopodium clavatum (Lycopodiaceae), *Lycopodium complanatum* (Lycopodiaceae), *Lycopodium lucidulum* (Lycopodiaceae), *Lycopodium obscurum* (Lycopodiaceae), *Lycopodium obscurum* var. *dendroideum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)		
687	*Lemalis* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
688	*Lembosia polystichicola*	*Arachniodes aristata* (Dryopteridaceae), *Polystichum tripteron* (Dryopteridaceae)	Japan	Ken (1975), Katsumoto (1979)
689	*Leotia lubrica*	*Pteridium* sp. (Dennstaedtiaceae)	England	Dennis (1978)
690	*Leptocorticium cyatheae*	*Cyathea boninsimensis* (Cyatheaceae), *Cyathea spinulosa* (Cyatheaceae)	Japan	Maekawa (1993), Kobayashi (2007)
691	*Leptopeltis aquilina*	*Pteridium aquilinum* (Dennstaedtiaceae)	Greece, Germany, Italy, Sweden, United Kingdom	Pantidou (1973), Cannon et al. (1985), Crane (1991), Eriksson (1992), Eriksson (2014)
692	*Leptopeltis gregaria*	*Phegopteris connectilis* (Thelypteridaceae), *Thelypteris phegopteris* (Thelypteridaceae)	Sweden	Eriksson (1992), Eriksson (2014)
693	*Leptopeltis litigiosa*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Sweden, United States	Cannon et al. (1985), Dennis (1986), French (1989), Eriksson (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
694	*Leptopeltis nebulosa*	*Athyrium filix-femina* (Woodsiaceae), *Gymnocarpium* dryopteris (Woodsiaceae), *Osmunda* sp. (Osmundaceae)	United Kingdom, Sweden	Cannon et al. (1985), Dennis (1986), Eriksson (2014)
695	*Leptosphaeria arvensis*	*Equisetum arvense* (Equisetaceae)	Italy, United States (California)	Anonymous (1960), Crane (1991)
696	*Leptosphaeria campi-silii*	*Lycopodium annotinum* (Lycopodiaceae)	Italy	Farr (1973)
697	*Leptosphaeria coorgica*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteris aquilina* (Pteridaceae)	India	Crane (1991), Pande (2008)
698	*Leptosphaeria equiseticola*	*Equisetum variegatum* (Equisetaceae)	Hungary	Petrak (1937)
699	*Leptosphaeria helvetica*	*Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae), *Selaginella asprella* (Selaginellaceae), *Selaginella helvetica* (Selaginellaceae), *Selaginella mutica* (Selaginellaceae), *Selaginella mutica* var. *limitanea* (Selaginellaceae), *Selaginella rupestris* (Selaginellaceae), *Selaginella wallacei* (Selaginellaceae)	Italy, United States	Farr and Horner (1968), Farr (1973)
700	*Leptosphaeria larvalis*	*Equisetum pallidum* (Equisetaceae)	Cape Verde	Crane (1991)
701	*Leptosphaeria limosa*	*Equisetum limosum* (Equisetaceae)	France	Crane (1991)
702	*Leptosphaeria major*	*Selaginella helvetica* (Selaginellaceae)	Italy, United States	Crane (1991)
703	*Leptosphaeria mellispora*	*Selaginella underwoodii* (Selaginellaceae)	United States	Farr and Horner (1968)
704	*Leptosphaeria pilulariae*	*Pilularia* sp. (Marsileaceae)	Germany	Crane (1991)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
705	*Leptosphaeria rostrata*	*Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae), *Selaginella rupestris* (Selaginellaceae)	United States	Farr and Horner (1968), Crane (1991)
706	*Leptosphaeria* sp.	*Equisetum hyemale* (Equisetaceae)	United States	Shaw (1973)
707	*Leptosphaeria* sp.	*Polypodium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
708	*Leptosphaerulina trifolii*	*Marsilea quadrifolia* (Marsileaceae)	India	Pande (2008)
709	*Leptosporella dicksoniae*	*Dicksonia squarrosa* (Dicksoniaceae)	Portugal	Unamuno (1941)
710	*Leptostroma osmundicola*	*Osmunda regalis* (Osmundaceae)	Germany	Bubák and Sydow (1915)
711	*Leptostroma pteridis*	*Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Poland, United States	Anonymous (1960), Mułenko et al. (2008)
712	*Leptostromella aquilina*	*Pteridium aquilinum* (Dennstaedtiaceae)	Pakistan	Ahmad et al. (1997)
713	*Leptostromella filicina*	*Dryopteris spinulosa* (Dryopteridaceae), *Osmunda cinnamomea* (Osmundaceae), *Osmunda regalis* (Osmundaceae), *Pteridium* sp. (Dennstaedtiaceae)	United States	Anonymous (1960)
714	*Leptostromella pteridina*	*Pteridium aquilinum* (Dennstaedtiaceae)	Pakistan	Ahmad et al. (1997)
715	*Leptothyrium gleicheniae*	*Dicranopteris* sp. (Gleicheniaceae), *Gleichenia longissima* (Gleicheniaceae), *Gleichenia* sp. (Gleicheniaceae), *Hicriopteris pinnata* (Gleicheniaceae)	United States	Stevens (1925), Raabe et al. (1981), Goos and Gowing (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
716	*Leptothyrium litigiosum*	*Osmunda cinnamomea* (Osmundaceae)	United States	Anonymous (1960)
717	*Lichenopeltella nigroannulata*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	United Kingdom	Ellis (1977), Cannon et al. (1985)
718	*Lichtheimia corymbifera*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
719	*Linnemannia gamsii*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
720	*Lophiostoma chamaecyparidis*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Poland, Sweden	Chlebicki (2005), Mułenko et al. (2008), Eriksson (2014)
721	*Lophiotrema pteridis*	*Pteris aquilina* (Pteridaceae)	Spain	Unamuno (1941), Index Fungorum
722	*Lophodermium dicranopteris*	*Dicranopteris dichotoma* (Gleicheniaceae)	China	Liu et al. (1995), Index Fungorum
723	*Lophodermium hawaiense*	*Polypodium* sp. (Polypodiaceae)	United States	Johnston (1988)
724	*Loramyces macrosporus*	*Equisetum limosum* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	United Kingdom	Cannon et al. (1985), Grünig et al. (2009)
725	*Luellia cystidiata*	*Dryopteris* sp. (Dryopteridaceae)	Sweden	Hjortstam and Larsson (1997)
726	*Luellia recondita*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
727	*Lycogala epidendrum*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
728	*Lycoperdon perlatum*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
729	*Lycoperdon* sp.	*Sadleria* sp. (Blechnaceae)	United States	Raabe et al. (1981)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
730	*Lyomyces sambuci*	*Cibotium chamissoi* (Dicksoniaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Spain, United States	Gilbertson et al. (2002), Farr et al. (2021)
731	*Macrophoma dryopteris*	*Dryopteris* sp. (Dryopteridaceae)	South Africa	Doidge (1950)
732	*Macrophoma neottopteridis*	*Asplenium nidus* (=*Neottopteris nidus*) (Aspleniaceae), *Neottopteris rigida* (Aspleniaceae)	Taiwan (China Province)	Sawada (1959), Anonymous (1979)
733	*Macrophoma* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
734	*Macrosporium* sp.	*Equisetum hyemale* (Equisetaceae)	Poland	Mułenko et al. (2008)
735	*Marasmiellus scandens*	*Stenochlaena palustris* (Blechnaceae)	Malaysia	Turner (1971)
736	*Marasmiellus* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	West Indies	Minter et al. (2001)
737	*Marasmius crinis-equi*	*Stenochlaena palustris* (Blechnaceae)	Malaysia	Turner (1971)
738	*Marasmius* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
739	*Marssonina necans*	*Rumohra adiantiformis* (Dryopteridaceae), *Pteridium* aquilinum (Dennstaedtiaceae), *Pteris aquilina* (Pteridaceae), *Pteris* sp. (Pteridaceae)	Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, France, Germany, Poland, Romania, Switzerland, United States, United Kingdom, USSR	Alfieri et al. (1984), Punithalingam (1988), Vanev et al. (1997), Mułenko et al. (2008)
740	*Massalongina aquilina*	*Pteridium aquilinum* (Dennstaedtiaceae), *Polypodium californicum* (Polypodiaceae), *Polypodium* sp. (Polypodiaceae)	Italy, Pakistan, United Kingdom	Ahmad (1969), French (1989), Massalongo (1889), Petrini (1992), Fisher and Punithalingam (1993)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
741	*Melampsora scolopendrii*	Onoclea *sensibilis* (Woodsiaceae), *Osmunda claytoniana* (Osmundaceae), *Woodwardia virginica* (Blechnaceae)	United States	Orton (1898)
742	*Melaniella oreophila*	*Selaginella abyssinica* (Selaginellaceae), *Selaginella chrysocaula* (Selaginellaceae), *Selanginella chrysorrhiza* (Selaginellaceae), *Selaginella delicatula* (Selaginellaceae), *Selaginella* sp. (Selaginellaceae), *Selaginella tenera* (*Selaginellaceae*),	India, Zimbabwe	Bauer et al. (1999), McClymont et al. (2013)
743	*Melaniella selaginellae*	*Selaginella* sp. (Selaginellaceae)	Republik Indonesia	Bauer et al. (1999)
744	*Melanomma* sp.	*Adiantum tenerum* (Adiantaceae)	West Indies	Minter et al. (2001)
745	*Melasmia imitans*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteris* sp. (Pteridaceae)	United States	Gilbertsonet al. (1979), French (1989)
746	*Meliola angiopteridis*	*Angiopteris evecta* (Marattiaceae)	India	Hosagoudar and Goos (1990)
747	*Meliola juddiana*	*Pellaea rotundifolia* (Adiantaceae)	United States	Raabe et al. (1981)
748	*Meliola peleae*	*Pellaea rotundifolia* (Adiantaceae)	United States	Raabe et al. (1981)
749	*Meliola* sp.	*Adiantum* sp. (Adiantaceae)	West Indies	Minter et al. (2001)
750	*Mellitiosporium pteridinum*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae), *Pteris* sp. (Pteridaceae)	United Kingdom (England, Great Britain)	Dennis (1978), Cannon et al. (1985), Index Fungorum)
751	*Memnoniella dichroa*	*Cyathea* sp. (Cyatheaceae), *Equisetum hyemale* (Equisetaceae), *Pteridiurn aquilinum* (Dennstaedtiaceae)	Cuba, Russia, United Kingdom	Frankland (1976)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
752	*Memnoniella guttulatispora*	*Alsophila spinulosa* (Cyatheaceae)	China	Du et al. (2025)
753	*Memnoniella pseudodichroa*	*Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province)	Yeh et al. (2023)
754	*Memnoniella reniformis*	*Dryopteris* sp. (Dryopteridaceae)	China	Du et al. (2025)
755	*Menisporopsis theobromae*	Dead leaf of fern	China	Wu and Diao (2022)
756	*Metacapnodium fraserae*	*Cyathea medullaris* (Cyatheaceae), *Sphaeropteris medullaris* (Cyatheaceae)	New Zealand	Gadgil (2005)
757	*Metacapnodium moniliforme*	*Alsophila smithii* (Cyatheaceae), *Alsophila tricolor* (Cyatheaceae), *Blechnum discolor* (Blechnaceae), *Blechnum minor* (Blechnaceae), *Blechnum procerum* (Blechnaceae), *Blechnum* sp. (Blechnaceae), *Cyathea dealbata* (Cyatheaceae), *Cyathea smithii* (Cyatheaceae), *Dicksonia squarrosa* (Dicksoniaceae), *Gleichenia cunninghami* (Gleicheniaceae), *Hemitelia smithii* (Cyatheaceae), *Hymenophyllum* sp. (Hymenophyllaceae), *Sticherus cunninghamii* (Gleicheniaceae)	New Zealand	Pennycook (1989), Hughes (1981), Gadgil (2005)
758	*Metameris japonica*	*Osmunda regalis* (Osmundaceae), *Osmunda regalis* var. *japonica* (Osmundaceae)	Japan, Portugal	Unamuno (1941), Zhang et al. (2012), Phookamsak et al. (2014)
759	*Metasphaeria adianti*	*Adiantum reniforme* (Adiantaceae)	Spain (Canary Islands)	Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
760	*Metasphaeria caffra*	*Marattia fraxinea* (Marattiaceae)	South Africa	Doidge (1950)
761	*Microascus brevicaulis*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
762	*Microbotryum dianthorum*	*Cheilanthes* hispanica (Adiantaceae)	Spain	Almaraz (2002)
763	*Microbotryum violaceum*	*Pteridium aquilinum* (Dennstaedtiaceae)	Spain	Almaraz (2002)
764	*Microcyclus stuebelii*	*Pteris deflexa* (Pteridaceae)	Colombia, Ecuador	Dennis (1970)
765	*Microcyclus tinctoria*	*Alsophila dregei* (Cyatheaceae), Cyathea *dregei* (Cyatheaceae)	South Africa	Doidge (1950), Gorter (1981), Crous et al. (2000)
766	*Microdochium lycopodinum*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Austria, Germany	Jaklitsch and Voglmayr (2012), Zhang et al. (2015), Hernández-Restrepo et al. (2016)
767	*Micropeltis trichomanis*	*Trichomanes melanotrichum* (Hymenophyllaceae), *Trichomanes pyxidiferum* (Hymenophyllaceae)	South Africa	Doidge (1950), Crous et al. (2000)
768	*Micropeziza diphasii*	*Lycopodium clavatum* (Lycopodiaceae)	Sweden	Eriksson (2014)
769	*Micropodia arenula*	*Matteuccia struthiopteris* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Sweden	Eriksson (2014)
770	*Micropodia filicea*	*Dicksonia squarrosa* (Dicksoniaceae)	New Zealand	Spooner (1987)
771	*Micropodia pteridina*	*Dennstaedtia punctilobula* (Dennstaedtiaceae), *Polystichum munitum* (Dryopteridaceae), *Polystichum* sp. (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Finland, Sweden, United Kingdom, United States	Kanouse (1947), Eriksson (2014)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
772	*Microscypha grisella*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	United Kingdom (England, Scotland)	Frankland (1976), Dennis (1978), Kirk and Spooner (1984), Cannon et al. (1985)
773	*Microscypha* sp.	*Alsophila spinulosa* (Cyatheaceae)	China (Taiwan Province)	Kirschner et al. (2019)
774	*Microsphaeropsis olivacea*	*Huperzia selago* (Lycopodiaceae)	Poland	Mułenko et al. (2008)
775	*Microthyrium dryopteridis*	*Dryopteris* sp. (Dryopteridaceae)	China (Taiwan Province)	Kirschner et al. (2019)
776	*Mikronegeria fagi*	*Asplenium adiantum* var. *nigrum* (Aspleniaceae)	United Kingdom	Henderson (2000)
777	*Milesia acuta*	*Woodwardia fimbriata* (Blechnaceae)	United States (California)	Faull (1956)
778	*Milesia kashmirana*	*Athyrium dentigerum* (Woodsiaceae)	Pakistan	Afshan et al. (2010)
779	*Milesia magnusiana*	*Asplenium* adiantum-*nigrum* (Aspleniaceae)	France	Bubner et al. (2019)
780	*Milesia marginalis*	*Dryopteris marginalis* (Dryopteridaceae)	Canada, United States	Petrak (1944), Greene (1952), Anonymous (1960)
781	*Milesia miyabei*	*Dryopteris buschiana* (Dryopteridaceae), *Dryopteris clarkei* (Dryopteridaceae), *Dryopteris crassirhizoma* (Dryopteridaceae)	China, Japan, USSR	Kuprevich and Transchel (1957), Zhuang (2001)
782	*Milesia silvae-knysnae*	*Polystichum pungens* (Dryopteridaceae)	South Africa	Berndt (2008)
783	*Milesia* sp.	*Asplenium rutifolium* (Aspleniaceae)	South Africa	Berndt (2008)
784	*Milesia* sp.	*Asplenium aethiopicum* (Aspleniaceae)	South Africa	Berndt (2008)
785	*Milesia tenuis*	*Nephrolepis cordifolia* [= *Nephrolepis auriculata*] (Davalliaceae)	China (Taiwan Province), Japan, Philippines	Hiratsuka et al. (1992), Petrak (1944), Zhuang and Wei (1999), Kirschner et al. (2019)
786	*Milesina andina*	*Dryopteris* sp. (Dryopteridaceae)	Ecuador	Dennis (1970)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
787	*Milesina arisanense*	*Arachniodes amabilis* [= *Polystichum amabile*] (Dryopteridaceae), *Athyrium delavayi* (Woodsiaceae), *Athyrium elegans* (Woodsiaceae)	China (Taiwan Province), Japan	Kuprevich and Transchel (1957), Hiratsuka et al. (1992), Kirschner et al. (2019)
788	*Milesina asplenii-incisi*	*Asplenium incisum* (Aspleniaceae)	Japan, Republic of Korea, USSR	Hiratsuka et al. (1992) Cho and Shin (2004)
789	*Milesina asplenii-bulbiferi*	*Asplenium bulbiferum* (Aspleniaceae)	New Zealand	McKenzie et al. (2024)
790	*Milesina australis*	*Blechnum occidentale* (Blechnaceae), *Blechnum polypodioides* (Blechnaceae), *Blechnum* sp. (Blechnaceae), *Lygodium polymorphum* (Schizaeaceae), *Polytaenium feei* (Vittariaceae), *Thelypteris rudis* (Thelypteridaceae)	Colombia, Costa Rica, Mexico, Puerto Rico, Trinidad-Tobago, Virgin Islands, West Indies	Stevenson (1975), León and Cummins (1981), Buriticá and Pardo-Cardona (1996), Minter et al. (2001), Berndt (2004), Berndt (2008), Farr et al. (2021)
791	*Milesina blechni*	*Blechnum occidentale* (Blechnaceae), *Blechnum punctulatum* (Blechnaceae), *Blechnum spicant* (Blechnaceae), *Blechnum* sp. (Blechnaceae), *Lygodium polymorphum* (Schizaeaceae), *Rumohra adiantiformis* (Dryopteridaceae), *Struthiopteris spicant* (Blechnaceae)	Azores, Belgium, Colombia, Costa Rica, Czech Republic, Denmark, France, Germany, Greece, Portugal (Madeira Islands), Norway, Poland, Romania, South Africa, Spain, Sweden, Switzerland, Trinidad-Tobago, United Kingdom (Scotland), USSR	Hylander (1953), Pantidou (1973), Braun (1982), Kirk and Spooner (1984), Gjærum and Sunding (1986), Henderson (2000), Müller (2003), Berndt (2004), Vanderweyen and Fraiture (2007), Berndt (2008), Mułenko et al. (2008), Farr et al. (2021)
792	*Milesina blechnicola*	*Blechnum nipponicum* (Blechnaceae)	Japan	Hiratsuka et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
793	*Milesina carpatica*	*Asplenium septentrionale* (Aspleniaceae), *Dryopteris crassirhizoma* (Dryopteridaceae), *Dryopteris crassirhizoma* var. *setosa* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris miqueliana* (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae),	Austria, England, Germany, Japan, Norway, Republic of Korea, Ukraine, USSR	Kuprevich and Transchel (1957), Cho and Shin (2004), Bubner et al. (2019), Farr et al. (2021)
794	*Milesina carpatorum*	*Dryopteris crassirhizoma* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Leptorumohra miqueliana* (Dryopteridaceae), *Polystichum standishii* (Dryopteridaceae)	Czechoslovakia, Japan, Norway, United Kingdom, USSR	Hylander (1953), Azbukina (1984), Hiratsuka et al. (1992), Henderson (2000)
795	*Milesina chikugoensis*	*Cyrtomium fortunei* (Dryopteridaceae)	Japan	Hiratsuka et al. (1992)
796	*Milesina columbiensis*	*Nephrolepis pendula* (Davalliaceae), *Nephrolepis rivularis* (Davalliaceae)	Colombia, Puerto Rico	Chardón and Toro (1930), Farr et al. (2021)
797	*Milesina coniogrammes*	*Coniogramme fraxinea* (Adiantaceae), *Coniogramme intermedia* (Adiantaceae), *Coniogramme japonica* (Adiantaceae), *Plagiogyria euphlebia* (Plagiogyriaceae), *Pteris cretica* (Pteridaceae), *Pteris multifida* (Pteridaceae)	China (Taiwan Province), Japan, USSR	Kuprevich and Transchel (1957), Tai (1979), Hiratsuka et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
798	*Milesina coniogrammicola*	*Coniogramme intermedia* (Adiantaceae), *Coniogramme japonica* (Adiantaceae), *Pteris cretica* (Pteridaceae)	China (Taiwan Province), Japan	Hiratsuka (1991), Hiratsuka et al. (1992)
799	*Milesina consimilis*	*Thelypteris patens* (Thelypteridaceae)	Jamaica	Dale (1955)
800	*Milesina coreana*	*Dryopteris bissetiana* (Dryopteridaceae), *Dryopteris yabei* (Dryopteridaceae), *Polystichum* sp. (Dryopteridaceae); *Polystichum varium*. (Dryopteridaceae)	China (Taiwan Province), Japan, Republic of Korea	Anon (1969), Tai (1979), Hiratsuka (1991), Cho and Shin (2004), Kirschner et al. (2019)
801	*Milesina darkeri*	*Cryptogramma acrostichoides* (Adiantaceae), *Cryptogramma crispa* (Adiantaceae), *Cryptogramma crispa* var. *acrostichoides* (Adiantaceae), *Cryptogramma* sp. (Adiantaceae)	Canada, United States, USSR	Shaw (1973), McCain et al. (1990), Farr et al. (2021)
802	*Milesina dennstaedtiae*	*Dennstaedtia rubiginosa* (Dennstaedtiaceae)	Colombia	Chardón and Toro (1930)
803	*Milesina dieteliana*	*Dryopteris affinis* subsp. *affinis* (Dryopteridaceae), *Dryopteris* affinis subsp. *borreri* (Dryopteridaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), Polypodium *cambricum* (Polypodiaceae),	Bulgaria, Denmark, Germany, Norway, Poland, South Africa, Sweden, United Kingdom (Scotland)	Hylander (1953), Crous et al. (2000), Henderson (2000), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		Polypodium interjectum (Polypodiaceae), *Polypodium lycopodioides* (Polypodiaceae), *Polypodium mantoniae* (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae), *Polypodium vulgare* var. *serratum* (Polypodiaceae)		
804	*Milesina dilatata*	*Dryopteris austriaca* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae)	Canada, United States	Shaw (1973), Ginns (1986)
805	*Milesina diplazii*	*Diplazium siroyamaense* (Woodsiaceae), *Diplazium squamigerum* (Woodsiaceae)	Japan	Petrak (1944), Hiratsuka et al. (1992)
806	*Milesina dryopteridis*	*Rumohra adiantiformis* (Dryopteridaceae), *Rumohra standishii* (Dryopteridaceae), *Pteris fauriei* (Pteridaceae)	Japan	Hiratsuka et al. (1992), Kakishima et al. (2016)
807	*Milesina erythrosora*	*Dryopteris bissetiana* (Dryopteridaceae), *Dryopteris bissetiana* var. *sacrosancta* (Dryopteridaceae), *Dryopteris championi* (Dryopteridaceae), *Dryopteris erythrosora* (Dryopteridaceae), *Dryopteris lacera* (Dryopteridaceae), *Dryopteris quadripinnata* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Dryopteris varia* (Dryopteridaceae), *Leptorumohra quadripinnata* (Dryopteridaceae)	China (Taiwan Province), Japan	Anonymous (1979), Tai (1979), Hiratsuka et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
808	*Milesina exigua*	*Athyrium* sp. (Woodsiaceae), *Aspidium braunii* (Dryopteridaceae), *Ctenitis apiciflora* (Dryopteridaceae), *Ctenitis maximowicziana* (Dryopteridaceae), *Ctenitis subtripinnata* (Dryopteridaceae), *Dryopteris apiciflora* (Dryopteridaceae), *Dennstaedtia scabra* (Dennstaedtiaceae), *Hypolepis punctata* (Dennstaedtiaceae), *Lastrea glanduligera* (Thelypteridaceae), *Lastrea miqueliana* (Thelypteridaceae), *Lastrea oligophlebia* (Thelypteridaceae), *Microlepia strigosa* (Dennstaedtiaceae), *Polystichum aculeatum* (Dryopteridaceae), *Polystichum aculeatum* var. retrosopaleaceum (Dryopteridaceae), *Polystichum braunii* (Dryopteridaceae), *Polystichum craspedosorum* (Dryopteridaceae), *Polystichum hancockii* (Dryopteridaceae), *Polystichum igaense* (Dryopteridaceae), *Polystichum japonicum* (Dryopteridaceae), *Polystichum pseudomakinoi* var. *ambiguum* (Dryopteridaceae), *Polystichum retrosopaleaceum* (Dryopteridaceae), *Polystichum tripteron* (Dryopteridaceae)	Austria, China (Taiwan Province), Japan, Norway, Poland, Republic of Korea, Ukraine, USSR	Tai (1979), Hiratsuka (1991), Hiratsuka et al. (1992), Cho and Shin (2004), Zhuang (2005), Index Fungorum, Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
809	*Milesina faulliana*	*Cyrtomium caryotideum* (Dryopteridaceae), *Cyrtomium falcatum* (Dryopteridaceae), *Cyrtomium fortunei* (Dryopteridaceae), *Cyrtomium fortunei* var. *clivicola* (Dryopteridaceae)	Japan	Hiratsuka et al. (1992)
810	*Milesina feurichii*	*Asplenium alternifolium* (Aspleniaceae), *Asplenium septentrionale* (Aspleniaceae)	Finland, Germany, Norway, Romania, Sweden, Switzerland, USSR	Hylander (1953), Savulescu (1953), Kuprevich and Transchel (1957), Braun (1982), Bubner et al. (2019)
811	*Milesina formosana*	*Diplazium kawakamii* (Woodsiaceae), *Diplazium mettenianum* (Woodsiaceae)	China (Taiwan Province), Japan	Tai (1979), Hiratsuka et al. (1992)
812	*Milesina fructuosa*	*Dryopteris chinensis* (Dryopteridaceae), *Dryopteris gymnophylla* (Dryopteridaceae), *Dryopteris intermedia* (Dryopteridaceae), *Dryopteris sacrosancta* (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae), *Dryopteris spinulosa* var. *fructuosa* (Dryopteridaceae), *Dryopteris subtripinnata* (Dryopteridaceae)	Canada, Japan, Republic of Korea, United States, USSR,	Kuprevich and Transchel (1957), Anonymous (1960), Ginns (1986), Hiratsuka et al. (1992), Cho and Shin (2004)
813	*Milesina hashiokae*	*Dryopteris clarkei* (Dryopteridaceae), *Dryopsis lachoongensis* (Dryopteridaceae), *Goniophlebium amoenum* (Polypodiaceae), *Plagiogyria euphlebia* (Plagiogyriaceae), *Polypodium amoenum* (Polypodiaceae)	China (Taiwan Province)	Kirschner et al. (2019), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
814	*Milesina hiratsukae*	*Plagiogyria adnata* (Plagiogyriaceae), *Plagiogyria euphlebia* (Plagiogyriaceae), *Plagiogyria japonica* (Plagiogyriaceae), *Plagiogyria matsumureana* (Plagiogyriaceae)	China (Taiwan Province), Japan	Hiratsuka (1991, 1992)
815	*Milesina histiopteridis*	*Histiopteris incisa* (Dennstaedtiaceae)	New Zealand	McKenzie et al. (1992)
816	*Milesina insularis*	*Nephrolepis rivularis* (Davalliaceae), *Nephrolepis* sp. (Davalliaceae)	Puerto Rico, Virgin Islands, West Indies	Stevenson (1975), Minter et al. (2001), Farr et al. (2021)
817	*Milesia intermedia*	*Dryopteris spinulosa* var. *intermedia* (Dryopteridaceae)	Canada	Petrak (1944)
818	*Milesina itoana*	*Dryopteris crassirhizoma* (Dryopteridaceae), *Dryopteris sabaei* (Dryopteridaceae)	Japan, USSR	Hiratsuka et al. (1992)
819	*Milesina jezoensis*	*Polypodium virginianum* (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae)	Japan, USSR	Azbukina (1984), Hiratsuka et al. (1992)
820	*Milesina kameiana*	*Blechnum amabile* (Blechnaceae)	Japan	Hiratsuka et al. (1992)
821	*Milesina kriegeriana*	*Aspidium spinulosum* (Dryopteridaceae), *Dryopteris austriaca* (Dryopteridaceae), Dryopteris *azorica* (Dryopteridaceae), *Dryopteris borreri* (Dryopteridaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae), *Dryopteris spinulosa* var. *dilatata* (Dryopteridaceae)	Azores, Czech Republic, Denmark, England, Finland, Germany, Greece, Norway, Poland, Romania, Sweden, United Kingdom (Scotland), USSR	Hylander (1953), Gjærum and Sunding (1986), Bubner et al. (2019), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
822	*Milesina leviuscula*	*Cyrtomium falcatum* (Dryopteridaceae), *Polypodium californicum* (Polypodiaceae), *Polypodium glycyrrhiza* (Polypodiaceae), *Polypodium hesperium* (Polypodiaceae), Polypodium *occidentale* (Polypodiaceae), *Polypodium* sp. (Polypodiaceae), *Polypodium vulgare* var. *occidentale* (Polypodiaceae)	Canada, United States	Gjærum and Sunding (1986), Farr et al. (2021)
823	*Milesina lindsaeae*	*Lindsaea cuneata* (Dennstaedtiaceae)	New Zealand	McKenzie et al. (1992)
824	*Milesina lygodii*	*Lygodium* sp. (Schizaeaceae)	Guyana	Sydow (1925), Index Fungorum
825	*Milesina magellanica*	*Asplenium adiantum-nigrum* (Aspleniaceae), *Asplenium magellanicum* (Aspleniaceae), *Asplenium nigrum* (Aspleniaceae)	Chile, France, Italy, United Kingdom, USSR	Berndt (2008), Farr et al. (2021)
826	*Milesina marginalis*	*Dryopteris marginalis* (Dryopteridaceae)	United States	Hiratsuka (1958)
827	*Milesina microspora*	*Cyclosorus acuminatus* (Thelypteridaceae), *Dennstaedtia hirsuta* (Dennstaedtiaceae), *Leptogramma totta* (Thelypteridaceae)	Japan	Hiratsuka et al. (1992)
828	*Milesina miikensis*	*Crypsinus hastatus* (Polypodiaceae), *Rumohra amabilis* (Dryopteridaceae), *Rumohra amabilis* var. *yakushimensis* (Dryopteridaceae), *Rumohra simplicior* (Dryopteridaceae)	Japan	Hiratsuka et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
829	*Milesina miyabei*	*Dryopsis lachoongensis* (Dryopteridaceae), *Dryopteris clarkei* (Dryopteridaceae), *Dryopteris wallichiana* (Dryopteridaceae)	China, Japan	Kirschner et al. (2019)
830	*Milesina morrisonensis*	*Dryopteris paleacea* (Dryopteridaceae), *Dryopteris wallichiana* (Dryopteridaceae	China (Taiwan Province), Japan	Kirschner et al. (2019), Index Fungorum
831	*Milesina murariae*	*Asplenium ruta-muraria* (Aspleniaceae)	Austria, Estonia, France, Germany, Italy, Norway, Poland, Romania, Sweden, Switzerland, Ukraine, USSR	Savulescu (1953), Kuprevich and Transchel (1957), Schmid-Heckel (1988), Bubner et al. (2019), Farr et al. (2021)
832	*Milesina nervisequa*	*Cheilanthes viridis* var. viridis (Adiantaceae), *Pellaea hastata* (Adiantaceae), *Pellaea pteroides* (Adiantaceae), *Pellaea viridis* (Adiantaceae), *Polystichum adiantiforme* (Dryopteridaceae), *Rumohra adiantiformis* (Dryopteridaceae)	South Africa	Doidge (1950), Gorter (1981), Crous et al. (2000), Berndt (2008)
833	*Milesina niitakensis*	*Dryopteris peranema* (Dryopteridaceae), *Peranema cyatheoides* (Dryopteridaceae)	China (Taiwan Province), Japan	Kirschner et al. (2019), Index Fungorum
834	*Milesina odontosoriae*	*Odontosoria chinensis* var. tenuifolia (Dennstaedtiaceae), *Sphenomeris chinensis* (Dennstaedtiaceae)	Japan	Hiratsuka et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
835	*Milesina philippinensis*	*Nephrolepis cordifolia* (Davalliaceae)	China (Taiwan Province), Philippines,	Teodoro (1937), Anonymous (1979)
836	*Milesina polypodii*	*Polypodium interjectum* (Polypodiaceae), *Polypodium mantoniae* (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae)	France, Germany, Norway, Romania, Switzerland, United Kingdom (Great Britain, Scotland), USSR	Kuprevich and Transchel (1957), Jøestad (1962), Bubner et al. (2019)
837	*Milesina polypodii-superficialis*	*Asplenium unilaterale* (Aspleniaceae), *Colysis elliptica* (Polypodiaceae), *Colysis pothifolia* (Polypodiaceae), *Lepidomicrosorium buergerianum* (Polypodiaceae), *Lepidomicrosorium superficiale* (Polypodiaceae), *Microsorum buergerianum* (Polypodiaceae), *Polypodium polypodii-superficialis* (Polypodiaceae), *Polypodium superficiale* (Polypodiaceae)	China (Taiwan Province), Japan	Petrak (1950b), Anonymous (1979), Farr et al. (2021)
838	*Milesina polypodophila*	*Polypodium virginianum* (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae)	Canada, United States	Hunt (1928), Petrak (1937)
839	*Milesina polystichi-vestiti*	*Polystichum vestitum* (Dryopteridaceae)	New Zealand	McKenzie (2008a)
840	*Milesina pteridicola*	*Pteris dispar* (Pteridaceae), *Pteris cretica* (Pteridaceae), *Pteris* sp. (Pteridaceae), *Pteris hachijoensis* (Pteridaceae), *Pteris* multifida (Pteridaceae), *Pteris natiensis* (Pteridaceae)	China (Taiwan Province), Japan	Hiratsuka (1991), Hiratsuka et al. (1992), Zhuang (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
841	*Milesina pteridis*	*Pteris aquilina* (Pteridaceae)	United States	(Index Fungorum)
842	*Milesina pycnograndis*	*Polypodium virginianum* (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae)	Canada, United States	Ginns (1986), Farr et al. (2021)
843	*Milesina scolopendrii*	*Asplenium scolopendrium* (Aspleniaceae), *Phyllitis scolopendrium* (Aspleniaceae), *Scolopendrium vulgare* (Aspleniaceae)	Austria, Bulgaria, Germany, Japan, Poland, Romania, Spain, Switzerland, United Kingdom (Scotland), USSR	Jøestad (1962), Kirk and Spooner (1984), Bubner et al. (2019), Farr et al. (2021)
844	*Milesina* sp.	*Diplazium* sp. (Woodsiaceae)	Nepal	Balfour-Browne (1968)
845	*Milesina sublevis*	*Phyllitis scolopendrium* (Aspleniaceae)	Japan	Hiratsuka et al. (1992)
846	*Milesina tempes*	*Polystichum setiferum* (Dryopteridaceae)	Greece	Pantidou (1973)
847	*Milesina thailandica*	*Lygodium flexuosum* (Schizaeaceae)	Thailand	Ono et al. (2020)
848	*Milesina theissenii*	*Polystichum braunii* (Dryopteridaceae)	Abkhazia	Index Fungorum, Siemaszko (1933)
849	*Milesina vogesiaca*	*Dryopteris bissetiana* (Dryopteridaceae), *Dryopteris saxifraga* (Dryopteridaceae), *Dryopteris sparsa* (Dryopteridaceae), *Dryopteris varia* (Dryopteridaceae), *Dryopteris yabei* (Dryopteridaceae), *Polystichum aculeatum* (Dryopteridaceae), *Polystichum lonchitis* (Dryopteridaceae), *Polystichum munitum* (Dryopteridaceae), *Polystichum setiferum* (Dryopteridaceae), *Polystichum* sp. (Dryopteridaceae)	Austria, Canada, Czech Republic, France, Germany, Greece, Japan, Norway, Poland, Romania, United Kingdom, United States	Savulescu (1953), Ginns (1986), Hiratsuka et al. (1992), Kobayashi (2007), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
850	*Milesina whitei*	*Polystichum aculeatum* (Dryopteridaceae), *Polystichum munitum* (Dryopteridaceae), *Polystichum setiferum* (Dryopteridaceae), *Polystichum* sp. (Dryopteridaceae),	Austria, Croatia, France, Switzerland, United Kingdom, United States, USSR, Yugoslavia	Kuprevich and Transchel (1957) Henderson (2000), Bubner et al. (2019)
851	*Milesina wilczekiana*	*Cheilanthes pteridioides* (Adiantaceae)	Morocco, USSR	Kuprevich and Transchel (1957)
852	*Milesina winelandi*	*Polystichum munitum* (Dryopteridaceae)	United States	Cash (1958)
853	*Milesina woodwardiana*	*Woodwardia radicans* (Blechnaceae)	Spain	Bubner et al. (2019)
854	*Milesina philippinensis*	*Nephrolepis cordifolia* (Davalliaceae)	Philippines	Ono et al. (2020)
855	*Milesina tobinagae*	*Woodwardia japonica* (Blechnaceae), *Woodwardia orientalis* var. *formosana* (Blechnaceae)	Japan	Hiratsuka et al. (1992)
856	*Mixia osmundae*	*Osmunda cinnamomea* (Osmundaceae), *Osmunda japonica* (Osmundaceae), *Osmunda regalis* var. *japonica* (Osmundaceae)	China (Taiwan Province), Japan, United States	Kramer (1958), Toome et al. (2014), Kirschner et al. (2019)
857	*Mollisia* sp.	*Diphasium complanatum* (Lycopodiaceae)	Poland	Chlebicki (2005)
858	*Mollisia* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
859	*Mollisia* sp.	*Dryopteris dilatata* (Dryopteridaceae)	United States	Sprague (1955)
860	*Mollisia ventosa*	*Cyathea bicrenata* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)
861	*Monilochaetes alsophilae*	*Alsophila spinulosa* (Cyatheaceae)	China	Yang et al. (2023)
862	*Monilochaetes laeensis*	Cyatheaceae sp., *Dicksonia antarctica* (Dicksoniaceae)	Australia, United Kingdom	Rong and Gams (2000), Zhang et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
863	*Monodidymaria equiseti*	*Equisetum arvense* (Equisetaceae)	Russia, USSR	Braun (1994), Crous and Braun (2003)
864	*Monodisma* sp.	*Adiantum tenerum* (Adiantaceae)	West Indies	Minter et al. (2001)
865	*Monographos fuckelii*	*Pteridium* sp. (Dennstaedtiaceae)	United Kingdom	Cannon et al. (1985)
866	*Montagnula rhodophaea*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteris* sp. (Pteridaceae)	Pakistan	Ahmad (1969), Ahmad et al. (1997)
867	*Morenoina selaginellae*	*Selaginella mutica* var. *limitanea* (Selaginellaceae), *Selaginella pilifera* var. *pringlei* (Selaginellaceae), *Selaginella wrightii* (Selaginellaceae)	United States	Farr and Horner (1968)
868	*Morenoina* sp.	*Athyrium* filix-*femina* (Woodsiaceae)	United Kingdom (Scotland)	Kirk and Spooner (1984)
869	*Mortierella* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
870	Mucor fragilis	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
871	Mucor genevensis	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
872	Mucor hiemalis	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1966), Frankland (1976)
873	Mucor nederlandicus	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
874	Mucor racemosus	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
875	Mucor silvaticus	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
876	*Mycena fragillima*	*Polystichum munitum* (Dryopteridaceae)	United States	Smith (1947)
877	Mycena galopus	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
878	*Mycena lohwagii*	*Athyrium filix-femina* (Woodsiaceae)	United States	Redhead (1984)
879	*Mycena mamaku*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	McKenzie et al. (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
880	*Mycena pterigena*	*Athyrium distentifolium* (Woodsiaceae), *Athyrium filix*-femina (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Onoclea sensibilis* (Woodsiaceae)	Germany, United States	Redhead (1984), Schmid-Heckel (1988)
881	*Mycena* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
882	*Mycena* sp.	*Cyathea* sp. (Cyatheaceae)	West Indies	Minter et al. (2001)
883	*Mycena tenerrima*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
884	*Mycena alboaculeata*	*Blechnum brasiliense* (Blechnaceae)	Germany	Miersch and Lehmann (2015)
885	*Mycocentrospora fusarioides*	*Alsophila spinulosa* (Cyatheaceae)	China (Taiwan Province)	Kirschner et al. (2019)
886	*Mycoglaena filicina*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Sweden	Eriksson (2014)
887	*Mycosphaerella altera*	*Equisetum arvense* (Equisetaceae), *Equisetum hyemale* (Equisetaceae)	United States	Anonymous (1960), Farr et al. (2021)
888	*Mycosphaerella aquilina*	*Pteridium aquilinum* (Dennstaedtiaceae)	Canada, Denmark, Pakistan, Poland, Portugal, Sweden	Fries (1821), Munk (1957), Ginns (1986), Ahmad et al. (1997), Mułenko et al. (2008)
889	*Mycosphaerella asperulata*	*Polypodium vulgare* (Polypodiaceae)	Sweden	Eriksson (2014)
890	*Mycosphaerella aspidii*	*Dryopteris* sp. (Dryopteridaceae), *Equisetum arvense* (Equisetaceae), *Equisetum palustre* (Equisetaceae), *Equisetum silvaticum* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Sweden, United Kingdom (Scotland)	Kirk and Spooner (1984), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
891	*Mycosphaerella asplenii*	*Adiantum* sp. (Adiantaceae), *Alsophila australis* (Cyatheaceae), Asplenium *antiquum* (Aspleniaceae), *Asplenium* nidus (Aspleniaceae), *Asplenium onopteris* (Aspleniaceae), *Asplenium septentrionale* (Aspleniaceae), *Asplenium trichomanes* (Aspleniaceae), *Christella dentata* (Thelypteridaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Cook Islands, Croatia, Germany, Greece, India, Japan, Myanmar, Poland, United States, Yugoslavia	Pantidou (1973), Farr et al. (2021)
892	*Mycosphaerella botrychii*	*Botrychium dissectum* var. *obliquum* (Ophioglossaceae), *Botrychium multifidum* (Ophioglossaceae), *Botrychium multifidum* var. *intermedium* (Ophioglossaceae)	Canada, Sweden, United States	Farr et al. (2021)
893	*Mycosphaerella danaeae*	*Danaea nodosa* (Marattiaceae)	Dominican Republic	Ciferri (1961)
894	*Mycosphaerella ditissima*	*Lycopodium flexuosum* (Lycopodiaceae)	Philippines	Teodoro (1937)
895	*Mycosphaerella equiseti*	*Equisetum fluviatile* (Equisetaceae), *Equisetum palustre* (Equisetaceae), *Equisetum scirpoides* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Equisetum sylvaticum* (Equisetaceae), *Equisetum telmateia* (Equisetaceae)	Germany, Norway, Poland, Spain, Sweden, United Kingdom	Fuckel (1869), Holm and Holm (1994), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
896	*Mycosphaerella equiseticola*	*Equisetum arvense* (Equisetaceae), *Equisetum fluviatile* (Equisetaceae), *Equisetum palustre* (Equisetaceae), *Equisetum scirpoides* (Equisetaceae), *Equisetum silvaticum* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Equisetum sylvaticum* (Equisetaceae), *Equisetum telmateia* (Equisetaceae)	Germany, Norway, Russia, Sweden	Holm and Holm (1994), Farr et al. (2021)
897	*Mycosphaerella equisetina*	*Equisetum fluviatile* (Equisetaceae)	Germany, Sweden	Holm and Holm (1981), Eriksson (2014)
898	*Mycosphaerella filicum*	*Adiantum pedatum* (Adiantaceae), *Aspidium aculeatum* (Dryopteridaceae), *Asplenium* sp. (Aspleniaceae), *Blechnum gibbum* (Blechnaceae), *Cystopteris fragilis* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae), *Osmunda regalis* (Osmundaceae)	Canada, Denmark, Germany, Poland, Sweden, United Kingdom, United States	Eriksson (2014), Farr et al. (2021)
899	*Mycosphaerella indistincta*	*Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae)	United States	Anonymous (1960)
900	*Mycosphaerella insignita*	*Pteridium arachnoideum* (Dennstaedtiaceae)	Ecuador	Dennis (1970)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
901	*Mycosphaerella lycopodii*	*Huperzia selago* (Lycopodiaceae), *Lycopodium annotinum* var. *acerifolium* (Lycopodiaceae), *Lycopodium annotinum* var. *pungens* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae), *Lycopodium obscurum* var. *dendroideum* (Lycopodiaceae), *Lycopodium selago* (Lycopodiaceae), *Lycopodium selago* var. *appressum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Canada, Germany, Norway, Sweden, United States	Schmid-Heckel (1988), Holm and Holm (1994), Farr et al. (2021)
902	*Mycosphaerella lycopodii-annotini*	*Lycopodium annotinum* (Lycopodiaceae)	Poland, Sweden	Chlebicki (2005), Eriksson (2014)
903	*Mycosphaerella minor*	*Osmunda regalis* (Osmundaceae)	Canada	Ginns (1986)
904	*Mycosphaerella olindensis*	*Pteris excelsa* (Pteridaceae)	United States	Petrak (1953)
905	*Mycosphaerella osmundicola*	*Osmunda regalis* (Osmundaceae)	Sweden	Eriksson (2014)
906	*Mycosphaerella pteridiicola*	*Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Canada, United States	Anonymous (1960), Ginns (1986)
907	*Mycosphaerella pteridis*	*Adiantum tenerum* (Adiantaceae), *Pellaea mucronata* (Adiantaceae), *Pellaea* sp. (Adiantaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	France, Italy, Poland, Sweden, United Kingdom, United States	French (1989), Farr et al. (2021)
908	*Mycosphaerella* sp.	*Adiantum* sp. (Adiantaceae)	United States	Anonymous (1960)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
909	*Mycosphaerella* sp.	*Adiantum pedatum* (Adiantaceae)	United States	Anonymous (1960)
910	*Mycosphaerella* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United States (Florida)	Alfieri et al. (1984)
911	*Mycosphaerella* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Foister (1961)
912	*Mycosphaerella* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Germany	Rudolph et al. (2018)
913	*Mycosphaerella* sp.	*Trichomanes* sp. (Hymenophyllaceae)	Samoa	Dingley et al. (1981)
914	*Mycosphaerella* sp.	*Asplenium bulbiferum* (Aspleniaceae)	United States	Farr et al. (2021)
915	*Mycosphaerella* sp.	*Polystichum lineare* (Dryopteridaceae)	Papua New Guinea	Shaw (1984)
916	*Mycosphaerella* sp.	*Botrychium virginianum* (Ophioglossaceae)	United States	Greene (1952)
917	*Mycosphaerella* sp.	*Osmunda regalis* (Osmundaceae)	Malawi	Wiehe (1953)
918	*Mycosphaerella* sp.	*Polypodium virginianum* (Polypodiaceae)	United States	Farr et al. (2021)
919	*Mycosphaerella* sp.	*Polypodium vulgare* (Polypodiaceae)	Denmark	Munk (1957)
920	*Mycosphaerella* sp.	*Selaginella* sp. (Selaginellaceae)	United States	Cooke (1985)
921	*Mycosphaerella subastoma*	*Anemia adiantifolia* (Schizaeaceae)	Puerto Rico, Virgin Islands	Stevenson (1975)
922	*Mycosphaerella tirolensis*	*Pityrogramma sulphurea* (Adiantaceae)	Puerto Rico, Virgin Islands, West Indies	Stevenson (1975), Minter et al. (2001)
923	*Mycosphaerella tocoyenae*	*Gleichenia dichotoma* (Gleicheniaceae)	Brazil	Mendes et al. (1998)
924	*Mycovellosiella* sp.	*Phlebodium aureum* (Polypodiaceae)	United States	Farr et al. (2021)
925	*Mycowinteria alpina*	*Lycopodium alpinum* (Lycopodiaceae)	Norway, Sweden	Holm and Holm (1993), Eriksson (2014)
926	*Myiocopron millepunctatum*	*Psilotum nudum* (Psilotaceae)	Samoa	Dingley et al. (1981)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
927	*Myiocopron* sp.	*Pteridium* sp. (Dennstaedtiaceae)	Canada	Ginns (1986)
928	*Myriophacidium alsophilicola*	*Alsophila* sp. (Cyatheaceae)	Panama	Hou and Piepenbring (2009)
929	*Myriostigma filicinum*	*Trichomanes* sp. (Hymenophyllaceae)	Jamaica	Cash (1952)
930	*Myrothecium* sp.	*Pellaea rotundifolia* (Adiantaceae)	United States	Alfieri et al. (1984)
931	*Myrothecium* sp.	*Asplenium nidus* (Aspleniaceae)	United States	Alfieri et al. (1984)
932	*Myrothecium* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Alfieri et al. (1984)
933	*Myzocytium proliferum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
934	*Nagrajchalara neonawawii*	Fern	China (Zhejiang province)	Wu and Diao (2023)
935	*Nannfeldtia phegopteridis*	*Phegopteris connectilis* (Thelypteridaceae)	Sweden	Eriksson (2014)
936	*Nectria dacryocarpa*	*Cyathea* sp. (Cyatheaceae)	Indonesia	Farr et al. (2021)
937	*Nectria equiseti-hiemalis*	*Equisetum hyemale* (Equisetaceae)	Denmark	Munk (1957)
938	*Nectria filicina*	*Cyathea* sp. (Cyatheaceae)	United States	Anonymous (1960), French (1989)
939	*Nectria inventa*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
940	*Nectria manuka*	*Cyathea dealbata* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae)	New Zealand	Gadgil (2005)
941	*Nectria sylvana*	*Cyathea dealbata* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae), *Cyathea smithii* (Cyatheaceae), *Equisetum arvense* (Equisetaceae)	New Zealand	Samuels (1976a, 1976b)
942	*Nectriopsis squamulosa*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	Samuels (1988)
943	*Neoceratosperma alsophilae*	*Alsophila* sp. (Cyatheaceae)	Brazil	Guatimosim et al. (2016)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
944	*Neoceratosperma cyatheae*	*Cyathea delgadii* (Cyatheaceae)	Brazil	Guatimosim et al. (2016)
945	*Neonectria austroradicicola*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	McKenzie et al. (1992)
946	*Neonectria lugdunensis*	Pteridophytes	India	Sati and Belwal (2005)
947	*Neopestalotiopsis acrostichi*	*Acrostichum* aureum (Pteridaceae)	Thailand	Norphanphoun et al. (2019)
948	*Neopestalotiopsis clavispora*	*Selaginella kraussiana* (Selaginellaceae)	New Zealand	McClymont et al. (2013a)
949	*Neopestalotiopsis guajavicola*	*Nephrolepis* sp. (Davalliaceae)	Thailand	Seifollahi et al. (2023)
950	*Neopestalotiopsis hydeana*	*Cyclosorus* sp. (Thelypteridaceae), an unidentified fern	Thailand	Huanaluek et al. (2021), Seifollahi et al. (2023)
951	*Neopestalotiopsis magna*	*Pteridium* sp. (Dennstaedtiaceae)	France	Maharachchikumbura et al. (2014)
952	*Neopestalotiopsis musae*	*Asplenium nidus* (Aspleniaceae)	Thailand	Seifollahi et al. (2023)
953	*Neopestalotiopsis pandanicola*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)
954	*Neopestalotiopsis phangngaensis*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)
955	*Neopestalotiopsis psidii*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
956	*Neopestalotiopsis saprophytica*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)
957	*Neopestalotiopsis* sp.	Fern	Indonesia	Widiastuti et al. (2024)
958	*Neopestalotiopsis steyaertii*	*Pteridium* sp. (Dennstaedtiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Australia, Sri Lanka, UK	Mordue (1985), Petrini et al. (1993)
959	*Neoscirrhia matteucciicola*	*Matteuccia struthiopteris* (Woodsiaceae)	Canada	De Gruyter et al. (2002)
960	*Neoscirrhia osmundae*	*Osmunda regalis* (Osmundaceae)	Sweden, United States	Anonymous (1960), Eriksson (1992)
961	*Neurospora calospora*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
962	*Nidula candida*	*Pteridium aquilinum* (Dennstaedtiaceae)	United States	Shaw (1973)
963	*Nigrospora oryzae*	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)
964	*Nigrospora lacticolonia*	*Acrostichum aureum* (Pteridaceae)	China	Chethana et al. (2023)
965	*Nimbomollisia melatephroides*	*Lycopodium* sp. (Lycopodiaceae)	United Kingdom	Dennis (1986)
966	*Niptera capensis*	*Todea barbara* (Osmundaceae)	South Africa	Raitviir and Schneller (2007)
967	*Niptera melatephroides*	*Lycopodium annotinum* (Lycopodiaceae)	Sweden	Eriksson (2014)
968	*Nochascypha jacksonii*	*Osmunda* sp. (Osmundaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada	Batista and Ciferri (1962)
969	*Nodulisporium* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
970	*Nolanea* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
971	*Nothodactylaria nephrolepidis*	*Nephrolepis exaltata* (Davalliaceae)	South Africa	Crous et al. (2019)
972	*Oberwinklerozyma dicranopteridis*	*Dicranopteris dichotoma* (Gleicheniaceae)	China	Li et al. (2020a)
973	*Oedocephalum* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
974	*Oidiodendron cereale*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
975	*Oidiodendron griseum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
976	*Oidiodendron tenuissimum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
977	*Oligonema verrucosum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
978	*Oliveonia pauxilla*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada, Scandinavia, United Kingdom (England, Wales)	Hjortstam and Larsson (1997), Roberts (1999)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
979	*Ophiodiaporthe cyatheae*	*Cyathea lepifera* (Cyatheaceae)	China (Taiwan Province)	Fu et al. (2013), Kirschner et al. (2019)
980	*Orbilia auricolor*	*Cyathea bicrenata* (Cyatheaceae), *Marattia laxa* (Marattiaceae)	Mexico	Medel-Ortiz et al. (2020)
981	*Orbilia cf. auricolor*	*Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province)	Kirschner et al. (2019)
982	*Oxydothis* sp.	*Diplopterygium glaucum* (Gleicheniaceae)	Japan	Hosoya and Tanaka (2007)
983	*Pachydisca helotioides*	*Equisetum limosum* (Equisetaceae)	England	Dennis (1972)
984	*Pachypatella alsophilae*	*Alsophila contaminans* (Cyatheaceae), *Alsophila tricolor* (Cyatheaceae), *Cyathea caudata* (Cyatheaceae), *Cyathea dealbata* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae), unknown fern	Indonesia (Jawa), Malaysia, New Zealand, Philippines	Teodoro (1937), Petrak (1954), Farr et al. (2021), Index Fungorum
985	*Paecilomyces* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
986	*Papulaspora selaginellae*	Selaginella densa var. scopulorum (Selaginellaceae)	United States	Farr and Horner (1968)
987	*Papulaspora* sp.	*Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae)	United States	Farr and Horner (1968)
988	*Papulaspora* sp.	*Selaginella asprella* (Selaginellaceae)	United States	Farr and Horner (1968)
989	*Papulaspora* sp.	*Selaginella apoda* (Selaginellaceae)	United States	Farr and Horner (1968)
990	*Paraboeremia adianticola*	*Polystichum adiantiforme* (Dryopteridaceae), *Pteris ensiformis* (Pteridaceae)	United States	Chen et al. (2015)
991	*Paraboeremia selaginellae*	*Selaginella helvetica* (Selaginellaceae), *Selaginella kraussiana* (Selaginellaceae), *Selaginella* sp. (Selaginellaceae)	Italy, Netherlands, New Zealand	Aveskamp et al. (2010), McClymont et al. (2013b)
992	*Parachnopeziza triseptata*	*Athyrium alpestre* (Woodsiaceae)	Switzerland	Lowen and Dumont (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
993	*Paraconiothyrium lycopodinum*	*Lycopodium annotinum* (Lycopodiaceae)	Poland	Crous et al. (2013a)
994	*Paraconiothyrium polonense*	*Lycopodium clavatum* (Lycopodiaceae)	Poland	Crous et al. (2013a)
995	*Paramycosphaerella blechni*	*Blechnum serrulatum* (Blechnaceae)	Brazil	Guatimosim et al. (2016)
996	*Paramycosphaerella cyatheae*	*Cyathea delgadii* (Cyatheaceae)	Brazil	Guatimosim et al. (2016)
997	*Paramycosphaerella dicranopteridis*	*Dicranopteris flexuosa* (Gleicheniaceae), *Dicranopteris linearis* (Gleicheniaceae), *Dicranopteris linearis* var. *linearis* (Gleicheniaceae)	China (Fujian, Taiwan Province)	Kirschner and Liu (2014), Kirschner and Wang (2015), Guatimosim et al. (2016)
998	*Paramycosphaerella dicranopteridis-flexuosae*	*Dicranopteris flexuosa* (Gleicheniaceae)	Brazil	Guatimosim et al. (2016)
999	*Paramycosphaerella gleicheniae*	*Dicranopteris linearis* (Gleicheniaceae)	China (Fujian, Taiwan Province), India, Malaysia	Kirschner and Liu (2014), Kirschner and Wang (2015), Guatimosim et al. (2016)
1000	*Paramycosphaerella sticheri*	*Sticherus penniger* (Gleicheniaceae)	Brazil	Guatimosim et al. (2016)
1001	*Paramyrothecium roridum*	*Hemionitis arifolia* (Adiantaceae), *Platycerium* sp. (Polypodiaceae)	China, United States	Farr et al. (2021)
1002	*Paranectriella minuta*	*Adiantum* sp. (Adiantaceae)	West Indies	Minter et al. (2001)
1003	*Paratrimmatostroma kunmingense*	Fern	China	Phookamsak et al. (2019)
1004	*Parmulina stigmatopteridis*	*Dryopteris* sp. (Dryopteridaceae), *Stigmatopteris* sp. (Dryopteridaceae)	Ecuador, Venezuela	Dennis (1970)
1005	*Parvobasidium cretatum*	*Polystichum setiferum* (Dryopteridaceae)	Spain	Salcedo and Salcedo (1997)
1006	*Passalora lygodii*	*Lygodium japonicum* (Schizaeaceae)	China (Taiwan Province)	Kirschner and Wang (2015), Kirschner et al. (2019)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1007	*Passalora pteridis*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae), *Pteris* sp. (Pteridaceae)	Colombia, Georgia, India, Japan, Myanmar, Russia, Spain, United States, USSR	Chupp (1954), Thaung (1984), Crous and Braun (2003), Kamal (2010), Farr et al. (2021)
1008	*Passalora pyrrosiae*	*Pyrrosia lingua* (Polypodiaceae)	Japan	Motohashi et al. (2008)
1009	*Pellidiscus pallidus*	*Pteridium aquilinum* (Dennstaedtiaceae)	Canada	Ginns (1986)
1010	*Peltella* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United States	Shaw (1973)
1011	*Penicillium atrovenetum*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1012	*Penicillium aurantiogriseum*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1013	*Penicillium biourgeianum*	*Polystichum acrostichoides* (Dryopteridaceae)	United States	Serra and Peterson (2007)
1014	*Penicillium canescens*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1015	*Penicillium chrysogenum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1016	*Penicillium citrinum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1017	*Penicillium glabrum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1018	*Penicillium janczewskii*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1019	*Penicillium jensenii*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1020	Penicillium miczynskii	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1021	*Penicillium* sp.	*Gleichenia linearis* (Gleicheniaceae)	India	Kumaresan et al. (2013)
1022	*Penicillium* sp.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1023	*Penicillium* sp. (*Penicillium herquei* Series)	*Pteridiurn aquilinum* (Dennstaedtiaceae	United Kingdom	Frankland (1976)
1024	*Penicillium spinulosum*	*Pteridiurn aquilinum* (Dennstaedtiaceae	United Kingdom	Frankland (1976)
1025	*Penicillium thomii*	*Pteridiurn aquilinum* (Dennstaedtiaceae	United Kingdom	Frankland (1976)
1026	*Penicillium vulpinum*	*Pteridiurn aquilinum* (Dennstaedtiaceae	United Kingdom	Frankland (1976)
1027	*Peniophora ovalispora*	*Cyathea glauca* (Cyatheaceae)	France (Reunion)	Boidin et al. (1991)
1028	*Periconia byssoides*	*Pteridiurn aquilinum* (Dennstaedtiaceae	United Kingdom	Frankland (1976)
1029	*Periconia kunmingensis*	Pteridophyta	China	Phookamsak et al. (2024)
1030	*Periconia shyamala*	*Pteridium aquilinum* (Dennstaedtiaceae)	England	Hawksworth and Punithalingam (1975)
1031	*Periconiella benkertii*	*Polypodium* sp. (Polypodiaceae)	Puerto Rico	Braun (2004)
1032	*Periconiella cyatheae*	*Cyathea macgillivrayi* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae)	Papua New Guinea	Ellis (1971), Shaw (1984), Braun (2004)
1033	*Periconiella lygodii*	*Lygodium flexuosum* (Schizaeaceae), *Lygodium japonicum* (Schizaeaceae), *Lygodium* sp. (Schizaeaceae)	China (Taiwan Province), India, Laos, Philippines	Braun (2004), Kirschner and Wang (2015), Kirschner et al. (2019)
1034	*Periconiella rhachidicola*	*Angiopteris lygodiifolia* (Marattiaceae), *Polypodium plesiosorum* (Polypodiaceae)	China (Taiwan Province), Costa Rica	Braun (2004), Kirschner et al. (2019)
1035	*Periconiella* sp.	*Lygodium flexuosum* (Schizaeaceae)	Myanmar	Thaung (2008)
1036	*Peristomialis berkeleyi*	*Cyathea dealbata* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae)	New Zealand	Samuels (1976a)
1037	*Pestalotia lycopodina*	*Lycopodium complanatum* (Lycopodiaceae)	United States	Nag Raj (1993)
1038	*Pestalotia pteridis*	*Pteridium aquilinum* (Dennstaedtiaceae)	Italy	Nag Raj (1993)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1039	*Pestalotia* sp.	*Acrostichum* sp. (Pteridaceae)	United States	Raabe et al. (1981)
1040	*Pestalotia* sp.	*Alsophila australis* (Cyatheaceae)	Mauritius	Orieux and Felix (1968)
1041	*Pestalotia* sp.	*Elaphoglossum* sp. (Lomariopsidaceae)	United States	Raabe et al. (1981)
1042	*Pestalotia uljanischevii*	*Dryopteris raddeana* (Dryopteridaceae)	USSR	Nag Raj (1993)
1043	*Pestalotiopsis cibotii*	*Cibotium barometz* (Dicksoniaceae), *Cibotium schiedei* (Dicksoniaceae), *Cibotium* sp. (Dicksoniaceae)	China, United States	Anonymous (1960), Sutton (1993), Ge et al. (2009)
1044	*Pestalotiopsis dracontomelon*	*Nephrolepis cordifolia* (Davalliaceae)	Thailand	Seifollahi et al. (2023)
1045	*Pestalotiopsis funerea*	*Pteridium aquilinum* (Dennstaedtiaceae)	France	Nag Raj (1993)
1046	*Pestalotiopsis hydei*	*Cyclosorus* sp. (Thelypteridaceae)	Thailand	Seifollahi et al. (2023)
1047	*Pestalotiopsis japonica*	*Pteridium aquilinum* (Dennstaedtiaceae)	Papua New Guinea	Shaw (1984)
1048	*Pestalotiopsis linguae*	*Pyrrosia lingua* (Polypodiaceae)	China	Li et al. (2023)
1049	*Pestalotiopsis macrospora*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteris aquilina* (Pteridaceae)	Italy	Nag Raj (1993)
1050	*Pestalotiopsis maculans*	*Lygodium venustum* (Schizaeaceae)	Argentina	Bejar et al. (2019)
1051	*Pestalotiopsis monochaetioides*	*Platycerium alcicorne* (Polypodiaceae)	India	Mathur (1979)
1052	*Pestalotiopsis nanjingensis*	*Pyrrosia lingua* (Polypodiaceae)	China	Li et al. (2023)
1053	Pestalotiopsis neglecta	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1054	*Pestalotiopsis* sp.	*Adiantum tenerum* (Adiantaceae)	Barbados	Norse (1974)
1055	*Pestalotiopsis* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Urtiaga (2004)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1056	*Pestalotiopsis* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Farr et al. (2021)
1057	*Pestalotiopsis* sp.	*Adiantum* sp. (Adiantaceae)	India	Kumaresan et al. (2013)
1058	*Pestalotiopsis* sp.	*Polypodium echinodes* (Polypodiaceae)	Venezuela	Urtiaga (2004)
1059	*Pestalotiopsis* sp.	*Polypodium* polypodioides (Polypodiaceae)	United States	Farr et al. (2021)
1060	*Pestalotiopsis submersa*	*Equisetum* sp. (Equisetaceae)	India	Sati and Belwal (2005)
1061	*Pestalotiopsis virgatula*	*Cibotium barometz* (Dicksoniaceae)	China	Ge et al. (2009)
1062	*Peyronelina glomerulata*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Fisher et al. (1976)
1063	*Pezizella eburnea*	*Pteridium aquilinum* (Dennstaedtiaceae)	Azores	Dennis et al. (1977)
1064	*Phacidiella alsophilae*	*Alsophila capensis* (Cyatheaceae)	South Africa	Crous et al. (2020a)
1065	*Phacidina gracilis*	*Lycopodium alpinum* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae), *Lycopodium complanatum (Lycopodiaceae)Lycopodium obscurum (Lycopodiaceae), Lycopodium sp. (Lycopodiaceae), Lycopodium tristachyum (Lycopodiaceae)*	Austria, Netherlands, United Kingdom, United States, Sweden	Cooke (1977), Voss (1882), Holm and Holm (1981a), Farr et al. (2021)
1066	*Phaeocytostroma* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1067	*Phaeodochium myrothecioides*	*Selaginella lepidophylla* (Selaginellaceae)	United States	Farr and Horner (1968)
1068	*Phaeoisariopsis lygodii*	*Lygodium flexuosum* (Schizaeaceae)	India	Khan and Morgan-Jones (1995)
1069	*Phaeophialocephala cardiospora*	*Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province)	Yeh et al. (2025)
1070	*Phaeophleospora hymenocallidicola*	An unidentified fern	Thailand	Crous et al. (2015a)
1071	*Phaeophleospora hymenocallidis*	An unidentified fern	Thailand	Crous et al. (2015a)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1072	*Phaeophleospora pteridivora*	*Serpocaulon triseriale* (Polypodiaceae)	Brazil	Guatimosim et al. (2016)
1073	*Phaeosaccardinula marsileae*	*Marsilea quadrifolia* (Marsileaceae)	India	Pande (2008)
1074	*Phaeoscypha pteridiicola*	*Pteridium aquilinum* (Dennstaedtiaceae)	South Africa	Raitviir and Schneller (2007)
1075	*Phaeosphaeria berlesei*	*Equisetum hyemale* (Equisetaceae)	Canada, Denmark, Germany, Hungary, Russia, Sweden, Switzerland, United States	Hedjaroude (1969), Holm and Holm (1981b), Shoemaker and Babcock (1989), Câmara et al. (2002), Popov et al. (2008), Eriksson (2014)
1076	*Phaeosphaeria caricis*	*Lycopodium clavatum* (Lycopodiaceae)	United States	Shoemaker and Babcock (1989)
1077	*Phaeosphaeria celata*	*Equisetum hyemale* (Equisetaceae)	United States	Shoemaker and Babcock (1989)
1078	*Phaeosphaeria equiseti*	*Equisetum arvense* (Equisetaceae), *Equisetum hyemale* (Equisetaceae), *Equisetum scirpoides* (Equisetaceae), *Equisetum variegatum* (Equisetaceae)	Canada, Finland, Norway, Sweden, United States, USSR	Anonymous (1960), Shoemaker and Babcock (1989), Crane (1991), Holm and Holm (1994), Eriksson (2014)
1079	*Phaeosphaeria equiseti* var. *equiseti*	*Equisetum variegatum* (Equisetaceae)	Greenland, Norway	Holm and Holm (1981b)
1080	*Phaeosphaeria equiseti* var. *lindii*	*Equisetum variegatum* (Equisetaceae)	Norway	Holm and Holm (1981b)
1081	*Phaeosphaeria eustoma*	*Equisetum fluviatile* (Equisetaceae), *Equisetum pratense* (Equisetaceae)	Sweden	Eriksson (2014)
1082	*Phaeosphaeria fuckelii*	*Equisetum arvense* (Equisetaceae), *Equisetum fluviatile* (Equisetaceae), *Equisetum limosum* (Equisetaceae), *Equisetum silvaticum* (Equisetaceae), *Lycopodium clavatum* (Lycopodiaceae)	Sweden	Holm and Holm (1981b), Leuchtmann (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1083	*Phaeosphaeria heptamera*	*Lycopodium clavatum* (Lycopodiaceae)	United States	Shoemaker and Babcock (1989)
1084	*Phaeosphaeria hiemalis*	*Equisetum hyemale* (Equisetaceae)	Canada, Italy, United States	Shoemaker and Babcock (1989), Index Fungorum
1085	*Phaeosphaeria lindii*	*Equisetum arvense* (Equisetaceae), *Equisetum hyemale* (Equisetaceae), *Equisetum scirpoides* (Equisetaceae), *Equisetum variegatum* (Equisetaceae)	Greenland, Iceland, Norway	Shoemaker and Babcock (1989), Holm and Holm (1994), Câmara et al. (2002)
1086	*Phaeosphaeria lycopodiicola*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae), *Lycopodium complanatum* var. *flabelliforme* (Lycopodiaceae)	Canada, United States	Povah (1931), Shoemaker and Babcock (1989), Crane (1991)
1087	*Phaeosphaeria lycopodiicola* var. *major*	*Selaginella helvetica* (Selaginellaceae)	Argentina	Crane (1991)
1088	*Phaeosphaeria lycopodina* (= *Leptosphaeria crepinii*)	*Huperzia selago* (Lycopodiaceae), *Lycopodium annotinum* (Lycopodiaceae), *Lycopodium annotinum* var. *alpestris* (Lycopodiaceae), *Lycopodium annotinum* var. *pungens* (Lycopodiaceae), *Lycopodium alpinum* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae), *Lycopodium obscurum* (Lycopodiaceae), *Lycopodium obscurum* var. *dendroideum* (Lycopodiaceae), *Lycopodium selago* var. *appressum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Austria, Belgium, Canada, Czechoslovakia, Denmark, England, Finland, Germany, Greece, Hungary, Italy, Norway, Poland, Scandinavia, Sweden, Switzerland, United States, USSR	Dennis (1978), Leuchtmann (1984), Shoemaker and Babcock (1989), Crane (1991), Mułenko et al. (2008), Eriksson (2014)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1089	*Phaeosphaeria marciensis*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium annotinum* var. *pungens* (Lycopodiaceae), *Lycopodium obscurum* (Lycopodiaceae), *Lycopodium selago* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Canada, Finland, Germany, Norway, Sweden, Switzerland, United States	Eriksson (2014), Farr et al. (2021)
1090	*Phaeosphaeria nigrans*	*Equisetum variegatum* (Equisetaceae)	Switzerland	Leuchtmann (1984)
1091	*Phanerochaete calotricha*	*Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1092	*Phanerochaete laevis*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1093	*Phanerochaete sordida*	*Dryopteris filix-mas* (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1094	*Phialea cyathoidea f. ciliatula*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
1095	*Phialophora* sp.	*Gleichenia linearis* (Gleicheniaceae)	India	Kumaresan et al. (2013)
1096	*Phialophora* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1097	*Pholiota peleae*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
1098	*Phoma adianticola*	*Adiantum tenerum* (Adiantaceae), *Polystichum adiantiforme* (Dryopteridaceae), *Pteris ensiformis* (Pteridaceae)	Costa Rica, Netherlands, Puerto Rico, United States, Virgin Islands, West Indies	Stevenson (1975), Minter et al. (2001), De Gruyter et al. (1993), Boerema (2004)
1099	*Phoma aquilina*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Foister (1961)
1100	*Phoma exigua* var. *exigua*	*Nephrolepis cordifolia* (Davalliaceae)	New Zealand	Pennycook (1989)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1101	*Phoma* sp.	*Polypodium punctatum* (Polypodiaceae)	Cuba	Urtiaga (1986)
1102	*Phoma* sp.	*Polypodium punctatum* f. cristatum (Polypodiaceae)	Cuba	Urtiaga (1986)
1103	*Phoma* sp.	*Doryopteris pedata* (Adiantaceae)	Australia	Cook and Dubé (1989)
1104	*Phoma* spp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976), Petrini (1992)
1105	*Phoma* sp.	*Dicksonia* sp. (Dicksoniaceae)	United States	French (1989)
1106	*Phoma* sp.	*Dryopteris* sp. (Dryopteridaceae)	United States	Alfieri et al. (1984)
1107	*Phomatospora endopteris*	*Pteridium* sp. (Dennstaedtiaceae)	United Kingdom	Cannon et al. (1985)
1108	*Phomopsis filicina*	*Athyrium angustum* (Woodsiaceae)	United States	Farr et al. (2021)
1109	*Phomopsis* sp.	*Polypodium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
1110	*Phomopsis* sp.	*Athyrium angustum* (Woodsiaceae)	United States	Farr et al. (2021)
1111	*Phomopsis* sp.	*Adiantum latifolium* (Adiantaceae)	Cuba	Urtiaga (1986)
1112	*Phomopsis* sp.	*Adiantum latifolium* (Adiantaceae)	West Indies	Minter et al. (2001)
1113	*Phomopsis* sp.	*Polystichum munitum* (Dryopteridaceae)	United States	Shaw (1973)
1114	*Phomopsis* sp.	*Lygodium flexuosum* (Schizaeaceae), *Pteris* sp. (Pteridaceae)	India	Kumaresan et al. (2013)
1115	*Phomopsis* sp.	*Selaginella* sp. (Selaginellaceae)	India	Kumaresan et al. (2013)
1116	Phomopsis sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1117	*Phragmonaevia laetissima*	*Equisetum palustre* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	Italy, Spain	Unamuno (1941), Greuter et al. (1991)
1118	*Phragmosperma marattiae*	*Adiantum latifolium* (Adiantaceae)	Puerto Rico, Virgin Islands, West Indies	Minter et al. (2001), Stevenson (1975)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1119	*Phragmothyrium cheiropleuriae*	*Cheiropleuria bicuspis* var. *integrifolia* (Dipteridaceae)	Japan	Ken (1975)
1120	*Phycopeltis expansa*	*Anarthropteris lanceolata* (Polypodiaceae), *Asplenium* flaccidum (Aspleniaceae), *Alsophila tricolor* (Cyatheaceae), Asplenium *oblongifolium* (Aspleniaceae), *Blechnum discolor* (Blechnaceae), *Blechnum filiforme* (Blechnaceae), *Blechnum* sp. (Blechnaceae), *Doodia media* var. *austrlais* (Blechnaceae), *Hymenophyllum flabellatum* (Hymenophyllaceae), *Phymatosorus diversifolius* (Polypodiaceae), *Phymatosorus scandens* (Polypodiaceae), *Pyrrosia serpens* (Polypodiaceae), *Trichomanes reniforme* (Hymenophyllaceae)	New Zealand	Pennycook (1989)
1121	*Phycopeltis irregularis*	*Blechnum* sp. (Blechnaceae)	New Zealand	Pennycook (1989)
1122	*Phycopeltis prostrata*	*Anarthropteris lanceolata* (Polypodiaceae)	New Zealand	Pennycook (1989)
1123	*Phyllachora cibotii*	*Cibotium glaucum* (Dicksoniaceae)	United States	Raabe et al. (1981)
1124	*Phyllachora filicina* (= *Trabutiella filicina*)	*Polystichum lonchitis* (Dryopteridaceae)	United States	Jorstad (1953), Anonymous (1960)
1125	*Phyllachora flabella*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae)	United States	Farr et al. (2021)
1126	*Phyllachora rhopographoides*	*Pteris aquilina* (Pteridaceae)	Brazil	Hanlin (1992), Mendes et al. (1998)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1127	*Phyllosticta asplenii*	*Asplenium nidus* (Aspleniaceae), *Asplenium ruta-muraria* (Aspleniaceae), *Asplenium* sp. (Aspleniaceae)	South Africa, Switzerland, Zimbabwe	Doidge (1950), Whiteside (1966), Index Fungorum
1128	*Phyllosticta capitalensis*	*Botrychium* sp. (Ophioglossaceae), *Pyrrosia adnascens* (Polypodiaceae)	Thailand, United States	Wikee et al. (2013a), Wikee et al. (2013b)
1129	*Phyllosticta cystopteridis*	*Cystopteris fragilis* (Woodsiaceae)	United States	Farr et al. (2021)
1130	*Phyllosticta dryopteridis*	*Dryopteris thelypteris* (Dryopteridaceae)	United States	Greene (1964)
1131	*Phyllosticta dryopteris*	*Dryopteris* sp. (Dryopteridaceae)	South Africa	Doidge (1950)
1132	*Phyllosticta polypodiorum*	*Polypodium phyllitidis* (Polypodiaceae)	Brazil	Farr et al. (2021)
1133	*Phyllosticta pteridina*	*Pteridium aquilinum* (Dennstaedtiaceae)	Mexico	Alvarez (1976)
1134	*Phyllosticta pteridis*	*Asplenium nidus* (Aspleniaceae), *Pteridium* sp. (Dennstaedtiaceae), *Pteris cretica* (Pteridaceae)	Canada, South Africa, United States	Anonymous (1960), Conners (1967), Crous et al. (2000)
1135	*Phyllosticta* spp.	*Adiantum* sp. (Adiantaceae), *Gleichenia linearis* (Gleicheniaceae), *Lygodium flexuosum* (Schizaeaceae), *Selaginella* sp. (Selaginellaceae)	India	Kumaresan et al. (2013)
1136	*Phyllosticta* sp.	*Adiantum pedatum* (Adiantaceae)	United States	Farr et al. (2021)
1137	*Phyllosticta* sp.	*Adiantum* sp. (Adiantaceae)	United States (Florida)	Alfieri et al. (1984)
1138	*Phyllosticta* sp.	*Adiantum* sp. (Adiantaceae)	Zimbabwe	Whiteside (1966)
1139	*Phyllosticta* sp.	*Asplenium nidus* (Aspleniaceae)	United States	Alfieri et al. (1984)
1140	*Phyllosticta* sp.	*Botrychium virginianum* (Ophioglossaceae)	United States	Greene (1952b)
1141	*Phyllosticta* sp.	*Cyrtomium falcatum* (Dryopteridaceae)	United States	Alfieri et al. (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1142	*Phyllosticta* sp.	*Cystopteris bulbifera* (Woodsiaceae)	United States	Greene (1952a)
1143	*Phyllosticta* sp.	*Doryopteris pedata* (Adiantaceae)	United States	Alfieri et al. (1984)
1144	*Phyllosticta* sp.	*Lycopodium phlegmaria* (Lycopodiaceae)	United States	Miller (1991)
1145	*Phyllosticta* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Alfieri et al. (1984)
1146	*Phyllosticta* sp.	*Nephrolepis* sp. (Davalliaceae)	United States	Alfieri et al. (1984)
1147	*Phyllosticta* sp.	*Onoclea sensibilis* (Woodsiaceae)	United States	Farr et al. (2021)
1148	*Phyllosticta* sp.	*Osmunda* sp. (Osmundaceae)	United States	Alfieri et al. (1984)
1149	*Phyllosticta* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
1150	*Phyllosticta* sp.	*Platycerium bifurcatum* (Polypodiaceae)	Venezuela	Farr et al. (2021)
1151	*Phyllosticta* sp.	*Polypodium* sp. (Polypodiaceae)	United States	Anonymous (1960)
1152	*Phyllosticta* sp.	*Polypodium virginianum* (Polypodiaceae)	United States (Virginia)	Alfieri et al. (1984)
1153	*Phyllosticta* sp.	*Polystichum munitum* (Dryopteridaceae)	United States	Shaw (1973)
1154	*Phyllosticta* sp.	*Selaginella* sp. (Selaginellaceae)	United States	Alfieri et al. (1984)
1155	*Phyllosticta* sp.	*Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae)	United States	Farr et al. (2021)
1156	*Phyllosticta* sp.	*Stenochlaena tenuifolia* (Blechnaceae)	United States	Miller (1991)
1157	*Physalospora* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
1158	*Physalospora* sp.	*Adiantum* sp. (Adiantaceae)	United States	Alfieri et al. (1984)
1159	*Physarum* sp.	*Blechnum* sp. (Blechnaceae)	West Indies	Minter et al. (2001)
1160	*Physoderma marsileae*	*Marsilea vestita* (Marsileaceae)	United States	Brewster (1952)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1161	*Phytophthora cinnamomi*	*Cibotium glaucum* (Dicksoniaceae), *Cibotium chamissoi* (Dicksoniaceae), *Cibotium splendens* (Dicksoniaceae), *Cibotium* sp. (Dicksoniaceae), *Dicksonia antarctica* (Dicksoniaceae), *Dicranopteris linearis* (Gleicheniaceae), *Gleichenia* sp. (Gleicheniaceae), *Lycopodium deuterodensum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae), *Polystichum munitum* (Dryopteridaceae), *Pteris ensiformis* (Pteridaceae)	Australia, New Zealand, United States	Bega (1974), Raabe et al. (1981), Tidwell and Kosta (1984), Cook and Dubé (1989), Pennycook (1989), Farr et al. (2021)
1162	*Phytophthora cryptogea*	*Asplenium* sp. (Aspleniaceae)	United Kingdom	Jung et al. (2016)
1163	*Phytophthora multivora*	*Cyathea cooperi* (Cyatheaceae)	Spain	Jung et al. (2016)
1164	*Phytophthora ramorum*	*Adiantum aleuticum* (Adiantaceae), *Adiantum jordanii* (Adiantaceae)	United States	Vettraino et al. (2006)
1165	*Phytophthora* sp.	*Dicksonia squarrosa* (Dicksoniaceae)	Spain	Jung et al. (2016)
1166	*Phytophthora* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Alfieri et al. (1984)
1167	*Phytophthora* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
1168	*Pirottaea frondicola*	*Osmunda* sp. (Osmundaceae)	United States	Dennis (1963b)
1169	*Pithomyces* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1170	*Placodiplodia copelandii*	*Cyathea* sp. (Cyatheaceae)	Philippines	Sutton (1980)
1171	*Placosphaeria equiseti*	*Equisetum hyemale* (Equisetaceae)	Ukraine	Dudka et al. (2004)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1172	*Placothyrium athyrinum*	*Athyrium filix-femina* (Woodsiaceae)	Germany	Li et al. (2020b)
1173	*Planticonsortium tenue*	*Pteridium esculentum* (Dennstaedtiaceae)	New Zealand	Cooper (1976), Gadgil (2005)
1174	*Platycarpa polypodii*	*Polypodium* sp. (Polypodiaceae)	Jamaica	Couch (1949), Oberwinkler and Bandoni (1984)
1175	*Plectosphaera polypodii*	*Asplenium* sp. (Aspleniaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Lycopodium complanatum* (Lycopodiaceae), *Polypodium punctatum* (Polypodiaceae), *Polypodium punctatum f. cristatum* (Polypodiaceae), *Polypodium* sp. (Polypodiaceae), *Polypodium vulgare* (Polypodiaceae)	Bulgaria, Cuba, Europe, Mauritius, Portugal, Sweden, United Kingdom, United States	Cannon et al. (1985), Eriksson (1992, 2014), Farr et al. (2021)
1176	*Plectosphaera selaginellae*	*Selaginella rupestris* (Selaginellaceae)	United States	Farr and Horner (1968)
1177	*Plenodomus lijiangensis*	Fern	China	Phookamsak et al. (2019)
1178	*Plenodomus sinensis*	Fern	China	Phookamsak et al. (2019)
1179	*Plenozythia equiseti*	*Equisetum arvense* (Equisetaceae), *Equisetum laevigatum* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	United States	Cash (1952), Anonymous (1960), Mankin (1969)
1180	*Pleospora comata*	*Cystopteris fragilis* (Woodsiaceae)	Greenland	Conners (1967)
1181	*Pleospora eleocharidis* var. *eleocharidis*	*Lycopodium selago* var. *appressum* (Lycopodiaceae)	United States	Kobayasi et al. (1969)
1182	*Pleospora equiseti*	*Equisetum* sp. (Equisetaceae)	United Kingdom (Scotland)	Shoemaker (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1183	*Pleospora farlowiana*	*Selaginella arizonica* (Selaginellaceae), *Selaginella arenicola* subsp. *acanthonota* (Selaginellaceae), *Selaginella bigelovii* (Selaginellaceae), *Selaginella hansenii* (Selaginellaceae), *Selaginella lepidophylla* (Selaginellaceae), *Selaginella mutica* (Selaginellaceae), *Selaginella mutica* var. *limitanea* (Selaginellaceae), *Selaginella* pilifera var. *pringlei* (Selaginellaceae), *Selaginella rupestris* (Selaginellaceae), *Selaginella underwoodii* (Selaginellaceae), *Selaginella viridissima* (Selaginellaceae), *Selaginella wallacei* (Selaginellaceae)	United States	Farr and Horner (1968)
1184	*Pleospora filicina*	*Pteris aquilina* (Pteridaceae)	Luxembourg	Shoemaker (1992)
1185	*Pleospora helvetica*	*Cystopteris fragilis* (Woodsiaceae), *Lycopodium selago* (Lycopodiaceae),	Norway (Svalbard), United States	Kobayasi et al. (1969), Holm and Holm (1994)
1186	*Pleospora islandica*	*Lycopodium* sp. (Lycopodiaceae)	Sweden	Eriksson (2014)
1187	*Pleospora lycopodii*	*Lycopodium clavatum* (Lycopodiaceae)	Denmark	Shoemaker (1992)
1188	*Pleospora lycopodiicola*	*Lycopodium* alpinum (Lycopodiaceae), *Lycopodium annotinum* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae), *Lycopodium* sp. (Lycopodiaceae)	Denmark, Sweden	Eriksson (1992), Shoemaker (1992)
1189	*Pleospora penicillus*	*Cystopteris fragilis* (Woodsiaceae)	Greenland	Conners (1967)
1190	*Pleospora phaeocomoides*	*Cystopteris fragilis* (Woodsiaceae)	Canada	Conners (1967)
1191	*Pleospora pteridis*	*Pteris aquilina* (Pteridaceae)	Germany	Shoemaker (1992)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1192	*Pleospora* sp.	*Selaginella asprella* (Selaginellaceae)	United States	Farr and Horner (1968)
1193	*Pleospora* sp.	*Selaginella mutica* (Selaginellaceae)	United States	Farr and Horner (1968)
1194	*Pleospora* sp.	*Selaginella underwoodii* (Selaginellaceae)	United States	Farr and Horner (1968)
1195	*Pleospora* sp.	*Selaginella viridissima* (Selaginellaceae)	United States	Farr and Horner (1968)
1196	*Pleurophomopsis* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1197	*Pleurophragmium capense*	*Adiantum latifolium* (Adiantaceae), *Adiantum* sp. (Adiantaceae), *Dipteris conjugata* (Dipteridaceae)	Papua New Guinea, West Indies	Shaw (1984), Minter et al. (2001)
1198	*Pleurothyrium longissimum*	*Athyrium filix-femina* (Woodsiaceae), *Athyrium filix-femina* var. *californicum* (Woodsiaceae), *Athyrium filix-femina* subsp. *cyclosorum* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae)	Austria, United States	French (1989), Sutton (1980), Farr et al. (2021)
1199	*Pleurotus cyatheae*	*Cyathea mertensiana* (Cyatheaceae), *Cyathea spinulosa* (Cyatheaceae)	Japan	Kobayashi (2007)
1200	*Poculopsis ogrensis*	*Lycopodium annotinum* (Lycopodiaceae), *Lycopodium clavatum* (Lycopodiaceae)	Norway, Sweden	Dennis (1963a), Holm and Holm (1981a)
1201	*Podila minutissima*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1202	*Podila verticillata*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1203	*Podochytrium clavatum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1204	*Poitrasia circinans*	*Equisetum arvense* (Equisetaceae)	India	Rai (1990)
1205	*Polycladium equiseti*	*Equisetum* sp. (Equisetaceae)	United Kingdom	Dennis (1986)
1206	*Polycyclina rhytismoides*	*Lomaria imperialis* (Blechnaceae)	Brazil, Venezuela	Theissen and Sydow (1915), Farr (1973), Marasinghe et al. (2023)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1207	*Polycyclus andinus*	Pteridophyta	Ecuador	Theissen and Sydow (1915)
1208	*Polycyclus marginalis*	*Diplazium lindbergii* (Woodsiaceae)	Ecuador	Petrak (1950a)
1209	*Preussia vulgaris*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1210	*Protocreopsis pertusa*	*Alsophila firma* (Cyatheaceae), *Cyathea dealbata* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae), *Marattia laxa* (Marattiaceae)	Mexico, New Zealand	Samuels (1976a), Medel-Ortiz et al. (2020)
1211	*Pseudocercospora abacopteridicola*	*Abacopteris urophylla* (Thelypteridaceae), *Adiantum* sp. (Adiantaceae)	Brazil, Singapore	Guatimosim et al. (2016)
1212	*Pseudocercospora adianti*	*Adiantum tetraphyllum* (Adiantaceae), *Adiantum tetraphyllum* var. *acuminata* (Adiantaceae), *Adiantum* sp. (Adiantaceae)	India, Venezuela	Chupp (1954), Dennis (1970), Kamal (2010), Braun et al. (2013)
1213	*Pseudocercospora angiopteridis*	*Angiopteris evecta* (Marattiaceae), *Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province), Indonesia	Braun et al. (2013), Kirschner et al. (2019)
1214	*Pseudocercospora arachniodis*	*Arachniodes* sp. (Dryopteridaceae)	China	Guo (1993)
1215	*Pseudocercospora athyrii*	*Deparia japonica* (Woodsiaceae), *Deparia longipes* (Woodsiaceae), *Deparia petersenii* (Woodsiaceae)	China (Taiwan Province)	Braun et al. (2013), Kirschner and Liu (2014), Kirschner et al. (2019)
1216	*Pseudocercospora blechi*	*Blechnum* sp. (Blechnaceae)	Panama	Piepenbring (2006)
1217	*Pseudocercospora brackenicola*	*Pteridium arachnoideum* (Dennstaedtiaceae)	Brazil	Guatimosim et al. (2016)
1218	*Pseudocercospora christellae*	*Christella parasitica* (Thelypteridaceae)	Thailand	Phengsintham et al. (2013)
1219	*Pseudocercospora cyatheae*	*Cyathea* sp. (Cyatheaceae), *Sphaeropteris lepifera* (Cyatheaceae)	China (Taiwan Province), Japan (Nansei-Shoto)	Nakashima et al. (2006), Kirschner et al. (2019)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1220	*Pseudocercospora cyatheicola*	*Cyathea australis* (Cyatheaceae)	Australia	Braun et al. (2013)
1221	*Pseudocercospora cyathicola*	*Cyathea australis* (Cyatheaceae)	Australia	Crous et al. (2011a)
1222	*Pseudocercospora cyclosori*	*Christella dentata* (Thelypteridaceae)	India (West Bengal)	Kirschner et al. (2019)
1223	*Pseudocercospora davalliae*	*Davallia fejeensis* (Davalliaceae), *Davallia tenuifolia* (Davalliaceae), *Odontosoria chinensis* (*Dennstaedtiaceae*)	Brazil, India	Braun and Freire (2004), Kamal (2010), Braun et al. (2013)
1224	*Pseudocercospora davalliicola*	*Davallia fejeensis* (Davalliaceae)	Brazil	Braun et al. (2013)
1225	*Pseudocercospora gleicheniae*	*Dicranopteris linearis* (Gleicheniaceae)	Gabon	Braun et al. (2013)
1226	*Pseudocercospora helminthostachydis*	*Helminthostachys zeylanica* (Ophioglossaceae)	India, Myanmar, Philippines	Crous and Braun (2003), Kamal (2010)
1227	*Pseudocercospora insueta*	*Alsophila hirta* (Cyatheaceae)	Ecuador	Petrak (1950a), Dennis (1970)
1228	*Pseudocercospora lonchitidis*	*Lonchitis hirsuta* (Dennstaedtiaceae)	Venezuela	Crous and Braun (2003)
1229	*Pseudocercospora lycopodis*	*Lygodium macrostachyum* (Schizaeaceae), *Lygodium microstachyum* (Schizaeaceae)	China (Taiwan Province)	Chupp (1954), Anonymous (1979)
1230	*Pseudocercospora lygodiicola*	*Lygodium japonicum* (Schizaeaceae), *Lygodium volubile* (Schizaeaceae)	Brazil, China	Guatimosim et al. (2016)
1231	*Pseudocercospora lygodiigena*	*Lygodium* sp. (Schizaeaceae)	India	Braun et al. (2013)
1232	*Pseudocercospora microlepiae*	*Microlepia speluncae* (Dennstaedtiaceae), *Microlepia trichocarpa* (Dennstaedtiaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1233	*Pseudocercospora microsori*	*Microsorum pustulatum* (Polypodiaceae)	Australia	Shivas et al. (2010)
1234	*Pseudocercospora nephrolepidicola*	*Nephrolepis falcata* (Davalliaceae)	Australia	Crous et al. (2010)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1235	*Pseudocercospora nephrolepidigena*	*Nephrolepis biserrata* (Davalliaceae), *Nephrolepis* cordifolia (Davalliaceae), *Nephrolepis* sp. (Davalliaceae)	Thailand	Braun et al. (2013), Chen et al. (2020)
1236	*Pseudocercospora nephrolepidis*	*Nephrolepis cordifolia* (Davalliaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1237	*Pseudocercospora paranaensis*	*Cyathea atrovirens* (Cyatheaceae)	Brazil	Guatimosim et al. (2016)
1238	*Pseudocercospora phyllitidis*	*Angiopteris* sp. (Marattiaceae), *Campyloneurum phyllitidis* (Polypodiaceae), *Davallia trichomanoides* (Davalliaceae), *Davallia trichomanoides* f. *barbata* (Davalliaceae), *Nephrolepis biserrata* (Davalliaceae),*Nephrolepis cordifolia* (Davalliaceae), *Nephrolepis exaltata* (Davalliaceae), *Osmunda regalis* (Osmundaceae), *Polypodium phyllitidis* (Polypodiaceae), *Polypodium polypodioides* (Polypodiaceae), *Pteris ensiformis* (Pteridaceae), *Pteris* sp. (Pteridaceae), *Rumohra adiantiformis* (Dryopteridaceae), *Thelypteris tetragona* (Thelypteridaceae)	India, Jamaica, North America, Panama, Puerto Rico, Thailand, United Kingdom, United States	Chupp (1954), Stevenson (1975), Alfieri et al. (1984), Thaung (1984), Meeboon et al. (2007), Kamal (2010), Braun et al. (2013), Chen et al. (2020), Farr et al. (2021)
1239	*Pseudocercospora plagiogyriae*	*Plagiogyria euphlebia* (Plagiogyriaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1240	*Pseudocercospora polypodiacearum*	*Lygodium flexuosum* (Schizaeaceae), *Lygodium japonicum* (Schizaeaceae), *Lygodium* sp. (Schizaeaceae), *Pteris biaurita* (Pteridaceae)	China, India	Shukla et al. (1982), Zhuang (2001), Kamal (2010), Braun et al. (2013)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1241	*Pseudocercospora pteridicola*	*Pteris alata* (Pteridaceae), *Pteris biaurita* (Pteridaceae), *Pteris semipinnata* (Pteridaceae), *Pteris vittata* (Pteridaceae)	China (Taiwan, Chongqing)	Braun et al. (2013), Kirschner and Wang (2015), Kirschner et al. (2019)
1242	*Pseudocercospora pteridigena*	*Pteris* sp. (Pteridaceae)	Colombia	Braun et al. (2013)
1243	*Pseudocercospora pteridis*	*Pteris vittata* (Pteridaceae)	China	Liu and Guo (1998)
1244	*Pseudocercospora pteridophytophila*	*Cyclosorus acuminatus* (Thelypteridaceae), *Cyclosorus parasiticus* (Thelypteridaceae)	China (Taiwan Province), Thailand	Kirschner and Liu (2014), Kirschner et al. (2019)
1245	*Pseudocercospora ptisanae*	*Ptisana salicina* (Marattiaceae)	New Zealand	Braun et al. (2013)
1246	*Pseudocercospora rumohrae*	*Arachniodes amabilis* (Dryopteridaceae), *Marattia salicina* (Marattiaceae), *Rumohra adiantiformis* (Dryopteridaceae)	China (Taiwan Province), New Zealand	Liu and Guo (1998), Braun et al. (2013), Guatimosim et al. (2016), Kirschner et al. (2019)
1247	*Pseudocercospora serpocaulonicola*	*Serpocaulon triseriale* (Polypodiaceae)	Brazil	Guatimosim et al. (2016)
1248	*Pseudocercospora* sp.	*Nephrolepis hirsutula* (Davalliaceae)	Australia	Hyde and Alcorn (1993)
1249	*Pseudocercospora* sp.	*Polypodium echinodes* (Polypodiaceae)	Venezuela	Urtiaga (2004)
1250	*Pseudocercospora tectariae*	*Tectaria harlandii* (Dryopteridaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1251	*Pseudocercospora thelypteridis*	*Nephrolepis* sp. (Davalliaceae), *Metathelypteris laxa* (Thelypteridaceae), *Thelypteris laxa* (Thelypteridaceae), *Thelypteris* sp. (Thelypteridaceae)	China (Taiwan Province), Brazil, Brunei Darussalam	Hsieh and Goh (1990), Liu and Guo (1998), Braun and Sivapalan (1999), Braun et al. (2013), Guatimosim et al. (2016), Kirschner et al. (2019)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1252	*Pseudocercospora trichogena*	*Deparia petersenii* (Woodsiaceae), *Macrothelypteris torresiana* (Thelypteridaceae)	Brazil	Guatimosim et al. (2016)
1253	*Pseudocercosporella aspidii*	*Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae)	Czechoslovakia, Germany, Switzerland, Ukraine	Braun (1995)
1254	*Pseudocercosporella* sp.	*Dipteris conjugata* (Dipteridaceae)	Papua New Guinea	Shaw (1984)
1255	*Pseudodiplodia asplenii*	*Asplenium* sp. (Aspleniaceae)	Armenia	Farr et al. (2021)
1256	*Pseudogliomastix protea*	*Cyathea arborea* (Cyatheaceae)	Cuba	Delgado-Rodriguez and Mena-Portales (2004)
1257	*Pseudopeltis filicum*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Sweden	Eriksson (2014)
1258	*Pseudopeltis perminuta*	*Diphasiastrum complanatum* (Lycopodiaceae)	Sweden	Eriksson (2014)
1259	*Pseudopithomyces chartarum*	*Equisetum hyemale* var. *japonici* (Equisetaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Brazil, Japan, Venezuela	Farr et al. (2021)
1260	*Pseudoplagiostoma alsophilae*	*Alsophila spinulosa* (Cyatheaceae)	China	Zhang et al. (2023b)
1261	*Psilachnum chrysostigmum*	*Athyrium distentifolium* (Woodsiaceae), *Athyrium filix-femina* (Woodsiaceae), *Adiantum pedatum* (Woodsiaceae), *Cibotium* sp. (Dicksoniaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Nephrodium filix-mas* (Dryopteridaceae), *Osmunda claytoniana* (Osmundaceae),	Germany, Spain, Sweden, United Kingdom (Scotland), United States	Raabe et al. (1981), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		Osmunda cinnamomea (Osmundaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Sadleria* sp. (Blechnaceae)		
1262	*Psilachnum inquilinum*	*Equisetum fluviatile* (Equisetaceae), *Equisetum limosum* (Equisetaceae), *Equisetum palustre* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Equisetum telmateia* (Equisetaceae)	Sweden, United Kingdom	Cannon et al. (1985), Dennis (1986), Eriksson (2014)
1263	*Psilachnum miniatum*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Sweden	Kanouse (1947), Eriksson (2014)
1264	*Psilachnum pteridigenum*	*Pteridium* sp. (Dennstaedtiaceae)	United Kingdom	Cannon et al. (1985)
1265	*Psilachnum* sp.	*Equisetum telmateia* (Equisetaceae)	Germany	Lotz-Winter et al. (2011)
1266	*Ptechetelium cyatheae*	*Cyathea stuebelii* (Cyatheaceae), unidentified fern	Bolivia, Ecuador	Oberwinkler and Bandoni (1984), Couch (1949)
1267	*Puccinia clematidis*	*Panicularia grandis* (Dicksoniaceae)	United States	Arthur (1924b)
1268	*Puccinia coronata*	*Panicularia pauciflora* (Dicksoniaceae)	United States	Hotson (1925)
1269	*Puccinia panicullariae*	*Panicularia americana* (Dicksoniaceae)	United States	Arthur (1901)
1270	*Puccinia poculiformis*	*Panicularia elata* (Dicksoniaceae), *Panicularia pauciflora* (Dicksoniaceae)	United States	Blasdale (1919), Farr et al. (2021)
1271	*Pyrenophora allosuri*	*Allosorus crispus* (Adiantaceae)	Switzerland	Farr et al. (2021)
1272	*Pyrenophora filicina*	*Cystopteris fragilis* (Woodsiaceae)	Greenland, Norway	Conners (1967), Holm and Holm (1994)
1273	*Pythium angustatum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1274	*Pythium aphanidermatum*	*Pteridium aquilinum* (Dennstaedtiaceae)	South Africa	Crous et al. (2000)
1275	*Pythium aquatile*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1276	*Pythium butleri*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1277	*Pythium dissimile*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1278	*Pythium myriotylum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1279	*Pythium* sp.	*Alsophila* sp. (Cyatheaceae)	United States	Alfieri et al. (1984)
1280	*Pythium* sp.	*Aglaomorpha meyeniana* (Polypodiaceae)	United States	Alfieri et al. (1984)
1281	*Pythium* sp.	*Platycerium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
1282	*Pythium* sp.	*Platycerium bifurcatum* (Polypodiaceae)	United States	Alfieri et al. (1984)
1283	*Pythium* sp.	*Ceratopteris thalictroides* (Pteridaceae)	United States	Alfieri et al. (1984)
1284	*Pythium* sp.	*Selaginella* sp. (Selaginellaceae)	United States	Alfieri et al. (1984)
1285	*Pythium* sp.	*Pteris* sp. (Pteridaceae)	United States	Raabe et al. (1981)
1286	*Pythium* sp.	*Pteris cretica* var. *wimsettii* (Pteridaceae)	United Kingdom (Scotland)	Farr et al. (2021)
1287	*Pythium* sp.	*Adiantum decorum* (Adiantaceae)	United States	Raabe et al. (1981)
1288	*Pythium* sp.	*Doryopteris pedata* var. *palmata* (Adiantaceae)	United States	Alfieri et al. (1984)
1289	*Pythium* sp.	*Pellaea rotundifolia* (Adiantaceae)	United States	Alfieri et al. (1984)
1290	*Pythium* sp.	*Asplenium* sp. (Aspleniaceae)	United States	Alfieri et al. (1984)
1291	*Pythium* sp.	*Asplenium nidus* (Aspleniaceae)	United States	Alfieri et al. (1984)
1292	*Pythium* sp.	*Asplenium bulbiferum* (Aspleniaceae)	United States	French (1989)
1293	*Pythium* sp.	*Davallia trichomanoides f. barbata* (Davalliaceae)	United States	Alfieri et al. (1984)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1294	*Pythium* sp.	*Nephrolepis biserrata* (Davalliaceae)	United States	Raabe et al. (1981)
1295	*Pythium* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Raabe et al. (1981)
1296	*Pythium* sp.	*Nephrolepis* sp. (Davalliaceae)	United States	Alfieri et al. (1984)
1297	*Pythium* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Germany	Rudolph et al. (2018)
1298	*Pythium* sp.	*Cibotium* sp. (Dicksoniaceae)	United States	Alfieri et al. (1984)
1299	*Pythium* sp.	*Cyrtomium* sp. (Dryopteridaceae)	United States	Alfieri et al. (1984)
1300	*Pythium* sp.	*Cyrtomium falcatum* (Dryopteridaceae)	United States	Alfieri et al. (1984)
1301	*Pythium* sp.	*Polystichum adiantiforme* (Dryopteridaceae)	United States	Raabe et al. (1981)
1302	*Pythium* sp.	*Polystichum munitum* (Dryopteridaceae)	United States	French (1989)
1303	*Pythium* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	United States (Florida)	Alfieri et al. (1984)
1304	*Pythium volutum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1305	*Radiciseta blechni*	*Blechnum orientale* (Blechnaceae)	China (Taiwan Province)	Sawada (1959)
1306	*Ramichloridium schulzeri*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
1307	*Ramularia asplenii*	*Asplenium ruta-muraria* (Aspleniaceae), *Asplenium trichomanes* (Aspleniaceae)	France, Germany, United Kingdom (Great Britain), Italy, Poland, Switzerland	Braun (1998), Ruszkiewicz (2000)
1308	*Ramularia botrychii*	*Botrychium lunaria* (Ophioglossaceae), *Botrychium robustrum* (Ophioglossaceae)	Asia, Finland, Russia, Switzerland	Braun (1998)
1309	*Ramularia dryopteridacearum*	*Dryopteris dilatata* (Dryopteridaceae)	Austria	Braun (1998)
1310	*Ramularia microlepiae*	*Microlepia* sp. (Dennstaedtiaceae)	United States	Raabe et al. (1981)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1311	*Ramularia nephrolepidis*	*Nephrolepis exaltata* (Davalliaceae)	United States	Raabe et al. (1981)
1312	*Ramularia pteridicola*	*Cyrtomium falcatum* (Dryopteridaceae), *Pteris aquilina*, *Dryopteris filix-mas* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Austria, Czech Republic, Germany, Slovenia	Braun (1998), Lotz-Winter et al. (2011)
1313	*Ramularia scolopendrii*	*Phyllitis scolopendrium* (Aspleniaceae)	France, Germany, United Kingdom (Great Britain), Ireland, Italy	Braun (1998), Braun (2000)
1314	*Repetobasidiellum fusisporum*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Norway, Scandinavia	Hjortstam and Larsson (1997), Ryvarden et al. (2003)
1315	*Resinicium bicolor*	*Cibotium chamissoi* (Dicksoniaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Scandinavia, United States	Hjortstam and Larsson (1997), Gilbertson and Hemmes (1997)
1316	*Resinomycena saccharifera*	*Pteridium aquilinum* (Dennstaedtiaceae)	Spain	Farr et al. (2021)
1317	*Resticularia marchaliana*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1318	*Resupinatus* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
1319	*Rhagadolobiopsis thelypteridis*	*Thelypteris serrata* (Thelypteridaceae)	Brazil	Guatimosim et al. (2014)
1320	*Rhagadolobium bakeri*	*Aspidium* sp. (Dryopteridaceae)	Philippines	Teodoro (1937)
1321	*Rhagadolobium dicksoniifolium*	*Dicksonia antarctica* (Dicksoniaceae), *Dicksonia lanata* (Dicksoniaceae), *Dicksonia squarrosa* (Dicksoniaceae)	Australasia, New Zealand	Swart (1988), Inácio and Cannon (2003)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1322	*Rhagadolobium filicinum*	*Alsophila smithii* (Cyatheaceae), *Cyathea smithii* (Cyatheaceae)	New Zealand	Pennycook (1989), Gadgil (2005)
1323	*Rhagadolobium filicum*	*Cyathea* sp. (Cyatheaceae)	Philippines	Teodoro (1937)
1324	*Rhagadolobium hemitheliae*	*Alsophila colensoi* (Cyatheaceae), *Alsophila smithii* (Cyatheaceae), *Cyathea gigantea* (Cyatheaceae), *Cyathea samoensis* (Cyatheaceae).	India, New Zealand, Samoa	Dingley et al. (1981), McKenzie and Dingley (1996), Pande (2008), Pennycook (1989), Gadgil (2005), Farr et al. (2021)
1325	*Rhagadolobium nervisequium*	*Polypodium varians* (Polypodiaceae)	Philippines	Teodoro (1937)
1326	*Rhagadolobium pteridis*	*Pteris* sp. (Pteridaceae)	Papua New Guinea	Shaw (1984)
1327	*Rhagadolobium stenochlaenae*	*Stenochlaena palustris* (Blechnaceae)	Philippines	Teodoro (1937)
1328	*Rhizoctonia anceps*	*Athyrium filix-femina* var. *michauxiana* (Woodsiaceae), *Adiantum pedatum* (Adiantaceae), *Cystopteris bulbifera* (Woodsiaceae), *Dennstaedtia punctilobula* (Dennstaedtiaceae), *Dryopteris thelypteris* (Dryopteridaceae), *Onoclea sensibilis* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium latiusculum* (Dennstaedtiaceae)	Canada, Germany, Ireland, United Kingdom (England, Scotland), United States	Anonymous (1960), Conners (1967), Farr et al. (2021)
1329	*Rhizoctonia fusispora*	*Dryopteris filix-mas* (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1330	*Rhizoctonia solan*	*Asplenium* sp. (Aspleniaceae), *Marsilea quadrifoliata* (Marsileaceae), *Nephrolepis exaltata* (Davalliaceae), *Phyllitis* sp. (Aspleniaceae), *Rumohra adiantiformis* (Dryopteridaceae)	Brazil, China (Taiwan Province), England, West Indies	Anonymous (1960), French (1989), Mendes et al. (1998), Roberts (1999), Kirschner et al. (2019), Farr et al. (2021)
1331	*Rhizoctonia solani*	*Adiantum* sp. (Adiantaceae), *Alsophila australis* (Cyatheaceae), *Asplenium* sp. (Aspleniaceae), *Cyrtomium falcatum* (Dryopteridaceae), *Cyrtomium* sp. (Dryopteridaceae), *Davallia* sp. (Davalliaceae), *Doryopteris pedata* (Adiantaceae), *Equisetum arvense* (Equisetaceae), *Equisetum hyemale* (Equisetaceae), *Marsilea minuta* (Marsileaceae), *Marsilea quadrifolia* (Marsileaceae), *Nephrolepis exaltata* (Davalliaceae), *Nephrolepis exaltata* var. *bostoniensis* (Davalliaceae), *Nephrolepis* sp. (Davalliaceae), *Pellaea rotundifolia* (Adiantaceae), *Phyllitis scolopendrium* (Aspleniaceae), *Phyllitis* sp. (Aspleniaceae), *Platycerium bifurcatum* (Polypodiaceae), *Platycerium* sp. (Polypodiaceae), *Polystichum* sp. (Dryopteridaceae), *Rumohra adiantiformis* (Dryopteridaceae), *Selaginella* sp. (Selaginellaceae)	China (Taiwan Province), United States	French (1989), Minter et al. (2001), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1332	*Rhizoctonia* sp.	*Microsorum punctatum* (Polypodiaceae)	United States	Raabe et al. (1981)
1333	*Rhizoctonia* sp.	*Pityrogramma calomelanos* (Adiantaceae)	United States	Alfieri et al. (1984)
1334	*Rhizoctonia* sp.	*Pityrogramma sulphurea* (Adiantaceae)	United States	Alfieri et al. (1984)
1335	*Rhizoctonia* sp.	*Sphaeropteris cooperi* (Cyatheaceae)	United States	Alfieri et al. (1984)
1336	*Rhizoctonia* sp.	*Nephrolepis* sp. (Davalliaceae)	United States	Raabe et al. (1981)
1337	*Rhizoctonia* sp.	*Nephrolepis exaltata* (Davalliaceae)	United States	Anonymous (1960)
1338	*Rhizoctonia* sp.	*Dryopteris filix-mas* (Dryopteridaceae)	Germany	Oberwinkler et al. (2013)
1339	*Rhizoctonia* sp.	*Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae)	United States	Anonymous (1960)
1340	*Rhizoctonia* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	Mexico	Alvarez (1976)
1341	*Rhizoctonia* sp.	*Polystichum* tsus-simense (Dryopteridaceae)	United States	Alfieri et al. (1984)
1342	*Rhizoctonia* sp.	*Polystichum adiantiforme* (Dryopteridaceae)	United States	Raabe et al. (1981)
1343	*Rhizoctonia* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Marousky and Wildt (1982)
1344	*Rhizoctonia terrigena*	*Athyrium filix-femina* (Woodsiaceae)	Sweden	Hjortstam and Larsson (1997)
1345	*Rhizophagus fasciculatus*	*Dryopteris filix-mas* (Dryopteridaceae), *Lycopodium* sp. (Lycopodiaceae)	Poland	Mułenko et al. (2008)
1346	*Rhizophlyctis rosea*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1347	*Rhizophydium xylophilum*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1348	*Rhodocollybia laulaha*	*Cibotium* sp. (Dicksoniaceae)	United States	Gilbertson et al. (2002)
1349	*Rhodocybe mellea*	*Cyathea* sp. (Cyatheaceae)	West Indies	Minter et al. (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1350	*Rhopographus anceps*	*Pteris* sp. (Pteridaceae)	United States	Petrak (1953)
1351	*Rhopographus filicinus*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Canada, Denmark, Greece, Pakistan, Poland, Portugal, Sweden, United Kingdom (Scotland), United States	Anonymous (1960), Ginns (1986), French (1989), Farr et al. (2021)
1352	*Rhynchosporium dryopteridis*	*Dryopteris* sp. (Dryopteridaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1353	*Rigidoporus sanguinolentus*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1354	*Rodwayella sessilis*	*Pteridium aquilinum* (Dennstaedtiaceae)	Australia	Spooner (1987)
1355	*Rommelaarsia flavovirens*	*Equisetum arvense* (Equisetaceae)	France, Netherlands	Baral and Haelewaters (2015)
1356	*Roridomyces roridus*	*Athyrium distentifolium* (Woodsiaceae)	Germany	Schmid-Heckel (1988)
1357	*Roseodiscus equisetinus*	*Equisetum fluviatile* (Equisetaceae), *Equisetum palustre* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	Germany, United Kingdom, Sweden	Dennis (1978), Cannon et al. (1985), Schmid-Heckel (1988)
1358	*Roseodiscus rhodoleucus*	*Equisetum arvense* (Equisetaceae), *Equisetum limosum* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	Sweden, United Kingdom, United States	Dennis (1978), Cannon et al. (1985), Dennis (1986)
1359	*Rosettozyma cystopteridis*	*Cystopteris moupinensis* (Woodsiaceae)	China	Li et al. (2020a)
1360	*Saprolegnia ferax*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1361	*Saprolegnia glomerata*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1362	*Saprolegnia unispora*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1363	*Sarcostroma restionis*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Liu et al. (2019)
1364	*Schizothyrium speireum*	*Osmunda regalis* (Osmundaceae)	England	Dennis (1978)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1365	*Scirrhia aspidiorum*	*Athyrium filix-femina* (Woodsiaceae), *Athyrium* sp. (*Woodsiaceae*), *Cystopteris fragilis* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Germany, Poland, United Kingdom	Schmid-Heckel (1988), Chlebicki (2005), Farr et al. (2021)
1366	*Scirrhia brasiliensis*	*Pteridium aquilinum* (Dennstaedtiaceae)	Brazil	Crous et al. (2011b)
1367	*Scirrhia castagnei*	*Equisetum arvense* (Equisetaceae), *Equisetum hyemale* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Equisetum variegatum* (Equisetaceae)	France, Norway, Sweden	Holm and Holm (1981), Eriksson (2014)
1368	*Scirrhia filicina*	*Osmunda* sp. (Osmundaceae), *Pteridium* sp. (Dennstaedtiaceae)	Australia, United States	Sherwood (1977)
1369	*Scirrhia microspora*	*Athyrium filix-femina* (Woodsiaceae), *Pteris aquilina* (Pteridaceae)	Poland, North America	Mułenko et al. (2008), Farr et al. (2021)
1370	*Scirrhia silvatica*	*Equisetum sylvaticum* (Equisetaceae)	Sweden	Holm and Holm (1981)
1371	*Sclerocystis microcarpus*	Fern	Pakistan	Raza et al. (2022)
1372	*Sclerospora magnusiana*	*Equisetum* sp. (Equisetaceae)	Russia	Sorokine (1889)
1373	*Sclerotinia sclerotiorum*	*Rumohra adiantiformis* (Dryopteridaceae)	United States	Alfieri et al. (1984)
1374	*Sclerotinia* sp.	*Polypodium* sp. (Polypodiaceae)	United States	Alfieri et al. (1984)
1375	*Scolecobasidium blechni*	*Blechnum capense* (Blechnaceae)	South Africa	Crous et al. (2019)
1376	*Scolecofusarium ciliatum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1377	*Scolecolachnum pteridii*	*Pteridium arachnoideum* (Dennstaedtiaceae)	Brazil	Guatimosim et al. (2016)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1378	*Scolecoleotia eriocamporesi*	*Pteridium aquilinum* (Dennstaedtiaceae)	Italy	Boonmee et al. (2021)
1379	*Scopuloides rimosa*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and (Larsson 1997)
1380	*Scotomyces subviolaceus*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Scandinavia, United Kingdom (Scotland)	Hjortstam and Larsson (1997), Roberts (1999)
1381	*Scytinostroma corneri*	*Asplenium nidus* (Aspleniaceae)	Singapore	Boidin and Lanquetin (1987)
1382	*Scytinostroma hemidichophyticum*	*Cibotium glaucum* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
1383	*Sebacina dimitica*	*Dryopteris filix-mas* (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
1384	*Sebacina filicicola*	*Dicksonia squarrosa* (Dicksoniaceae)	New Zealand	McKenzie et al. (1992)
1385	*Sebacina incrustans*	*Athyrium filix-femina* (Woodsiaceae), *Adiantum pedatum* (Adiantaceae), *Onoclea sensibilis* (Woodsiaceae), *Polystichum acrostichoides* (Dryopteridaceae), *Thelypteris noveboracensis* (Thelypteridaceae)	Scandinavia, United States	Hjortstam and Larsson (1997), Farr et al. (2021)
1386	*Sebacina pteridiicola*	*Pteridium aquilinum* var. *esculentum* (Dennstaedtiaceae)	New Zealand	McKenzie et al. (1992)
1387	*Seimatosporium hakeae*	*Pteridium aquilinum* (Dennstaedtiaceae)	Japan, United Kingdom	Frankland (1976), Lawrence et al. (2018)
1388	*Seimatosporium* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
1389	*Seimatosporium tostum*	*Alsophila firma* (Cyatheaceae), *Cyathea bicrenata* (Cyatheaceae)	Mexico	Medel-Ortiz et al. (2020)
1390	*Septogloeum pteridis*	*Pteris aquilina* (Pteridaceae)	United States	Farr et al. (2021)
1391	*Septoria aquilina*	*Pteridium aquilinum* (Dennstaedtiaceae), *Thelypteris palustris* (Thelypteridaceae)	Greece, Poland	Pantidou (1973), Mułenko et al. (2008)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1392	*Septoria asplenii*	*Asplenium* angustifolium (Aspleniaceae), *Asplenium nidus* (Aspleniaceae), *Athyrium* sp. (Woodsiaceae)	Romania, United States	Cash (1952), Anonymous (1960), Radulescu et al. (1973)
1393	*Septoria equiseti*	*Equisetum fluviatile* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	Poland, United States	Gilman and Archer (1929), Mułenko et al. (2008)
1394	*Septoria pityrogrammae*	*Pityrogramma calomelanos* (Adiantaceae)	Puerto Rico, Virgin Islands, West Indies	Stevenson (1975), Minter et al. (2001)
1395	*Septoria protearum*	*Asplenium ruta-muraria* (Aspleniaceae), *Nephrolepis* sp. (Davalliaceae)	Germany, New Zealand	Verkley et al. (2013)
1396	*Septoria pteridis*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae)	China, United States	Anonymous (1960), Guo (1997)
1397	*Sertulicium niveocremeum*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris* sp. (Dryopteridaceae)	Scandinavia	Hjortstam and Larsson (1997)
1398	*Sesquicillium buxi*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
1399	*Setigeroclavula ascendens*	*Asplenium bulbiferum* (Aspleniaceae)	New Zealand	Petersen (1988)
1400	*Setomyces belluciae*	*Blechnum volubile* (Blechnaceae)	Brazil	Mendes et al. (1998)
1401	*Seuratia* sp.	*Elaphoglossum* sp. (Lomariopsidaceae)	West Indies	Minter et al. (2001)
1402	*Simplicillium lamellicola*	*Azolla* sp. (Salviniaceae)	United Kingdom	Farr et al. (2021)
1403	*Simplicillium lanosoniveum*	*Salvinia auriculata* (Salviniaceae), *Salvinia molesta* (Salviniaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1404	*Sistotrema brinkmannii*	*Cibotium* sp. (Dicksoniaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Germany, United States	Schmid-Heckel (1988), Gilbertson et al. (2002)
1405	*Sistotrema diademiferum*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Scandinavia	Hjortstam and Larsson (1997)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1406	*Sistotrema heteronemum*	Athyrium filix-femina (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1407	*Sistotrema muscicola*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1408	*Sistotrema octosporum*	*Athyrium distentifolium* (Woodsiaceae), *Athyrium filix*-femina (*Woodsiaceae*), *Blechnum spicant* (Blechnaceae), *Dryopteris* sp. (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Germany, Scandinavia	Schmid-Heckel (1988), Hjortstam and Larsson (1997)
1409	*Sistotrema pteriphilum*	*Athyrium* filix-*femina* (Woodsiaceae), *Athyrium filix-mas* (Woodsiaceae)	Norway, Scandinavia	Hjortstam and Larsson (1997), Ryvarden et al. (2003)
1410	*Sordaria fimicola*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976), Petrini (1992)
1411	*Sphaceloma* sp.	*Cheilanthes elegans* (Adiantaceae)	Mexico	Alvarez (1976)
1412	*Sphacelotheca hydropiperis*	*Polypodium* sp. (Polypodiaceae)	Pakistan	Ahmad et al. (1997)
1413	*Sphaerella polypodii f. pteridinis*	Fern	-	Fuckel (1869)
1414	*Sphaeria epipteridis*	*Pteris* sp. (Pteridaceae)	United States	French (1989)
1415	*Sphaeriothyrium filicinum*	*Gymnocarpium dryopteris* (Woodsiaceae), *Onoclea struthiopteris* (Woodsiaceae), *Osmunda regalis* (Osmundaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Czechoslovakia, Germany, Poland	Farr et al. (2021)
1416	*Sphaeriothyrium praecastrense*	*Pteridis aquilinae* (Dennstaedtiaceae)	Italy	Index Fungorum
1417	*Sphaerulina cibotii*	*Cibotium menziesii* (Dicksoniaceae), *Cibotium* sp. (Dicksoniaceae)	United States	Anonymous (1960), Raabe et al. (1981)
1418	*Sphaerulina marsileae*	*Marsilea quadrifoliata* (Marsileaceae)	Myanmar	Thaung (2008)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1419	*Sphaerulina polypodii*	*Polypodium vulgare* (Polypodiaceae)	Spain	Unamuno (1941)
1420	*Sporormiella* sp.	*Adiantum* sp. (Adiantaceae), *Lygodium flexuosum* (Schizaeaceae)	India	Kumaresan et al. (2013)
1421	*Stagonospora marsileae*	*Marsilea quadrifolia* (Marsileaceae)	India	Mathur (1979)
1422	*Stagonospora pteridiicola*	*Pteridium aquilinum* (Dennstaedtiaceae)	Australia, Hungary, United Kingdom (Great Britain)	Fisher (1996), Fisher and Punithalingam (1993)
1423	*Stagonospora* sp.	*Cyathea* sp. (Cyatheaceae)	United States	French (1989)
1424	*Stagonospora* sp.	*Cyathea arborea* (Cyatheaceae)	United States	Anonymous (1960)
1425	*Stagonospora* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Foister (1961)
1426	*Stagonospora* spp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976), Petrini (1992)
1427	*Stagonospora* sp.	*Equisetum arvense* (Equisetaceae)	United States	Greene (1964)
1428	*Stagonospora* sp.	*Equisetum hyemale* (Equisetaceae)	United States	Farr et al. (2021)
1429	*Stamnaria americana*	*Equisetum hyemale* (Equisetaceae), *Equisetum* sp. (Equisetaceae)	United States	Greene (1950), Anonymous (1960)
1430	*Stamnaria equiseti*	*Equisetum palustre* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Equisetum* variegatum (Equisetaceae)	Portugal, Spain, United States	Unamuno (1941), Sprague (1955)
1431	*Stamnaria persoonii*	*Equisetum arvense* (Equisetaceae),, *Equisetum hyemale* (Equisetaceae), *Equisetum laevigatum* (Equisetaceae), *Equisetum limosum* (Equisetaceae), *Equisetum palustre* (Equisetaceae), *Equisetum* sp. (Equisetaceae), *Equisetum sylvaticum* (Equisetaceae)	China, Germany, Ireland, Italy, Poland, Republic of Korea, Sweden, Ukraine, United Kingdom, United States	Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1432	*Stamnaria* sp.	*Equisetum arvense* (Equisetaceae)	United States	French (1989)
1433	*Stemphylium lycopersici*	*Polypodium* sp. (Polypodiaceae)	United States	Schubert (1991)
1434	*Stemphylium* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Foister (1961)
1435	Stemphylium spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1436	*Stictis carnea*	*Cyathea bicrenata* (Cyatheaceae)	New Zealand, Mexico	Johnston (1983), Medel-Ortiz et al. (2020)
1437	*Stictis clavata*	*Cyathea meduliaris* (Cyatheaceae)	New Zealand	Johnston (1983)
1438	*Stictis dealbata*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	Johnston (1983)
1439	*Stictis dumontii*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	Johnston (1983)
1440	*Stictis filicicola* var. *dryopteridis*	*Dryopteris* sp. (Dryopteridaceae)	Azores	Dennis et al. (1977)
1441	*Stictis laciniata*	*Cyathea dealbata* (Cyatheaceae), *Dicksonia squarrosa* (Dicksoniaceae)	New Zealand	Johnston (1983), McKenzie et al. (1992)
1442	*Stictis ramuligera*	*Cyathea dealbata* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae), *Dicksonia squarrosa* (Dicksoniaceae)	New Zealand	Johnston (1983)
1443	*Stictis ramuligera* var. *minor*	*Cyathea dealbata* (Cyatheaceae), *Dicksonia squarrosa* (Dicksoniaceae)	New Zealand	Johnston (1983)
1444	*Stictis subiculata*	*Cyathea medullaris* (Cyatheaceae)	New Zealand	Johnston (1983)
1445	*Stilbella aciculosa*	*Lycopodium* sp. (Lycopodiaceae)	England	Seifert (1985)
1446	*Stilbella* sp.	*Asplenium nidus* (Aspleniaceae)	Fiji	Dingley et al. (1981)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1447	*Strasseria geniculata*	*Lycopodium complanatum* (Lycopodiaceae), *Lycopodium complanatum* var. *flabelliforme* (Lycopodiaceae)	Canada, United States	Raj (1983), Nag Raj (1993)
1448	*Strasseria nigra*	*Lycopodium clavatum* (Lycopodiaceae), *Lycopodium complanatum* (Lycopodiaceae)	United States	Cooke (1977)
1449	*Stysanus* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1450	*Subulicium lautum*	*Athyrium filix-femina* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Dryopteris* sp. (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Norway, Scandinavia	Hjortstam and Larsson (1997), Ryvarden et al. (2003)
1451	*Synchytrium athyrii*	*Athyrium felix* var. *femina* (Woodsiaceae), *Cystopteris fragilis* (Woodsiaceae)	Canada, Norway	Karling (1964), Conners (1967)
1452	*Synchytrium phegopteridis*	*Phegopteris polypodioides* (Thelypteridaceae), *Thelypteris phegopteris* (Thelypteridaceae)	Norway, Sweden	Karling (1964)
1453	*Talaromyces flavus*	*Selaginella oregana* (Selaginellaceae)	United States	Farr and Horner (1968)
1454	*Taphrina amplians*	*Pteris orizabae* (Pteridaceae)	Guatemala	Mix (1949)
1455	*Taphrina athyrii*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris* sp. (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae)	Armenia, Georgia, Norway, United Kingdom (England), USSR	Petrak (1937), Mix (1949), Dennis (1978), Cannon et al. (1985)
1456	*Taphrina californica*	*Asplenium* sp. (Aspleniaceae), *Dicksonia* sp. (Dicksoniaceae), *Dryopteris arguta* (Dryopteridaceae)	United States	Mix (1938, 1954a), French (1989)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1457	*Taphrina cornu-cervi*	*Polystichum aristatum* (Dryopteridaceae)	Fiji, India, Indonesia, Japan, Nepal, New Caledonia	Mix (1949)
1458	*Taphrina cystopteridis*	*Cystopteris fragilis* (Woodsiaceae), *Cystopteris fragilis* var. *protrusa* (Woodsiaceae)	United States	Mix (1938, 1954a)
1459	*Taphrina ecuadorensis*	*Dryopteris cheilanthoides* (Dryopteridaceae)	Ecuador	Mix (1949)
1460	*Taphrina fasciculata*	*Dryopteris* sp. (Dryopteridaceae)	Ecuador	Mix (1949)
1461	*Taphrina faulliana*	*Polystichum munitum* (Dryopteridaceae)	Canada, United States	Mix (1938)
1462	*Taphrina filicina*	*Dryopteris arguta* (Dryopteridaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris marginalis* (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae), *Dryopteris spinulosa* var. *intermedia* (Dryopteridaceae), *Onoclea sensibilis* (Woodsiaceae), *Polystichum aculeatum* (Dryopteridaceae)	Germany, Poland, Sweden, United Kingdom, United States, Venezuela, USSR	Mix (1938), Mix (1949), Stevenson (1945), Anonymous (1960), Dennis (1978), Mułenko et al. (2008), Farr et al. (2021)
1463	*Taphrina fusca*	*Dryopteris rigida* (Dryopteridaceae), *Dryopteris pallida* (Dryopteridaceae), *Dryopteris spinulosa* (Dryopteridaceae)	Albania, United States	Anonymous (1960), Mix (1938, 1949)
1464	*Taphrina gracilis*	*Dryopteris marginalis* (Dryopteridaceae)	United States	Anonymous (1960)
1465	*Taphrina higginsii*	*Osmunda cinnamomea* (Osmundaceae)	United States	Anonymous (1960)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1466	*Taphrina hiratsukae*	*Matteuccia struthiopteris* (Woodsiaceae), *Onoclea sensibilis* (Woodsiaceae), *Pteretis nodulosa* (Onocleaceae), *Pteretis struthiopteris* (Onocleaceae), *Struthiopteris germanica* (Blechnaceae), *Thelypteris* sp. (Thelypteridaceae)	Japan, Sweden, United States, USSR	Mix (1938, 1949), Anonymous (1960), Eriksson (2014)
1467	*Taphrina laurencia*	*Pteris quadriaurita* (Pteridaceae)	India, Nepal, Sri Lanka (= Ceylon)	Mix (1938, 1949), Index Fungorum
1468	*Taphrina lutescens*	*Dryopteris* sp. (Dryopteridaceae), *Dryopteris thelypteris* (Dryopteridaceae), *Thelypteris palustris* (Thelypteridaceae), *Thelypteris* sp. (Thelypteridaceae)	Denmark, Germany, Greece, Poland, United States, USSR	Alfieri et al. (1984), Mix (1938), Greene (1944a), Mix (1949), Pantidou (1973), Mułenko et al. (2008)
1469	*Taphrina moriformis*	*Dryopteris arguta* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae)	United States	French (1989)
1470	*Taphrina polystichi*	*Dryopteris carthusiana* (Dryopteridaceae), *Polystichum acrostichoides* (Dryopteridaceae)	United States	Stevenson (1945), Mix (1938), Selbmann et al. (2014)
1471	*Taphrina pteridis*	*Pteris* sp. (Pteridaceae)	Brazil	Viégas (1944)
1472	*Taphrina rhomboidalis*	*Pteris biaurita* (Pteridaceae), *Pteris quadriaurita* (Pteridaceae)	India	Mix (1949)
1473	*Taphrina siemaszkoi*	*Matteuccia struthiopteris* (Woodsiaceae),	Armenia, Azerbaijan, Georgia	Anon (1969), Petrak (1937)
1474	*Taphrina* sp.	*Dryopteris arguta* (Dryopteridaceae)	United States	French (1989)
1475	*Taphrina* sp.	*Asplenium bulbiferum* (Aspleniaceae)	United States	French (1989)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1476	*Taphrina* sp.	*Polystichum* sp. (Dryopteridaceae)	United States	French (1989)
1477	*Taphrina struthiopteridis*	*Onoclea struthiopteris* (Woodsiaceae), *Pteretis nodulosa* (Onocleaceae)	Japan, Trinidad-Tobago, USA	Mix (1938), Anon (1969)
1478	*Taphrina thaxteri*	*Dryopteris poiteana* (Dryopteridaceae)	Trinidad-Tobago, West Indies	Mix (1949), Minter et al. (2001)
1479	*Taphrina tonduziana*	*Pteris spinosa* (Pteridaceae)	Costa Rica	(Mix 1949)
1480	*Taphrina vestergrenii*	*Dryopteris borreri* (Dryopteridaceae), *Dryopteris carthusiana* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris lacera* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae)	China, Denmark, Germany, Japan, Norway, Poland, Slovakia, Sweden, United Kingdom, USSR	Mix (1949), Gjaerum (1964), Dennis (1978), Bacigálová et al. (2002), Tai (1979), Mułenko et al. (2008), Selbmann et al. (2014)
1481	*Taphrina wettsteiniana*	*Polystichum lonchitis* (Dryopteridaceae)	Austria, Norway	Mix (1938)
1482	*Teratosperma dicranopteridis*	*Dicranopteris linearis* (Gleicheniaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1483	*Tetrachaetum elegans*	Pteridophyte	India	Sati and Belwal (2005)
1484	*Tetracladium marchalianum*	Ferns	India	Sati and Belwal (2005)
1485	*Tetracladium setigerum*	*Equisetum* sp. (Equisetaceae)	India	Sati and Belwal (2005)
1486	*Thekopsora filicina*	*Phegopteris polypodioides* (Thelypteridaceae)	Poland	Majewski (2014)
1487	*Thelephora ellisii*	*Blechnum spicant* (Blechnaceae)	Faeroe Islands	Farr et al. (2021)
1488	*Thelephora terrestris*	*Dryopteris* dilatata (Dryopteridaceae), *Equisetum* sp. (Equisetaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Canada, Scandinavia	Ginns (1986), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1489	*Thelephora wakefieldiae*	*Athyrium filix-femina* (Woodsiaceae), *Lycopodium* sp. (Lycopodiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Portugal, Scandinavia, Spain, United States	Hjortstam and Larsson (1997), Farr et al. (2021)
1490	*Thelonectria olida*	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
1491	*Thielavia* sp.	*Rumohra adiantiformis* (Dryopteridaceae)	West Indies	Minter et al. (2001)
1492	*Thraustotheca clavata*	*Equisetum palustre* (Equisetaceae)	Poland	Czeczuga et al. (2007)
1493	*Titaeospora detospora*	*Equisetum arvense* (Equisetaceae), *Equisetum hyemale* (Equisetaceae), *Equisetum kansanum* (Equisetaceae), *Equisetum laevigatum* (Equisetaceae)	Poland, United States	Greene (1944b, 1949), Mułenko et al. (2008)
1494	*Titaeospora* sp.1	*Equisetum* sp. (Equisetaceae)	United States (Wyoming)	Sutton (1980)
1495	*Titaeospora* sp.2	*Equisetum* sp. (Equisetaceae)	United States (California)	Sutton (1980)
1496	*Titaeospora* sp.3	*Equisetum* sp. (Equisetaceae)	United States (North Dakota)	Sutton (1980)
1497	*Tomentellopsis echinospora*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1498	*Tomentellopsis pusilla*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1499	*Torula herbarum*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom (Scotland)	Kirk and Spooner (1984)
1500	*Trechispora byssinella*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1501	*Trechispora caucasica*	*Dryopteris dilatata* (Dryopteridaceae), *Osmunda regalis* (Osmundaceae)	France, Scandinavia	Hjortstam and Larsson (1997)
1502	*Trechispora cohaerens*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1503	*Trechispora farinacea*	*Athyrium filix-femina* (Woodsiaceae), *Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Scandinavia, United States	Hjortstam and Larsson (1997), Gilbertson and Hemmes (1997)
1504	*Trechispora hymenocystis*	*Athyrium* filix-*femina* (Woodsiaceae), *Dryopteris dilatata* (Dryopteridaceae)	Scandinavia	(Hjortstam and Larsson 1997), Farr et al. (2021)
1505	*Trechispora incisa*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1506	*Trechispora invisitata*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1507	*Trechispora praefocata*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1508	*Trechispora* sp.	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1509	*Trechispora* sp.	*Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1510	*Trechispora stellulata*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1511	*Trechispora subsphaerospora*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1512	*Trechispora tenuicula*	*Athyrium filix-femina* (Woodsiaceae), *Matteuccia struthiopteris* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1513	*Trichia botrytis*	*Aspidium elongatum* (Dryopteridaceae)	Spain (Canary Islands)	de Urríes (1956)
1514	*Trichoderma polysporum*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1515	*Trichoderma pseudokoningii*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
1516	*Trichoderma* sp.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)
1517	*Trichoderma* sp.	*Adiantum* sp. (Adiantaceae)	India	Kumaresan et al. (2013)
1518	*Trichoderma* sp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1519	*Trichoderma* sp. (*T. tawa* series)	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1520	*Trichoderma viride*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1521	*Trichoglossum walteri*	*Dicksonia antarctica* (Dicksoniaceae), *Dicksonia* sp. (Dicksoniaceae)	Australia	Spooner (1987)
1522	*Tricholomopsis pteridiicola*	*Pteridium aquilinum* (Dennstaedtiaceae)	Spain	Olariaga et al. (2015)
1523	*Trichopeltheca asiatica*	*Asplenium bulbiferum* (Aspleniaceae), *Asplenium flaccidum* (Aspleniaceae), *Asplenium oblongifolium* (Aspleniaceae), *Asplenium polyodon* (Aspleniaceae), *Alsophila smithii* (Cyatheaceae), *Alsophila tricolor* (Cyatheaceae), *Blechnum discolor* (Blechnaceae), *Blechnum filiforme* (Blechnaceae), *Blechnum procerum* (Blechnaceae), *Blechnum* sp. (Blechnaceae), *Cyathea dealbata* (Cyatheaceae), *Cyathea medullaris* (Cyatheaceae), *Cyathea*	New Zealand	Pennycook (1989), Gadgil (2005), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
		smithii (Cyatheaceae), *Dicksonia squarrosa* (Dicksoniaceae), *Grammitis billardierei* (Grammitidaceae), *Lastreopsis hispida* (Dryopteridaceae), *Lygodium articulatum* (Schizaeaceae), *Phymatosorus diversifolius* (Polypodiaceae), *Phymatosorus scandens* (Polypodiaceae), *Sphaeropteris medullaris* (Cyatheaceae), *Sticherus cunninghamii* (Gleicheniaceae)		
1524	*Trichopeltheca stevensii*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Sivanesan (1984)
1525	*Trichopeltulum* sp.	*Elaphoglossum* sp. (Lomariopsidaceae)	West Indies	Minter et al. (2001)
1526	*Trichosporiella cerebriformis*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
1527	*Trichothallus hawaiiensis*	*Cibotium* sp. (Dicksoniaceae), *Elaphoglossum* sp. (Lomariopsidaceae)	United States	Anonymous (1960), Raabe et al. (1981)
1528	*Trichothecium campaniforme*	*Adiantum* sp. (Adiantaceae), *Adiantum tenerum* (Adiantaceae)	West Indies	Minter et al. (2001)
1529	*Trichothecium roseum*	*Dryopteris carthusiana* (Dryopteridaceae), *Pteris* sp. (Pteridaceae), *Woodwardia* sp. (Blechnaceae)	Poland, United States (California, Indiana)	Anonymous (1960), French (1989), Mułenko et al. (2008), Farr et al. (2021)
1530	*Trichothyrium dubiosum*	*Adiantum* sp. (Adiantaceae)	West Indies	Minter et al. (2001)
1531	*Trichothyrium reptans*	*Elaphoglossum* sp. (Lomariopsidaceae)	United States	Stevens (1925)
1532	*Tritirachium* sp.	*Acrostichum aureum* (Pteridaceae)	India	Maria et al. (2005)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1533	*Tubulicium dussii*	*Cibotium chamissoi* (Dicksoniaceae), *Cibotium glaucum* (Dicksoniaceae)	United States (Hawaii)	Gilbertson and Hemmes (1997)
1534	*Tubulicium filicicola*	*Cyathea dealbata* (Cyatheaceae)	New Zealand	McKenzie et al. (1992)
1535	*Tubulicium* sp.	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
1536	*Tubulicrinis australis*	*Lophosoria quadripinnata* (Dicksoniaceae)	Chile	Crous et al. (2016)
1537	*Tulasnella calospora*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson et al. (2002)
1538	*Tulasnella rosea*	*Dryopteris filix-mas* (Dryopteridaceae)	Sweden	Hjortstam and (Larsson 1997)
1539	*Tylospora asterophora*	Athyrium filix-femina (Woodsiaceae)	Scandinavia	Hjortstam and (Larsson 1997)
1540	*Tylospora fibrillosa*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and (Larsson 1997)
1541	*Typhula filicina*	*Osmunda cinnamomea* (Osmundaceae)	United States	Anonymous (1960)
1542	*Typhula quisquiliaris*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1543	*Typhula todei*	*Athyrium angustum* (Woodsiaceae), *Athyrium distentifolium* (Woodsiaceae), *Athyrium filix-femina* var. *michauxii* (Woodsiaceae)	Canada, Germany, United States	Remsberg (1940), Ginns (1986), Schmid-Heckel (1988)
1544	*Typhula tremula*	*Athyrium distentifolium* (Woodsiaceae)	Germany	Schmid-Heckel (1988)
1545	*Uleodothis pteridis*	*Pteridium aquilinum* var. *caudatum* (Dennstaedtiaceae)	Puerto Rico, Virgin Islands, West Indies	Stevenson (1975), Minter et al. (2001)
1546	*Umbelopsis isabellina*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1547	*Umbelopsis ramanniana*	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1548	*Uncol diazii*	Cyatheaceae sp., *Lindsaea lancea* (Dennstaedtiaceae), *Lindsaea ulei* (Dennstaedtiaceae), *Polypodium brasiliensis* (Polypodiaceae), *Thelypteris* sp. (Thelypteridaceae)	Brazil, Colombia	Buritica and Rodriguez (2000), Hennen et al. (2005), Salazar-Yepes (2021)
1549	*Unguicularia aspera*	*Osmunda regalis* (Osmundaceae), *Osmunda* sp. (Osmundaceae)	Ireland, Sweden, United Kingdom	Muskett and Malone (1983), Cannon et al. (1985), Eriksson (2014)
1550	Unguicularia carestiana	*Athyrium* filix-*femina* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Matteuccia* sp. (Woodsiaceae), *Thelypteris nipponica* (Thelypteridaceae)	Germany, Japan, Sweden, United Kingdom (Scotland)	Schmid-Heckel (1988), Kirk and Spooner (1984), Han et al. (2014), Farr et al. (2021)
1551	*Urceolella amphipila*	*Struthiopteris* sp. (Blechnaceae)	United States	Huhtinen (1987)
1552	*Urceolella todeae*	*Todea barbara* (Osmundaceae)	South Africa	Raitviir and Schneller (2007)
1553	*Urceolella lycopodii*	*Lycopodium clavatum* (Lycopodiaceae), *Lycopodium obscurum* (Lycopodiaceae)	United States	Cooke (1977)
1554	*Urceolella pani*	*Diphasiastrum complanatum* (Lycopodiaceae)	Sweden	Eriksson (2014)
1555	*Uredinophila tropicalis*	*Adiantum latifolium* (Adiantaceae)	West Indies	Minter et al. (2001)
1556	*Uredinopsis acrostichoides*	Athyrium *acrostichoides* (Woodsiaceae), *Athyrium thelypteroides* (Woodsiaceae)	United States	Hiratsuka (1958)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1557	*Uredinopsis adianti*	*Adiantum pedatum* (Adiantaceae)	China, Japan, Republic of Korea, USSR	Kuprevich and Transchel (1957), Tai (1979), Azbukina (1984), Hiratsuka et al. (1992), Cho and Shin (2004)
1558	*Uredinopsis americana*	*Onoclea sensibilis* (Woodsiaceae), *Woodwardia areolata* (Blechnaceae)	Canada, Puerto Rico, United Kingdom, United States, USSR	Hiratsuka (1958), Ginns (1986), Henderson (2000), Farr et al. (2021)
1559	*Uredinopsis arthurii*	*Woodwardia virginica* (Blechnaceae)	United States	Anonymous (1960)
1560	*Uredinopsis aspera*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *decompositum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae)	United States	Hiratsuka (1958), Anonymous (1960), Raabe et al. (1981)
1561	*Uredinopsis athyrii*	*Athyrium filix-femina* var. *melanolepis* (Woodsiaceae), *Athyrium melanolepis* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae)	China (Taiwan Province), Himalaya, Japan, USSR	Sawada (1959), Tai (1979), Zhuang (1983), Hiratsuka et al. (1992), Kirschner et al. (2019)
1562	*Uredinopsis atkinsonii*	Athyrium *cyclosorum* (Woodsiaceae), *Dryopteris thelypteris* (Dryopteridaceae), *Dryopteris thelypteris* var. *pubescens* (Dryopteridaceae), *Thelypteris palustris* (Thelypteridaceae)	Canada, Japan, United States, USSR	Hiratsuka (1958), Kuprevich and Transchel (1957) Anonymous (1960), Ginns (1986), Farr et al. (2021)
1563	*Uredinopsis ceratophora*	*Cystopteris bulbifera* (Woodsiaceae), *Cystopteris fragilis* (Woodsiaceae)	Canada, United States	Anonymous (1960), Peterson (1965), Conners (1967)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1564	*Uredinopsis copelandi*	*Asplenium filix-femina* (Aspleniaceae), *Athyrium cyclosorum* (Woodsiaceae), *Athyrium filix-femina* subsp. *Cyclosorum* (Woodsiaceae), *Athyrium filix-femina* var. *californicum* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Aspidium* sp. (Dryopteridaceae), *Aspidium thelypteris* (Dryopteridaceae), *Dryopteris thelypteris* (Dryopteridaceae), *Polystichum acrostichoides* (Dryopteridaceae)	United Kingdom (Bermuda), United States, USSR	Hunt (1928), Whetzel and Jackson (1928), Cooke (1955), Kuprevich and Transchel (1957), Anonymous (1960), French (1989)
1565	*Uredinopsis daisenensis*	*Athyrium clivicola* (Woodsiaceae), *Athyrium multifidum* var. *deltoideum* (Woodsiaceae), *Athyrium otophorum* (Woodsiaceae), *Athyrium rigescens* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Athyrium vidalii* (Woodsiaceae)	Japan, USSR	Kuprevich and Transchel (1957), Hiratsuka et al. (1992)
1566	*Uredinopsis filicina*	*Aspidium phegopteris* (Dryopteridaceae), *Dryopteris phegopteris* (Dryopteridaceae), *Gymnocarpium dryopteris* (Woodsiaceae), *Phegopteris connectilis* (Thelypteridaceae), *Phegopteris polypodioides* (Thelypteridaceae), *Phegopteris vulgaris* (Thelypteridaceae), *Polypodium phegopteris* (Polypodiaceae), *Thelypteris phegopteris* (Thelypteridaceae)	Austria, Belgium, China, Czech Republic, Finland, Germany, Japan, Norway, Poland, Republic of Korea, Sweden, United Kingdom, USSR	Kuprevich and Transchel (1957), Mułenko et al. (2004), Bubner et al. (2019), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1567	*Uredinopsis glabra*	*Cheilanthes pyramidalis* (Adiantaceae), *Cystopteris fragilis* (Woodsiaceae), *Pellaea cordata* (Adiantaceae)	Mexico, United States	Peterson (1965), León and Cummins (1981)
1568	*Uredinopsis hashiokae*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. latiusculum (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae)	Canada, China (Taiwan Province), United States	Shaw (1973), Gardner and Hodges Jr (1989), Gardner (1994), Kirschner et al. (2019)
1569	*Uredinopsis hirosakiensis*	*Dryopteris* sp. (Dryopteridaceae), *Dryopteris thelypteris* (Dryopteridaceae), *Lastrea thelypteris* (Thelypteridaceae), *Thelypteris palustris* (Thelypteridaceae)	China, Japan, Republic of Korea, USSR	Kuprevich and Transchel (1957), Tai (1979), Azbukina (1984), Hiratsuka et al. (1992), Cho and Shin (2004), Zhuang (2005)
1570	*Uredinopsis intermedia*	*Athyrium acrostichoides* (Woodsiaceae), *Athyrium mesosorum* (Woodsiaceae), *Athyrium pterorachis* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Coniogramme intermedia* (*Adiantaceae*), *Deparia pycnosora* (Woodsiaceae)	Himalaya, Japan, USSR	Kuprevich and Transchel (1957), Azbukina (1984), Hiratsuka et al. (1992), Zhuang and Wei (1994), Rossman and Samuels (1998)
1571	*Uredinopsis kameiana*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae)	China, Japan, Republic of Korea, USSR	Kuprevich and Transchel (1957), Tai (1979), Hiratsuka et al. (1992), Cho and Shin (2004)
1572	*Uredinopsis komagatakensis*	*Athyrium yokoscense* (Woodsiaceae)	Japan, Republic of Korea	Hiratsuka et al. (1992), Cho and Shin (2004)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1573	*Uredinopsis longimucronata*	*Athyrium angustum* (Woodsiaceae), *Athyrium cyclosorum* (Woodsiaceae), *Athyrium* filix-*femina* (Woodsiaceae), *Athyrium filix-femina* subsp. *cyclosorum* (Woodsiaceae), *Athyrium filix-femina* var. *michauxii* (Woodsiaceae)	Canada, United States, USSR	Hiratsuka (19580, Conners (1967), Ginns (1986), French (1989)
1574	*Uredinopsis macrosperma*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *japonicum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pubescens* (Dennstaedtiaceae), *Pteridium caudatum* (Dennstaedtiaceae), *Pteridium latiusculum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae)	Brazil, Canada, China (Taiwan Province), Colombia, Sierra Leone, South Africa, United Kingdom (Bermuda), United States, USSR, Venezuela	Doidge (1950), Kirschner et al. (2019), Farr et al. (2021)
1575	*Uredinopsis maculata*	*Woodwardia areolata* (Blechnaceae), *Woodwardia virginica* (Blechnaceae)	United States	Hiratsuka (1958), Anonymous (1960), Alfieri et al. (1984)
1576	*Uredinopsis mayoriana*	*Blechnum blechnoides* (Blechnaceae)	Colombia	Chardón and Toro (1930)
1577	*Uredinopsis osmundae*	*Osmunda cinnamomea* (Osmundaceae), *Osmunda claytoniana* (Osmundaceae), *Osmunda regalis* (Osmundaceae), *Osmunda regalis* var. *spectabilis* (Osmundaceae), *Osmunda* sp. (Osmundaceae)	Canada, United Kingdom (Bermuda), United States, USSR	Ono et al. (2020), Farr et al. (2021)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1578	*Uredinopsis ossiiformis*	*Dryopteris amurensis* (Dryopteridaceae), *Dryopteris austriaca* (Dryopteridaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris monticola* (Dryopteridaceae)	Japan, Republic of Korea, USSR	Kuprevich and Transchel (1957), Hiratsuka et al. (1992), Cho and Shin (2004)
1579	*Uredinopsis phegopteridis*	*Dryopteris austriaca* (Dryopteridaceae), *Dryopteris disjuncta* (Dryopteridaceae), *Dryopteris linnaeana* (Dryopteridaceae), *Gymnocarpium dryopteris* (Woodsiaceae)	Canada, United States, USSR	Kuprevich and Transchel (1957), Anonymous (1960), Shaw (1973), Ginns (1986)
1580	*Uredinopsis pteridis*	*Pteridium aquilinum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pseudocaudatum* (Dennstaedtiaceae), *Pteridium caudatum* (Dennstaedtiaceae), *Pteridium esculentum* (Dennstaedtiaceae), *Pteridium feei* (Dennstaedtiaceae), *Pteridium revolutum* (Dennstaedtiaceae), *Pteridium* sp. (Dennstaedtiaceae), *Pteris* sp. (Pteridaceae), *Stenochlaena tenuifolia* (Blechnaceae)	Australia, Brazil, Canada, China (Taiwan Province), Colombia, Costa Rica, Japan, Mexico, Pakistan, Republic of Korea, South Africa, United States, USSR	Hiratsuka (1958), French (1989), Yohem et al. (1985), McTaggart et al. (2014), Kirschner et al. (2019)
1581	*Uredinopsis* sp.	*Lygodium japonicum* (Schizaeaceae)	United States	Alfieri et al. (1984)
1582	*Uredinopsis* sp.	*Pteridium* sp. (Dennstaedtiaceae)	Canada	Ginns (1986)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1583	*Uredinopsis struthiopteridis*	*Athyrium filix-femina* (Woodsiaceae), *Athyrium filix-femina* subsp. *cyclosorum* (Woodsiaceae), *Athyrium filix-femina* var. *californicum* (Woodsiaceae), *Athyrium* sp. (Woodsiaceae), *Lunathyrium acrostichoides* (Woodsiaceae), *Matteuccia struthiopteris* (Woodsiaceae), *Matteuccia struthiopteris* var. *acutiloba* (Woodsiaceae), *Onoclea struthiopteris* (Woodsiaceae), *Woodwardia virginica* (Blechnaceae)	China, Finland, Germany, Japan, Norway, Poland, Sweden, United States, USSR	Anderson (1952), Hylander (1953), Kuprevich and Transchel (1957), Jøestad (1962), Ginns (1986), Braun (1982), French (1989), Hiratsuka et al. (1992), Mułenko et al. (2008), Zhuang (2001, 2005), Farr et al. (2021)
1584	*Uredinopsis syngrammes*	*Coniogramme fraxinea* (Adiantaceae)	India	Anon (1972), Index Fungorum
1585	*Uredinopsis virginiana*	*Pteridium aquilinum* var. *latiusculum* (Dennstaedtiaceae), *Pteridium aquilinum* var. *pseudocaudatum* (Dennstaedtiaceae)	United States	Anonymous (1960)
1586	*Uredinopsis woodsiae*	*Woodsia polystichoides* (Woodsiaceae), *Woodsia polystichoides* var. *nudiuscula* (Woodsiaceae)	Japan, USSR	Kuprevich and Transchel (1957), Hiratsuka et al. (1992)
1587	*Uredo aztecana*	*Asplenium monanthes* (Aspleniaceae)	Mexico	León and Cummins (1981)
1588	*Uredo capilli-veneris*	*Adiantum capillus-veneris* (Adiantaceae)	Pakistan	Ahmad (1969)
1589	*Uredo lindsaeae-japonicae*	*Lindsaea japonica* (Dennstaedtiaceae)	Japan	Hiratsuka et al. (1992)
1590	*Uredo nankaiensis*	*Lindsaea orbiculata* (Dennstaedtiaceae), *Lindsaea orbiculata* var. *chienii* (Dennstaedtiaceae)	China, Japan	Hiratsuka et al. (1992), Zhuang (2001)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1591	*Uredo nephrolepidis*	*Nephrolepis pendula* (Davalliaceae)	Colombia	Farr et al. (2021)
1592	*Uredo orientalis*	*Blechnum orientale* (Blechnaceae)	China (Taiwan Province), Indonesia, Japan	Ito (1950), Boedijn (1960), Tai (1979), Hiratsuka (1991)
1593	*Uredo osmundae*	*Osmunda claytoniana* (Osmundaceae)	United States	Cash (1952)
1594	*Uredo polytaenii*	*Antrophyum* sp. (Vittariaceae), *Polytaenium feei* (Vittariaceae)	Dominican Republic, Puerto Rico, Virgin Islands, West Indies	Minter et al. (2001), Ciferri (1961), Stevenson (1975)
1595	*Uredo pseudocystopteridis*	*Pseudocystopteris atkinsonii* (Woodsiaceae), *Pseudocystopteris tibetica* (Woodsiaceae)	China	Wang et al. (1981), Zhuang (2001)
1596	*Uredo sagamiensis*	*Polystichum lepidocaulon* (Dryopteridaceae)	Japan	Hiratsuka et al. (1992)
1597	*Uredo semidiscifera*	*Thelypteris atrovirens* (Thelypteridaceae), *Thelypteris oligocarpa* (Thelypteridaceae), *Thelypteris* sp. (Thelypteridaceae)	Costa Rica, Ecuador	Berndt (1999), Berndt (2004)
1598	*Uredo* sp.	*Adiantum subcordatum* (Adiantaceae)	Brazil	Mendes et al. (1998)
1599	*Uredo* sp.	*Asplenium monanthes* var. *galeottii* (Aspleniaceae)	Mexico	León and Cummins (1981)
1600	*Uredo stenochlaenae*	*Stenochlaena vestita* (Blechnaceae)	Honduras	Cummins (1952)
1601	*Uredo thelypteridis*	*Pseudophegopteris aurita* (Thelypteridaceae)	India	De (2000)
1602	*Uredo verruculosa*	*Pteridium aquilinum* (Dennstaedtiaceae)	Venezuela	Berndt (1998)
1603	*Uredo vetus*	*Selaginella* sp. (Selaginellaceae)	China	Hennen (1997)
1604	*Uredo viegasii*	*Adiantum subcordatum* (Adiantaceae)	Brazil	Mendes et al. (1998), Hennen et al. (1982)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1605	*Uredo vittariae*	*Vittaria flexuosa* (Vittariaceae)	Japan	Hiratsuka et al. (1992)
1606	*Ustilago filiformis*	*Panicularia americana* (Dicksoniaceae)	United States	Brenckle (1918)
1607	*Valdensinia heterodoxa*	*Asplenium filix-femina* (Aspleniaceae), *Dryopteris austriaca* (Dryopteridaceae), *Pteridium aquilinum* (Dennstaedtiaceae), *Polystichum munitum* (Dryopteridaceae)	Canada, Poland	Ginns (1986), Mułenko et al. (2008), Farr et al. (2021)
1608	*Vararia microhyphidia*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
1609	*Vararia minidichophysa*	*Cyathea arborea* (Cyatheaceae)	West Indies	Minter et al. (2001)
1610	*Vararia* sp.	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
1611	*Vararia* sp.	*Angiopteris evecta* (Marattiaceae)	United States	Gilbertson and Hemmes (1997)
1612	*Venturia haglundii*	*Lycopodium alpinum* (Lycopodiaceae), *Lycopodium complanatum* (Lycopodiaceae)	Sweden	Eriksson (1992)
1613	*Venustosynnema reniformisporum*	*Selaginella moellendorffii* (Selaginellaceae)	China (Taiwan Province)	Kirschner et al. (2019)
1614	*Vermiculariopsiella pteridis*	*Pteris vittata* (Pteridaceae)	India	Bhat (2008)
1615	*Verrucostoma martinicensis*	*Danaea elliptica* (Marattiaceae)	French West Indies	Crous et al. (2015a)
1616	*Verticillium dahliae*	*Equisetum arvense* (Equisetaceae)	Canada	Ginns (1986)
1617	*Verticillium* spp.	*Pteridiurn aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1618	*Violaceomyces palustris*	*Azolla caroliana* (Salviniaceae), *Salvinia minima* (Salviniaceae), *Salvinia molesta* (Salviniaceae)	United States	Albu et al. (2015)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1619	*Virgariella* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Petrini (1992)
1620	*Virosphaerella gleicheniacearum*	*Diplopterygium blotianum* (Gleicheniaceae)	China (Taiwan Province)	Huang et al. (2024)
1621	*Wardomyces inflatus*	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)
1622	*Wettsteinina mirabilis*	*Selaginella stauntoniana* (Selaginellaceae)	China	Tai (1979)
1623	*Wickerhamomyces anomalus*	*Psilotum nudum* (Psilotaceae)	Europe	Rashmi et al. (2019)
1624	*Woldmaria filicina*	*Matteuccia struthiopteris* (Woodsiaceae), *Onoclea struthiopteris* (Woodsiaceae), *Pteretis* sp. (Onocleaceae)	Austria, Belgium, Canada, Denmark, Estonia, Finland, Germany, Kingdom, North America, Norway, Poland, Russia, Sweden, United Kingdom, United States, Ukraine	Cooke (1961), Vlasenko and Vlasenko (2013)
1625	*Xenasma tulasnelloideum*	*Athyrium filix-femina* (Woodsiaceae), *Cibotium chamissoi* (Dicksoniaceae)	Scandinavia, United States	Hjortstam and Larsson (1997), Gilbertson and Hemmes (1997), Gilbertson et al. (2002)
1626	*Xenasmatella gaspesica*	*Athyrium filix-femina* (Woodsiaceae), *Dryopteris filix-mas* (Dryopteridaceae)	Norway, Scandinavia	Hjortstam and Larsson (1997), Ryvarden et al. (2003)
1627	*Xenoanthostomella chromolaenae*	*Nephrolepis* sp. (Davalliaceae)	Thailand	Samarakoon et al. (2022)
1628	*Xenomycosphaerella diplazii*	*Diplazium* sp. (Woodsiaceae)	Brazil	Guatimosim et al. (2016a)
1629	*Xeromphalina testacea*	*Cyathea* sp. (Cyatheaceae)	New Zealand	McKenzie et al. (1992)
1630	*Xylaria filiformis*	*Equisetum* sp. (Equisetaceae)	Austria	Scheuer (1988)
1631	*Xylaria* sp.	*Pteridium aquilinum* (Dennstaedtiaceae)	United Kingdom	Frankland (1976)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1632	*Xylobotryum portentosum*	*Cyathea aspera* (Cyatheaceae), *Cyathea serra* (Cyatheaceae), *Cyathea* sp. (Cyatheaceae)	West Indies	Minter et al. (2001)
1633	*Xylodon detriticus*	*Athyrium filix-femina* (Woodsiaceae), *Pteridium aquilinum* (Dennstaedtiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1634	*Xylodon echinatus*	Fern	China (Taiwan Province)	Kirschner et al. (2019)
1635	*Xylodon flaviporus*	*Cibotium chamissoi* (Dicksoniaceae)	United States	Gilbertson and Hemmes (1997)
1636	*Xylodon nudisetus*	*Athyrium filix-femina* (Woodsiaceae)	Scandinavia	Hjortstam and Larsson (1997)
1637	*Xylolentia simplex*	*Angiopteris lygodiifolia* (Marattiaceae)	China (Taiwan Province)	Kirschner and Hsieh (2023)
1638	*Zasmidium australiense*	*Blechnum indicum* (Blechnaceae), *Blechnum serrulatum* (Blechnaceae)	Australia	Braun et al. (2013)
1639	*Zasmidium cyatheae*	*Cyathea delgadii* (Cyatheaceae)	Brazil	Guatimosim et al. (2016a)
1640	*Zasmidium dicranopteridis*	*Dicranopteris linearis* var. *linearis* (Gleicheniaceae)	China (Taiwan Province)	Kirschner and Liu (2014)
1641	*Zasmidium* sp.	*Blechnum serrulatum* (Blechnaceae)	Brazil	Guatimosim et al. (2016a)
1642	*Zasmidium* sp.	*Blechnum serrulatum* (Blechnaceae)	Brazil	Guatimosim et al. (2016a)
1643	*Zygosporium gibbum*	*Cyathea* sp. (Cyatheaceae), *Polypodium* sp. (Polypodiaceae)	Cuba, Ghana	Hughes (1952), Delgado-Rodríguez et al. (2002)
1644	*Zygosporium masonii*	*Cyathea* sp. (Cyatheaceae), *Polypodium punctatum f. cristatus* (Polypodiaceae)	Cuba	Urtiaga (1986), Delgado-Rodríguez et al. (2002)
1645	*Zygosporium oscheoides*	*Polypodium* sp. (Polypodiaceae)	Ghana	Hughes (1952)
1646	*Zygosporium* sp.	*Platycerium bifurcatum* (Polypodiaceae)	Venezuela	Urtiaga (2004)

Table 2.1 (continued)

No.	Species	Host	Distribution	Reference
1647	*Zymochalara cyatheae*	*Cyathea delgadii* (Cyatheaceae)	Brazil	Guatimosim et al. (2016b)
1648	*Zymochalara lygodii*	*Lygodium volubile* (Schizaeaceae)	Brazil	Guatimosim et al. (2016b)

Note New species are indicated in bold and ex-type strains are denoted as T.

Table 2.2 Taxonomic classification of species associated with pteridophytes

Phyla	Class	Order	Family	Genus
Ascomycota	Arthoniomycetes	Arthoniales	Arthoniaceae	*Herpothallon*/1
				Myriostigma/1
			Opegraphaceae	*Fouragea*/1
	Dothideomycetes	Acrospermales	Acrospermaceae	*Acrospermum*/2
		Asterinales	Asterinaceae	*Echidnodella*/3
				Halbania/1
				Asterina/3(1)
				Dimerosporium/1
			Incertae sedis	*Inocyclus*/3
			Lembosiaceae	*Lembosia*/1
			Morenoinaceae	*Morenoina*/2(1)
		Aulographales	Aulographaceae	*Echidnodes*/3(1)
		Botryosphaeriales	Botryosphaeriaceae	*Diplodia*/1(1)
				Lasiodiplodia/3
				Macrophoma/3(1)
				Botryosphaeria/2(2)
			Incertae sedis	*Metameris*/1
			Phyllostictaceae	*Guignardia*/1
				Phyllosticta/30(22)
		Capnodiales	Euantennariaceae	*Euantennaria*/3
				Hormisciomyces/1(1)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Trichothallus/1
			Metacapnodiaceae	*Antennaria*/1
				Capnocybe/1
				Capnophialophora/1
				Metacapnodium/2
			Mycospharellaceae	*Mycosphaerella*/37(13)
		Cladosporiales	Cladosporiaceae	*Cladosporium*/21(10)
				Heterosporium/2
		Dothideales	Dothideaceae	*Dothidea*/1
				Monographos/1
				Uleodothis/1
			Saccotheciaceae	*Aureobasidium*/2(1)
				Metasphaeria/2
		Hysteriales	Hysteriaceae	*Gloniella*/2
				Hysterium/1
			Incertae sedis	*Graphyllium*/1
		Incertae sedis	Incertae sedis	*Cilioplea*/1
				Clavariopsis/1
				Gibbera/3
				Griggsia/1
				Heptameria/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Mycoglaena/1
				Phacidina/1
				Phragmosperma/1
				Placosphaeria/1
				Rhopographus/2
				Uredinophila/1
				Wettsteinina/1
			Leptopeltidaceae	*Leptopeltis*/4
			Paranectriellaceae	*Paranectriella*/1
			Polystomellaceae	*Dothidella*/2
			Pseudoperisporiaceae	*Eudimeriolum*/1
			Trichopeltinaceae	*Trichopeltheca*/2
			Trichothyriaceae	*Chaetothyriopsis*/1
				Lichenopeltella/1
				Trichothyrium/2
		Microthyriales	Microthyriaceae	*Microthyrium*/1
				Myiocopron/2(1)
				Phragmothyrium/1
		Muyocopronales	Muyocopronaceae	*Peltella*/1(1)
		Mycosphaerellales	Dissoconiaceae	*Ramichloridium*/1
			Mycosphaerellaceae	*Acrotheca*/2(2)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Cercospora/54(26)
				Cercosporella/4(1)
				Cladosporiella/1
				Clypeosphaerella/1
				Janetia/1
				Microcyclus/2
				Mycovellosiella/1(1)
				Neoceratosperma/2
				Paramycosphaerella/6
				Passalora/3
				Periconiella/5(1)
				Phaeoisariopsis/1
				Phaeophleospora/3
				Pseudocercospora/42(2)
				Pseudocercosporella/2(1)
				Ramularia/7
				Scirrhia/6
				Septoria/6
				Sphaerella/1
				Sphaerulina/3
				Xenomycosphaerella/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Zasmidium/5(2)
			Schizothyriaceae	*Schizothyrium*/1
		Myriangiales	Elsinoaceae	*Sphaceloma*/1(1)
		Parmulariales	Parmulariaceae	*Dothidasteroma*/1
				Pachypatella/1
				Parmulina/1
				Polycyclina/1
				Polycyclus/2
				Rhagadolobiopsis/1
				Rhagadolobium/8
		Patellariales	Patellariaceae	*Hysteropeltella*/1
		Pleosporales	Amniculicolaceae	*Amniculicola*/1
				Anguillospora/1
			Astrosphaeriellaceae	*Pithomyces*/1(1)
			Camarosporiaceae	*Camarosporium*/1
			Coniothyriaceae	*Coniothyrium*/4(1)
			Corynesporascaceae	*Corynespora*/2(1)
			Dictyosporiaceae	*Dictyocheirospora*/1
				Jalapriya/1
			Didymellaceae	*Ascochyta*/6(1)
				Boeremia/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Calophoma/1
				Chaetasbolisia/1
				Didymella/6(2)
				Epicoccum/3(2)
				Leptosphaerulina/1
				Microsphaeropsis/1
				Neoscirrhia/2
				Paraboeremia/2
				Phoma/9(6)
			Didymosphaeriaceae	*Didymosphaeria*/2
				Montagnula/1
				Paraconiothyrium/2
				Pseudopithomyces/1
			Dothidotthiaceae	*Mycocentrospora*/1
			Hermatomycetaceae	*Hermatomyces*/1
			Incertae sedis	*Camarographium*/1
				Dangeardiella/2
			Leptosphaeriaceae	*Leptosphaeria*/13(2)
				Plenodomus/2
				Sphaeria/1
			Lophiostomataceae	*Lophiostoma*/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Lophiotremataceae	*Lophiotrema*/1
			Massarinaceae	*Helminthosporium*/3
				Stagonospora/8(6)
			Melanommataceae	*Camposporium*/1
				Melanomma/1(1)
			Parabambusicolaceae	*Paratrimmatostroma*/1
			Periconiaceae	*Periconia*/3
			Phaeosphaeriaceae	*Amarenomyces*/1
				Equiseticola/1
				Hendersonia/5(3)
				Phaeosphaeria/16
			Pleosporaceae	*Alternaria*/19(15)
				Bipolaris/1
				Clathrospora/1
				Comoclathris/1
				Curvularia/3(1)
				Drechslera/2(1)
				Exserohilum/1
				Macrosporium/1(1)
				Pleospora/16(4)
				Pyrenophora/2

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Stemphylium/3(2)
			Sporormiaceae	*Preussia*/1
				Sporormiella/1(1)
			Teichosporaceae	*Chaetomastia*/1
			Torulaceae	*Torula*/1
		Strigulales	Strigulaceae	*Phycopeltis*/3
		Tubeufiales	Tubeufiaceae	*Acanthophiobolus*/1
				Helicoma/1
		Venturiales	Sympoventuriaceae	*Scolecobasidium*/1
			Venturiaceae	*Dimeriella*/1
				Venturia/1
	Eurotiomycetes	Chaetothyriales	Chaetothyriaceae	*Ceramothyrium*/2
				Chaetothyrium/1
				Phaeosaccardinula/1
			Coccodiniaceae	*Dennisiella*/1
			Cyphellophoraceae	*Cyphellophora*/1
			Herpotrichiellaceae	*Capronia*/1
				Exophiala/1(1)
				Herpotrichiella/1
				Phialophora/2(2)
		Coryneliales	Coryneliaceae	*Hypsotheca*/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
		Eurotiales	Aspergillaceae	*Aspergillus*/7(3)
				Corynelia/1
				Penicillium/16(3)
			Thermoascaceae	*Paecilomyces*/1(1)
			Trichocomaceae	*Talaromyces*/1
		Onygenales	Gymnoascaceae	Arachniotus/1
	Geoglossomycetes	Geoglossales	Geoglossaceae	*Trichoglossum*/1
	Incertae sedis	Diporthales	Incertae sedis	*Botryodiplodia*/1(1)
		Incertae sedis	Incertae sedis	*Angulospora*/1
				Antennatula/1(1)
				Atractilina/1
				Balaniopsis/2
				Capnofrasera/1
				Carrismyces/1
				Ceratosporella/1
				Chromosporium/1(1)
				Clypeolum/1
				Endoconospora/1(1)
				Endophragmiella/1
				Fumago/1
				Hymenopsis/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Hyphopolynema/1
				Leptostromella/3
				Leptothyrium/2
				Massalongina/1
				Melampsora/1
				Monodidymaria/1
				Monodisma/1(1)
				Phaeodochium/1
				Placodiplodia/1
				Placothyrium/1
				Plenozythia/1
				Pleurophomopsis/1(1)
				Pleurothyrium/1
				Polycladium/1
				Pseudodiplodia/1
				Radiciseta/1
				Septogloeum/1
				Sphaeriothyrium/2
				Teratosperma/1
				Titaeospora/4(3)
				Trichopeltulum/1(1)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Trichosporiella/1
				Venustosynnema/1
				Virgariella/1(1)
			Seuratiaceae	*Seuratia*/1(1)
	Lecanoromycetes	Baeomycetales	Protothelenellaceae	*Mycowinteria*/1
		Graphidales	Gomphillaceae	*Setomyces*/1
		Gyalectales	Coenogoniaceae	*Coenogonium*/1
		Incertae sedis	Micropeltidaceae	*Clypeolina*/1
				Micropeltis/1
		Lecanorales	Pilocarpaceae	*Byssoloma*/1
				Fellhanera/1
		Ostropales	Stictidaceae	*Cryptodiscus*/2
				Cyanodermella/1
				Stictis/9
		Thelenellales	Thelenellaceae	*Hyalopsora*/2
	Leotiomycetes	Helotiales	Arachnopezizaceae	Incertae sedis/1
				Parachnopeziza/1
			Calloriaceae	*Laetinaevia*/1
				Micropodia/3
			Chlorociboriaceae	*Chlorociboria*/1
			Dermateaceae	*Gloeosporium*/4(1)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Discinellaceae	*Tetrachaetum*/1
			Drepanopezizaceae	*Marssonina*/1
			Gelatinodiscaceae	*Ascocoryne*/2(1)
			Helotiaceae	*Bisporella*/1
				Cyathicula/4(1)
				Hymenoscyphus/3
				Poculopsis/1
			Hyaloscyphaceae	*Dematioscypha*/1
				Fuscolachnum/2
				Hispidula/1
				Hyalopeziza/1
				Hyaloscypha/2
				Incrupila/1
				Pezizella/1
				Scolecolachnum/1
			Incertae sedis	*Asterocalycella*/1
				Bioscypha/2
				Cashiella/1
				Cistella/4
				Crocicreas/3
				Crucellisporium/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Dactylaria/1(1)
				Durella/1
				Gorgoniceps/1
				Lemalis/1(1)
				Pachydisca/1
				Phacidiella/1
				Phialea/1
				Phragmonaevia/1
				Pseudopeltis/2
				Rommelaarsia/1
				Roseodiscus/2
				Stamnaria/4(1)
				Tetracladium/2
				Unguicularia/2
				Urceolella/4
			Lachnaceae	*Dasyscyphella*/1
				Dasyscyphus/6
				Lachnopsis/4(1)
				Lachnum/23(4)
				Lasiobelonium/1
			Loramycetaceae	*Loramyces*/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Mollisiaceae	*Mollisia*/4(3)
				Nimbomollisia/1
				Niptera/2
			Myxotrichaceae	*Oidiodendron*/3
			Neolauriomycetaceae	*Exochalara*/1
			Pezizellaceae	*Allophylaria*/1
				Bloxamiella/1
				Calycellina/2
				Chalara/7
				Cylindrocephalum/1
				Hamatocanthoscypha/2
				Micropeziza/1
				Microscypha/2(1)
				Nagrajchalara/1
				Phaeoscypha/1
				Psilachnum/5(1)
				Rodwayella/1
				Zymochalara/2
			Ploettnerulaceae	*Cylindrosporium*/2(1)
				Pirottaea/1
				Rhynchosporium/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Rutstroemiaceae	*Lanzia*/1
			Sclerotiniaceae	*Botryotinia*/1(1)
				Botrytis/2(1)
				Sclerotinia/2(1)
				Valdensinia/1
			Tricladiaceae	*Helotium*/1
		Incertae sedis	Incertae sedis	*Nannfeldtia*/1
		Leotiales	Incertae sedis	*Alatospora*/1
				Scolecoleotia/1
			Leotiaceae	*Leotia*/1
		Marthamycetales	Marthamycetaceae	*Mellitiosporium*/1
		Phacidiales	Phacidiaceae	*Allantophomopsis*/1
				Ceuthospora/2(1)
				Strasseria/2
		Rhytismatales	Rhytismataceae	*Bifusella*/1
				Coccomyces/2
				Hypoderma/3
				Leptostroma/2
				Lophodermium/2
				Melasmia/1
				Myriophacidium/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
	Orbiliomycetes	Orbiliales	Orbiliaceae	*Arthrobotrys*/2
				Orbilia/2
	Pezizomycetes	Pezizales	Incertae sedis	*Coprotus*/1
				Oedocephalum/1(1)
			Sarcosomataceae	*Conoplea*/1
	Saccharomycetes	Saccharomycetales	Phaffomycetaceae	*Wickerhamomyces*/1
	Sordariomycetes	Amphisphaeriales	Apiosporaceae	*Apiospora*/4
				Nigrospora/1
			Clypeophysalosporaceae	*Plectosphaera*/2
			Hyponectriaceae	*Iodosphaeria*/1
				Physalospora/2(2)
			Nothodactylariaceae	*Nothodactylaria*/1
			Oxydothidaceae	*Oxydothis*/1(1)
			Pseudomassariaceae	*Leiosphaerella*/1
			Sporocadaceae	*Cryptostictis*/1
				Discosia/2
				Neopestalotiopsis/12(1)
				Pestalotia/6(3)
				Pestalotiopsis/19(6)
				Sarcostroma/1
				Seimatosporium/3(1)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
		Chaetosphaeriales	Chaetosphaeriaceae	*Chloridium*/2(1)
			Chaetosphaeriaceae	*Menisporopsis*/1
			Helminthosphaeriaceae	*Echinosphaeria*/1
			Leptosporellaceae	*Leptosporella*/1
		Coniochaetales	Coniochaetaceae	*Coniochaeta*/1
			Incertae sedis	*Pseudogliomastix*/1
		Coronophorales	Incertae sedis	*Papulaspora*/4(3)
		Diaporthales	Cytosporaceae	*Cytospora*/1(1)
			Diaporthaceae	*Diaporthe*/4
				Diaporthopsis/1
				Ophiodiaporthe/1
				Phaeocytostroma/1(1)
				Phomopsis/9(8)
			Gnomoniaceae	*Diplodina*/3(2)
				Gnomonia/1
			Pseudoplagiostomataceae	*Pseudoplagiostoma*/1
			Tubakiaceae	*Actinopelte*/1(1)
		Glomerellales	Australiascaceae	*Dischloridium*/1
				Monilochaetes/2
			Glomerellaceae	*Colletotrichum*/21(10)
				Glomerella/4(3)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Plectosphaerellaceae	*Brunneochlamydosporium*/2
				Gibellulopsis/1
				Verticillium/2(1)
		Hypocreales	Bionectriaceae	*Acremonium*/9(3)
				Bionectria/1
				Clonostachys/2
				Hydropisphaera/5(1)
				Ijuhya/1
				Lasionectriopsis/1
				Nectriopsis/1
				Peristomialis/1
				Protocreopsis/1
				Sesquicillium/1
				Verrucostoma/1
				Gliomastix/1
			Clavicipitaceae	*Aschersonia*/6(1)
				Atkinsonella/1
				Hypocrella/3
			Cordycipitaceae	*Cordyceps*/1
				Gamszarea/1
				Isaria/2(2)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Lecanicillium/1
				Simplicillium/2
			Hypocreaceae	*Hypomyces*/1
				Trichoderma/7(4)
			Incertae sedis	*Cephalosporium*/2(2)
				Stilbella/2(1)
			Myrotheciomycetaceae	*Trichothecium*/2
			Nectriaceae	*Calonectria*/9
				Cylindrocarpon/3(2)
				Cylindrocladium/3(1)
				Dactylonectria/2
				Fusarium/26(15)
				Ilyonectria/2
				Nectria/6
				Neonectria/2
				Scolecofusarium/1
				Thelonectria/1
			Stachybotryaceae	*Albosynnema*/1
				Memnoniella/2
				Myrothecium/3(3)
				Paramyrothecium/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
		Incertae sedis	Acrodictyaceae	*Acrodictys*/1
			Campylosporaceae	*Campylospora*/1
			Incertae sedis	*Botryosporium*/1
				Cryptomycella/3(2)
				Cryptomycina/2
				Pleurophragmium/1
			Junewangiaceae	*Jennwenomyces*/1
		Magnaporthales	Magnaporthaceae	*Clasterosporium*/1
		Meliolales	Meliolaceae	*Asteridiella*/1
				Irenina/1
				Irenopsis/4
				Meliola/4(1)
		Microascales	Ceratocystidaceae	*Berkeleyomyces*/1
			Microascaceae	*Microascus*/1
				Stysanus/1(1)
				Wardomyces/1
		Phomatosporales	Phomatosporaceae	*Phomatospora*/1
		Phyllachorales	Phyllachoraceae	*Coccodiella*/1
				Coccostroma/1
				Phyllachora/4
		Sordariales	Chaetomiaceae	*Thielavia*/1(1)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Dichotomopilus/1
			Incertae sedis	*Arnium*/1
			Neurospora	*Neurospora*/1
			Sordariaceae	*Sordaria*/1
		Vermiculariopsiellales	Vermiculariopsiellaceae	*Vermiculariopsiella*/1
		Xylariales	Diatrypaceae	*Eutypella*/1
			Graphostromataceae	*Biscogniauxia*/2
			Hypoxylaceae	*Nodulisporium*/1(1)
			Incertae sedis	*Xenoanthostomella*/1
			Microdochiaceae	*Microdochium*/1
			Xylariaceae	*Xylaria*/2(1)
			Zygosporiaceae	*Zygosporium*/4(1)
	Taphrinomycetes	Taphrinales	Protomycetaceae	*Burenia*/1
			Taphrinaceae	*Taphrina*/28(3)
	Xylobotryomycetes	Xylobotryales	Xylobotryaceae	*Xylobotryum*/1
Basidiomycota	Agaricomycete	Agaricales	Clavariaceae	*Hyphodontiella*/2
				Setigeroclavula/1
			Crepidotaceae	*Pellidiscus*/1
			Cyphellaceae	*Cyphella*/2
				Incrustocalyptella/1
			Cyphellopsidaceae	*Woldmaria*/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Cystostereaceae	*Parvobasidium*/1
			Entolomataceae	*Clitopilus*/2
				Entoloma/2
				Nolanea/1(1)
				Rhodocybe/1
			Hygrophoraceae	*Hygrocybe*/1
			Hymenogastraceae	*Galerina*/1
			Incertae sedis	*Cephaloscypha*/1
				Collybia/1
				Crucibulum/1
				Deigloria/1
				Glabrocyphella/1
				Lactocollybia/1
				Nidula/1
				Nochascypha/1
				Tricholomopsis/1
			Lycoperdaceae	*Lycoperdon*/2(1)
			Marasmiaceae	*Marasmius*/2(1)
			Mycenaceae	*Favolaschia*/1
				Hemimycena/1
				Hydropus/1(1)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Mycena/9(2)
				Resinomycena/1
				Roridomyces/1
				Xeromphalina/1
			Niaceae	*Flagelloscypha*/2
				Lachnella/4
				Peyronelina/1
			Omphalotaceae	*Gymnopus*/1
				Marasmiellus/2(1)
				Rhodocollybia/1
			Physalacriaceae	*Armillaria*/1
				Desarmillaria/1
			Pleurotaceae	*Pleurotus*/1
				Resupinatus/1(1)
			Pterulaceae	*Coronicium*/1
			Radulomycetaceae	*Aphanobasidium*/2
			Stephanosporaceae	*Cristinia*/2
			Strophariaceae	*Deconica*/1
				Pholiota/1
			Typhulaceae	*Typhula*/4
		Amylocorticiales	Amylocorticiaceae	*Agroathelia*/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
		Atheliales	Atheliaceae	*Amphinema*/1
				Athelia/10(1)
				Athelopsis/3
				Fibulomyces/1
				Hypochniciellum/1
				Tylospora/2
			Auriculariaceae	*Heterochaete*/1
		Auriculariales	Incertae sedis	*Basidiodendron*/1
				Bourdotia/1
				Endoperplexa/1
		Cantharellales	Botryobasidiaceae	*Botryobasidium*/5
			Ceratobasidiaceae	*Ceratobasidium*/1
				Ceratorhiza/1
				Rhizoctonia/17(12)
				Scotomyces/1
			Hydnaceae	*Repetobasidiellum*/1
				Sistotrema/6
			Oliveoniaceae	*Oliveonia*/1
			Tulasnellaceae	*Tulasnella*/2
		Corticiales	Corticiaceae	*Corticirama*/1
				Corticium/2

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Erythricium/1
			Incertae sedis	*Leptocorticium*/1
		Hymenochaetales	Hymenochaetaceae	*Fuscoporia*/1
				Hydnoporia/1
				Hymenochaete/2(1)
				Tubulicrinis/1
			Incertae sedis	*Fibricium*/1
				Subulicium/1
			Rickenellaceae	*Resinicium*/1
			Schizoporaceae	*Hyphodontia*/3
				Lyomyces/1
				Xylodon/4
		Polyporales	Hyphodermataceae	*Hyphoderma*/2
			Incertae sedis	*Bulbillomyces*/1
				Hypochnicium/3
			Meripilaceae	*Rigidoporus*/1
			Meruliaceae	*Scopuloides*/1
			Phanerochaetaceae	*Phanerochaete*/3
			Polyporaceae	*Epithele*/1
		Russulales	Peniophoraceae	*Asterostroma*/1
				Gloiothele/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
				Peniophora/1
				Scytinostroma/2
				Vararia/4(2)
			Russulaceae	*Gloeopeniophorella*/1
			Xenasmataceae	*Xenasma*/1
				Xenasmatella/1
		Sebacinales	Sebacinaceae	*Chaetospermum*/1
				Sebacina/4
		Thelephorales	Thelephoraceae	*Thelephora*/3
				Tomentellopsis/2
		Trechisporales	Hydnodontaceae	*Luellia*/2
				Trechispora/13(2)
				Tubulicium/3(1)
			Incertae sedis	*Sertulicium*/1
	Atractiellomycetes	Atractiellales	Phleogenaceae	*Helicogloea*/1
				Hobsonia/1
	Exobasidiomycetes	Doassansiales	Melaniellaceae	*Melaniella*/2
		Entylomatales	Entylomataceae	*Entyloma*/3(1)
	Microbotryomycetes	Incertae sedis	Incertae sedis	*Oberwinklerozyma*/1
		Microbotryales	Microbotryaceae	*Microbotryum*/2
				Sphacelotheca/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
		Rosettozymales	Rosettozymaceae	*Rosettozyma*/1
	Mixiomycetes	Mixiales	Mixiaceae	*Mixia*/1
	Pucciniomycetes	Helicobasidiales	Helicobasidiaceae	*Helicobasidium*/1
		Platygloeales	Eocronartiaceae	*Herpobasidium*/2
				Platycarpa/1
				Ptechetelium/1
			Pucciniastraceae	*Hyalopsora*/23
				Thekopsora/1
		Pucciniales	Incertae sedis	*Caeoma*/1
				Uredo/19(2)
			Mikronegeriaceae	*Mikronegeria*/1
			Milesinaceae	*Milesia*/9(2)
				Milesina/70(1)
				Uredinopsis/31(2)
			Pucciniaceae	*Desmella*/5
				Puccinia/4
			Uncolaceae	*Calidion*/3
				Uncol/1
	Tritirachiomycetes	Tritirachiales	Tritirachiaceae	*Tritirachium*/1(1)
	Ustilaginomycetes	Ustilaginales	Anthracoideaceae	*Farysia*/3
			Melanotaeniaceae	*Exoteliospora*/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
			Ustilaginaceae	*Anthracocystis*/1
				Ustilago/1
		Violaceomycetales	Violaceomycetaceae	*Violaceomyces*/1
Blastocladiomycota	Physodermatomycetes	Physodermatales	Physodermataceae	*Physoderma*/1
Chytridiomycota	Chytridiomycetes	Chytridiales	Chytriomycetaceae	*Podochytrium*/1
	Rhizophlyctidomycetes	Rhizophlyctidales	Rhizophlyctidaceae	*Rhizophlyctis*/1
	Rhizophydiomycetes	Rhizophydiales	Rhizophydiaceae	*Rhizophydium*/1
	Synchytriomycetes	Synchytriales	Synchytriaceae	*Synchytrium*/2
Entomophthoromycota	Entomophthoromycetes	Entomophthorales	Completoriaceae	*Completoria*/1
Entorrhizomycota	Entorrhizomycetes	Entorrhizales	Entorrhizaceae	*Entorrhiza*/1
Eumycetozoa	Myxomycetes	Cribrariales	Cribrariaceae	*Cribraria*/1(1)
		Physarales	Didymiaceae	*Diderma*/1
			Lamprodermataceae	*Lamproderma*/2(1)
			Physaraceae	*Physarum*/1(1)
		Reticulariales	Reticulariaceae	*Lycogala*/1
		Stemonitidales	Amaurochaetaceae	*Comatricha*/1
		Trichiales	Trichiaceae	*Oligonema*/1
				Trichia/1

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
Glomeromycota	Glomeromycetes	Diversisporales	Acaulosporaceae	*Acaulospora*/1
		Gigasporales	Racocetraceae	*Cetraspora*/1
		Glomerales	Glomeraceae	*Funneliformis*/1
				Rhizophagus/1
				Sclerocystis/1
Mortierellomycota	Mortierellomycetes	Mortierellales	Mortierellaceae	*Entomortierella*/2
				Linnemannia/1
				Mortierella/1(1)
				Podila/2
Mucoromycota	Incertae sedis	Incertae sedis	Incertae sedis	*Planticonsortium*/1
	Mucoromycetes	Mucorales	Choanephoraceae	*Poitrasia*/1
			Cunninghamellaceae	*Absidia*/2
			Lichtheimiaceae	*Lichtheimia*/1
			Mucoraceae	*Mucor*/6
	Umbelopsidomycetes	Umbelopsidales	Umbelopsidaceae	*Umbelopsis*/2
Oomycota	Peronosporomycetes	Peronosporales	Myzocytiopsidaceae	*Resticularia*/1
			Peronosporaceae	*Phytophthora*/7(3)
				Sclerospora/1
			Pythiaceae	*Globisporangium*/5
				Myzocytium/1
				Pythium/32(25)

Table 2.2 (continued)

Phyla	Class	Order	Family	Genus
	Saprolegniomycetes	Saprolegniales	Achlyaceae	*Achlya*/4
				Thraustotheca/1
			Saprolegniaceae	*Saprolegnia*/3
			Verrucalvaceae	*Aphanomyces*/1

Note The numbers of species in each genus are provided after the genus name and the number of unidentified species is provided inside the brackets. For example: *Phytophthora*/7(3) denotes seven *Phytophthora* species including three unidentified species associated with pteridophytes.

Table 2.2 based on Table 2.1, the numbers of species in each genus are provided after the genus name and the number of unidentified species is provided inside the brackets. For example: *Phytophthora*/7(3) denotes seven *Phytophthora* species including three unidentified species associated with pteridophytes.

2.4 Result Part 2: Notes and Redrawn Plates on Selected Fungal Genera

Based on the above checklists (Table 2.1 and Table 2.2), we have compiled a significant record of 1,637 pteridophyte-related fungal species (including undetermined species) from 608 genera, with a worldwide distribution. Our investigation has led to the identification of some high frequency and interesting groups that are exclusive to pteridophytes. To this end, we have provided detailed notes for two major fungal groups: (1) 36 genera with host specificity at genus level, and (2) the ten most species-rich genera (Table 2.3). Notably, three fungal genera, *Hyalopsora*, *Milesina* and *Uredinopsis*, are featured in both lists. All members of these genera are rust fungi found on ferns, with *Abies* species serving as with their alternate hosts.

2.4.1 Interesting Fungal Genera Likely Restricted to Pteridophytes

Asterocalycella Höhn. ex R. Kirschner, Taiwania 64(2): 170 (2019)

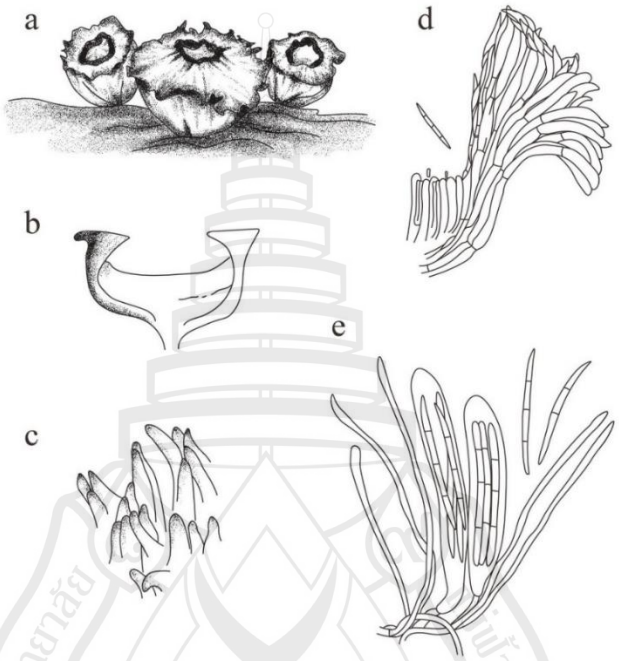
Index Fungorum number: IF556311; one species and one unidentified species associated with pteridophytes; Figure 2.1

Type species: *Asterocalycella mirabilis* (Höhn.) R. Kirschner

≡ *Asterocalyx mirabilis* Höhn.

Notes: *Asterocalycella* was proposed by Kirschner et al. (2019) to replace the illegitimate generic name *Asterocalyx* Höhn, which was a synonym of the fossil plant *Asterocalyx* Ettingsh (http://fossilplants.info). The phylogenetic placement of *Asterocalycella* was recommended as *incertae sedis* within Helotiales (Leotiomycetes, Ascomycota) by Kirschner et al. (2019) based on short DNA sequences of the ITS region and limited taxa sampling and this is followed in the Outline of Fungi and fungus-like organisms (Hyde et al., 2024). The morphology of *Asterocalycella* is represented by the one species, *A. mirabilis*, with a sexual morph characterized by unique host-preference on various ferns. It has scattered or gregarious, rounded, white to grayish brown to dark brown apothecia with openings, white to grayish brown to dark brown apothecia, radialized dentate with colloid trichoid hypha on the lateral margin, unitunicate asci with subsessile or short sessile,

and fusiform, straight or slightly curved, septate, hyaline ascospores (Wu, 2002; Kirschner et al., 2019). *Asterocalycella mirabilis* has been recorded from dead petioles and rachises of several collections restricted to ferns (Cyatheaceae and Marattiaceae) in Taiwan Province, China.



Note a Apothecia. b Vertical section of an apothecium. c, d Hairs. e Asci and ascospores. Redrawn from the website (https://biotanz.landcareresearch.co.nz/).

Figure 2.1 *Asterocalycella mirabilis*

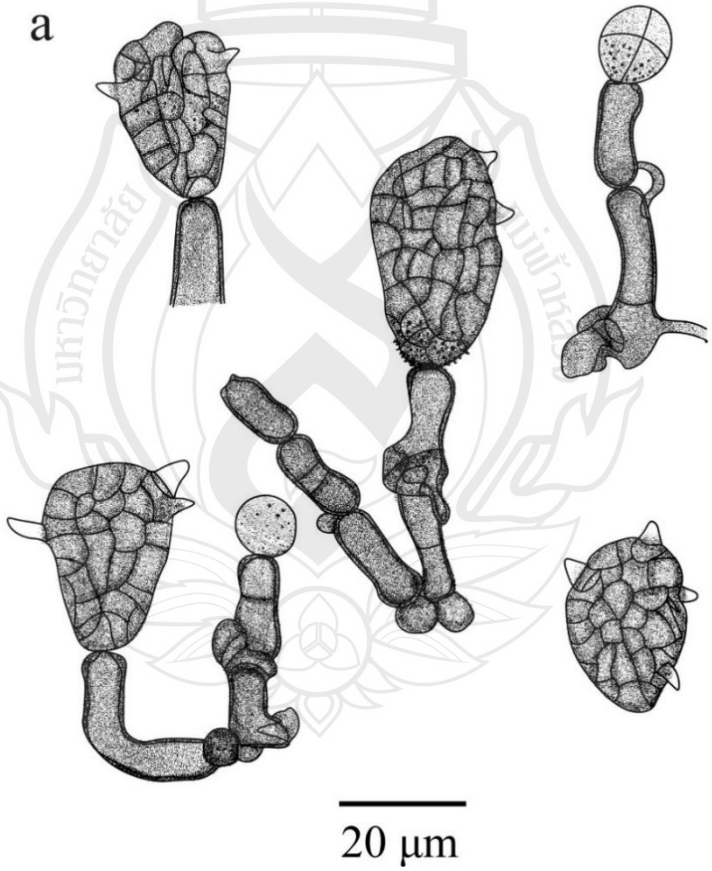
Carrismyces R.F. Castañeda & Heredia, Mycotaxon 76: 125 (2000)

Index Fungorum number: IF466213; one species associated with pteridophytes; Figure 2.2

Type species: *Carrismyces proliferatus* R.F. Castañeda & Heredia

Notes: The hyphomycetous genus *Carrismyces* was introduced by Castañeda Ruiz and Heredia (2000) and placed in Ascomycota genera *incertae sedis* (Wijayawardene et al., 2022; Hyde et al., 2024). *Carrismyces* is monotypic, containing the single species *Carrismyces proliferates*, collected on rotten stem of a tree fern (*Cyathea* sp.) in a Mexican cloud forest (Castañeda Ruiz & Heredia, 2000). The genus is characterized by

mononematous or fasciculate, smooth or verrucose, brown to black conidiophores with adventitious hyphae arising towards the base, monotretic, integrated, percurrent conidiogenous cells with thickened walls around the pore, and obconical to subglobose to pyriform to turbinate, muriform (dictyoseptate), dark brown or black conidia often with corniform to conical, hyaline appendages (Castañeda Ruiz & Heredia, 2000). *Carrismyces* resemble *Hughesinia* in the obconical conidia but differs in having dictyoseptate conidia and adventitious hyphae at the base of conidiophores (Delgado et al., 2005; Heredia et al., 2012). No molecular date is available for this genus. Therefore, collections and isolation, with DNA sequence data are needed to achieve a natural classification and verify the host-preference of pteridophytes in this genus.



Note a Conidiophores, conidiogenous cells and conidia of C*arrismyces proliferates*. Redrawn from Castañeda Ruiz and Heredia (2000).

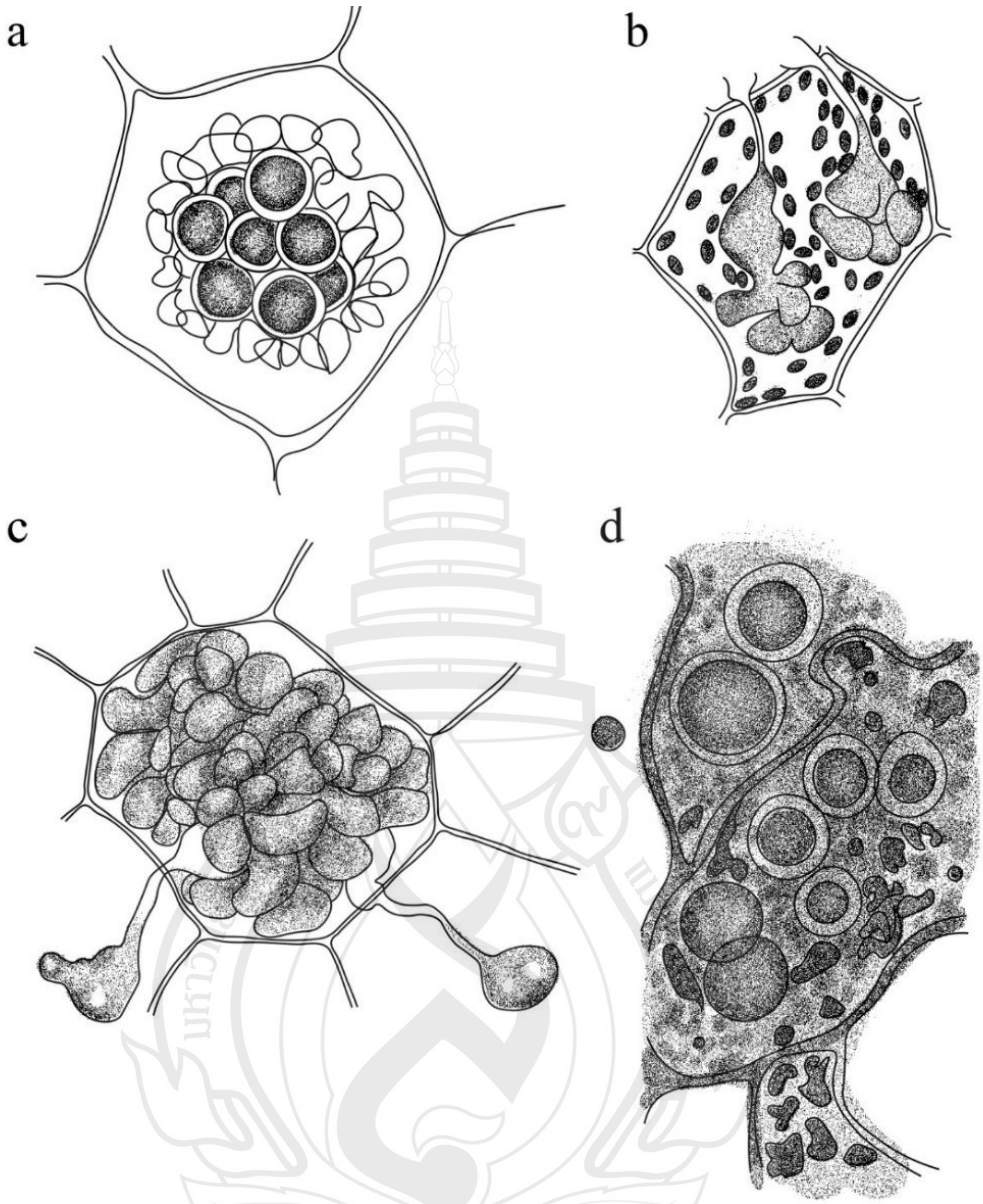
Figure 2.2 *Carrismyces proliferates*

Completoria Lohde, Tagebl. Versamm. dt. naturf. Ärzte (Breslau) 47: 203–206 (1874)

Index Fungorum number: IF20142; one species associated with pteridophytes; Figure 2.3

Type species: *Completoria complens* Lohde

Notes: *Completoria* was proposed by Lohde (1874) within the monotypic family Completoriaceae (Humber, 1989). The morphological characteristics of the monotypic genus *Completoria* are simple, with apparently botryose, protoplastic vegetative growth, large nuclei filled with condensed chromatin at interphase, simple conidiophores arising from vegetative cells, subglobose conidia, and globose resting spores (Atkinson, 1894, 1895; Humber, 1989). These characteristics are similar to some entomopathogenic fungi (Humber, 2016). *Completoria complens* is considered to be a rare species and an interesting obligate intracellular parasite of fern prothallia, with a unique ecology that has only been observed in greenhouse cultures (Atkinson, 1894; Humber, 1989; Gryganskyi et al., 2013). A comprehensive investigation of this species was carried out by Klasse (1881), who grew it in the fern prothallia of a large variety of species (Klasse, 1881). Molecular data is unavailable for this genus and it is placed in Completoriaceae, Entomophthorales, Entomophthoromycetes, Entomophthoromycotina, Entomophthoromycota (Hyde et al., 2024c).



Note a Host cell invaded with resting spores of *Completoria complens*. b Two young plants in one host cell, having entered from an adjacent cell. c Fungus body in the host, with peripheral cells that develop tube penetrating adjacent cells of the fern prothallium. d The binucleate mature, thick-walled resting spores. Redrawn from Humber (2016) and the website of Alamy (https://www.alamy.com/stock-photo/adjacent-cells.html?sortBy=relevant).

Figure 2.3 *Completoria complens* in cells of fern gametophyte

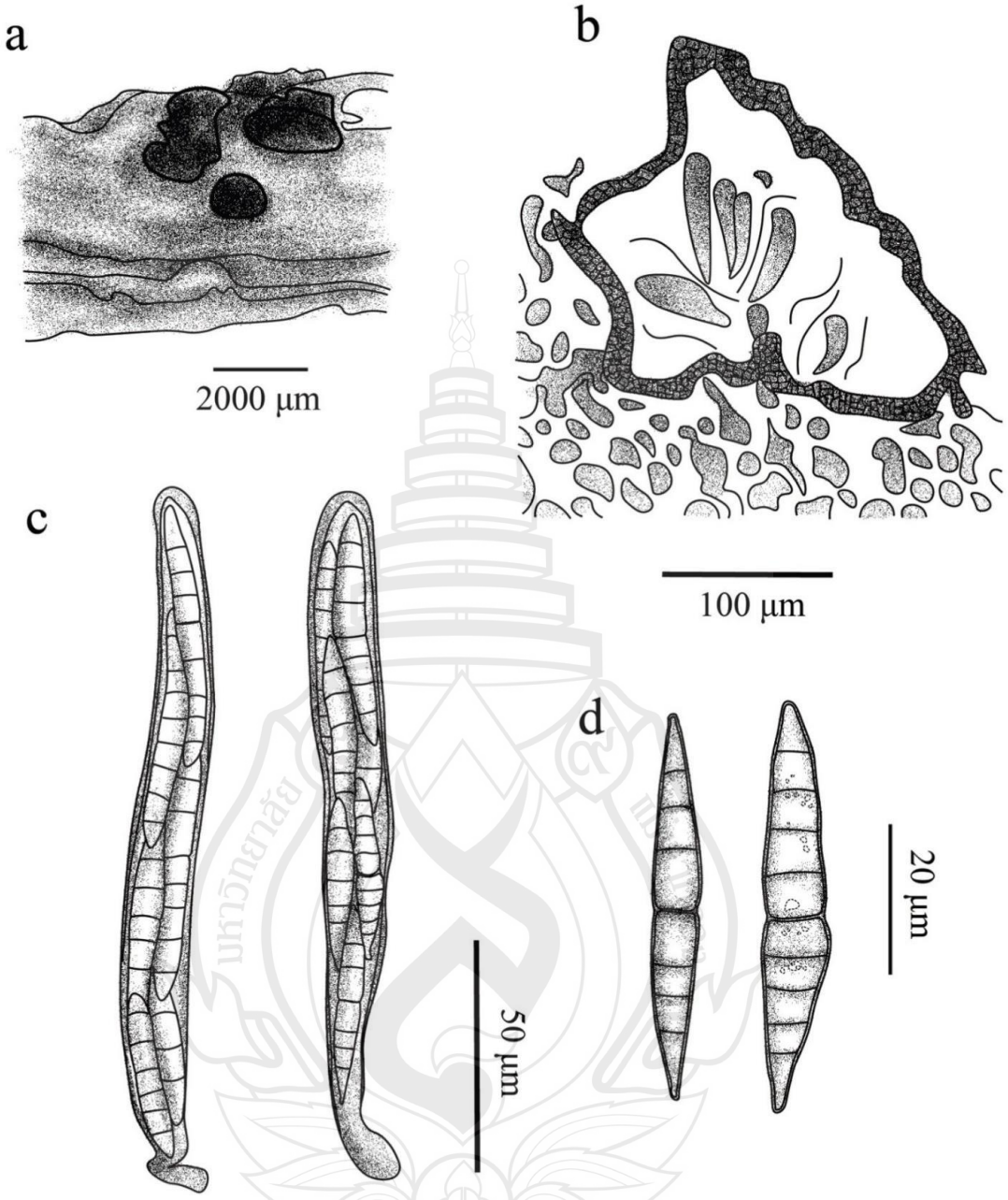
Dangeardiella Sacc. & P. Syd., Syll. fung. (Abellini) 14(2): 683 (1899)

Index Fungorum number: IF 1410; two species associated with pteridophytes; Figure 2.4

Type species: *Dangeardiella macrospora* (J. Schröt.) Sacc. & P. Syd.

≡ *Monographos macrosporus* J. Schröt.

Notes: *Dangeardiella* was introduced by Saccardo and Sydow (1899), with *Dangeardiella macrospora* as the type species. The phylogenetic status of *Dangeardiella* is uncertain and has been placed in Dothideales genera *incertae sedis* (Hawksworth et al., 1995), or Melanommataceae in Pleosporales (Kirk et al., 2008) or Dothideomycetes genera *incertae sedis* (Lumbsch & Huhndorf, 2010) and was located in Pleosporales genera *incertae sedis* in the latest treatments (Thambugala et al., 2014; Hongsanan et al., 2020a; Hyde et al., 2024c; Pem et al., 2024). *Dangeardiella* comprises two species, *D. fusiformis* and *D. macrospora*, which are saprobic on stalks and petioles of ferns. Members of the genus are known for their sexual morph characterized by black ascomata with an indistinct slit-like ostiole, aseptate pseudoparaphyses, bitunicate asci with short pedicels and 5–10 septate, fusoid to fusiform, hyaline ascospores (Saccardo & Sydow, 1899; Holm & Holm, 1978; Thambugala et al., 2014). This genus only has SSU sequence of *D. macrospora* available.



Note a Ascomata on host surface. b Section through ascoma. c Bitunicate asci. d Ascospores. Redrawn from Thambugala et al. (2014).

Figure 2.4 *Dangeardiella macrospora*

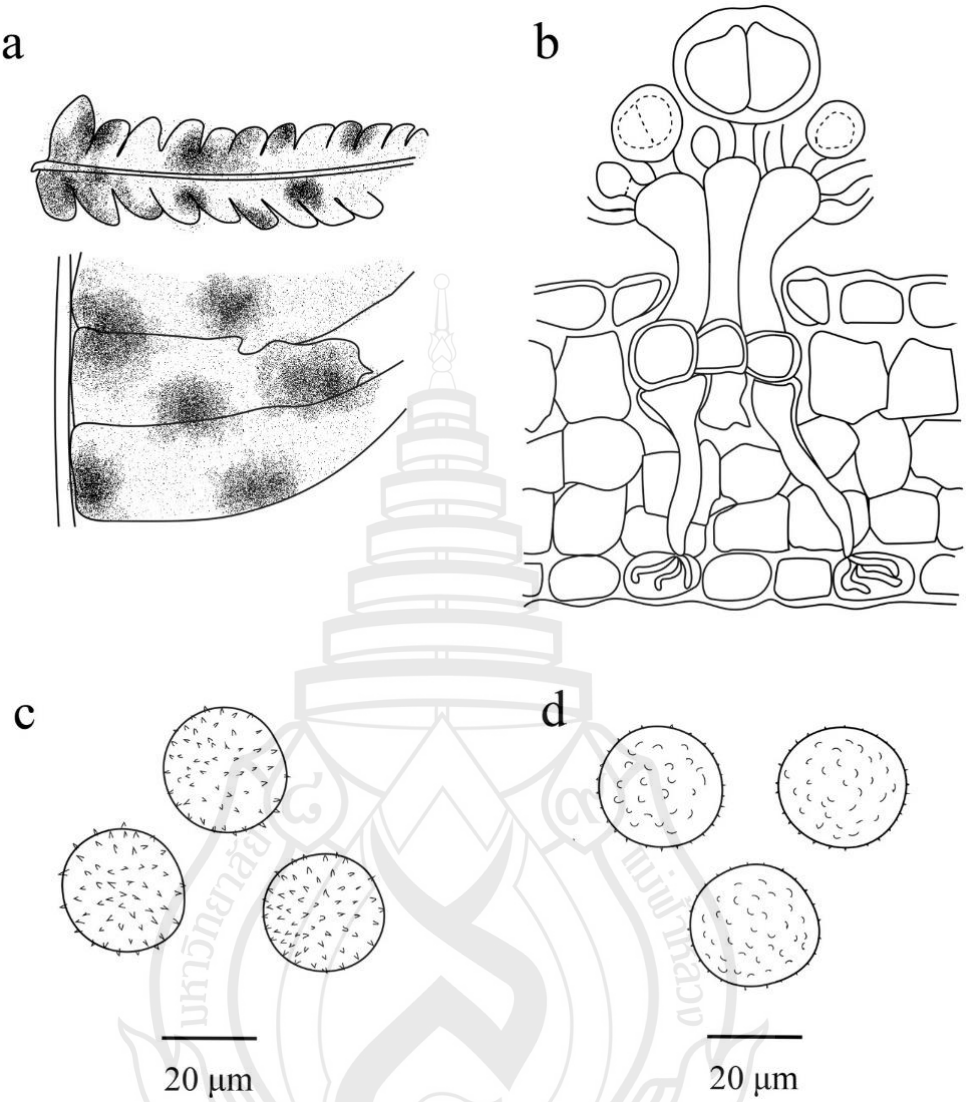
Desmella Syd. & P. Syd., Annales Mycologici 16 (3–6): 241 (1918)

Index Fungorum number: IF16094; five species associated with pteridophytes; Figure 2.5

Type species: *Desmella aneimiae* Syd. & P. Syd.

≡ *Uredo aneimiae* Henn.

Notes: *Desmella*, a genus of fern rust, was introduced by Sydow (1919) to accommodate four new combinations, namely *Desmella aneimiae*, *D. gymnogrammes*, *D. mbatobiensis* and *D. superficialis*. Recently, based on 28S nuclear rDNA sequence data, a phylogenetic relationship was reconstructed revealing *Desmella* in Pucciniaceae (Pucciniales, Pucciniomycetes, Basidiomycota) (Aime & McTaggart, 2021), which is closely related to Sphaerophragmiaceae *sensu stricto* (Okane et al., 2021). Morphologically, the genus is characterized by scab symptoms caused by minute, subepidermal sori, short-pedicellate, globose, elliptical or oval urediniospores arising from the apices of the hypha, and bicellular, hyaline teliospores (Sydow, 1919; Arthur, 1929; Cummins, 1940; Thirumalachar & Cummins, 1948; Ono, 2020). Currently, five species are accepted in *Desmella* (Sydow, 1919; Okane et al., 2021). The genus is known exclusively from its uredinial and telial stages of the life cycle, with no known alternate host (Hennen & Ono, 1978; Cummins & Hiratsuka, 2003; Ono, 2020). It exhibits a clear preference for obligatory fern host parasitism, especially on tropical ferns (Faull, 1947; Hennen & Ono, 1978; Cummins & Hiratsuka, 2003; Ono, 2020; Okane et al., 2021). Although there are only five species, *Desmella* is one of the most commonly occurring on ferns (Helfer, 2006). Among these, *D. aneimiae* infects 19 genera of ferns and their allies. *Desmella superficialis* is a common and widely distributed species, found on more than 20 kinds of ferns. Notably, *D. lygodii* is found only on *Lygodium* spp. (Schizaeaceae, Schizeaeales), and is likely restricted to this fern genus.



Note a Mature uredinia densely distributed on the leaf surface of *Christella dentata* and *Nephrolepis exaltata* subsp. *hawaiiensis*. c Urediniospores focus on tangential plane to show spines on the wall surface. d Urediniospores focused on median plane. Redrawn from Ono (2020). b Superstomatal telial development of *Desmella* species, showing structure in longitudinal section. Redrawn from Hennen and Ono (1978).

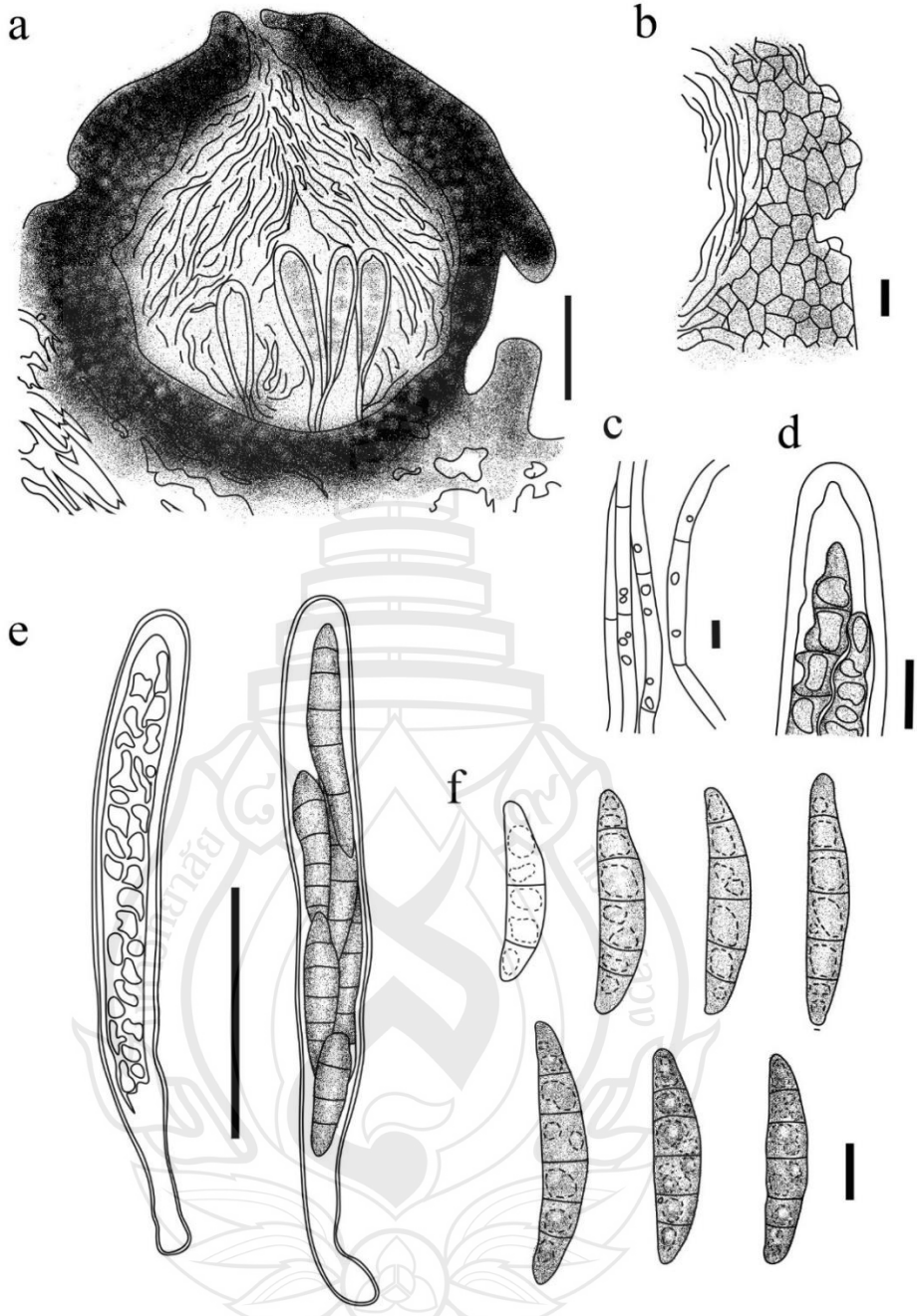
Figure 2.5 *Desmella aneimiae*

Equiseticola Abdelsalam, Tibpromma, Wanas. & K.D. Hyde, Phytotaxa 284(3): 173 (2016)

Index Fungorum number: IF 551562; two species associated with pteridophytes (including one species newly described in this study); Figure 2.6

Type species: *Equiseticola fusispora* Abdelsalam, Tibpromma, Wanasinghe & K.D. Hyde

Notes: The monotypic genus *Equiseticola* was introduced in Phaeosphaeriaceae (Pleosporales, Dothideomycetes) by Abd-Elsalam et al. (2016) based on phylogenetic analyses of combined LSU, SSU and ITS sequence data. Phylogenetically, *Equiseticola* is closely related to *Ophiosphaerella* in Phaeosphaeriaceae, but they are distinct in morphology (Abd-Elsalam et al., 2016). *Equiseticola* has a long, acute or knob-like pedicel, a well-developed ocular chamber and fusiform ascospores, while *Ophiosphaerella* has short pedicellate asci, an indistinct ocular chamber, and fasciculate ascospores. The type species, *E. fusispora*, was isolated from *Equisetum* sp. in Italy. The genus is characterized by ovoid ascomata with a minute papilla, bitunicate, cylindrical asci with a long, acute or knob-like pedicel, and hyaline to yellowish to pale brown, fusiform ascospores (Abd-Elsalam et al., 2016). In this study, we introduce the second species of *Equiseticola*, which was also collected from *Equisetum* sp.



Note a Section of an ascoma. b The texture of the cell wall of the peridium, showing brown to dark brown cells of *textura angularis*. c Pseudoparaphyses. d Ocular chamber. e Asci. fAscospores. Scale bars: a = 50 µm, b, d, f = 5 µm, c = 2 µm, e = 20 µm. Redrawn from Abd-Elsalam et al. (2016).

Figure 2.6 *Equiseticola fusispora*

Exoteliospora R. Bauer, Oberw. & Vánky, Mycologia 91(4): 669–675 (1999)

Index Fungorum number: IF 28331; one species associated with pteridophytes; Figure 2.7

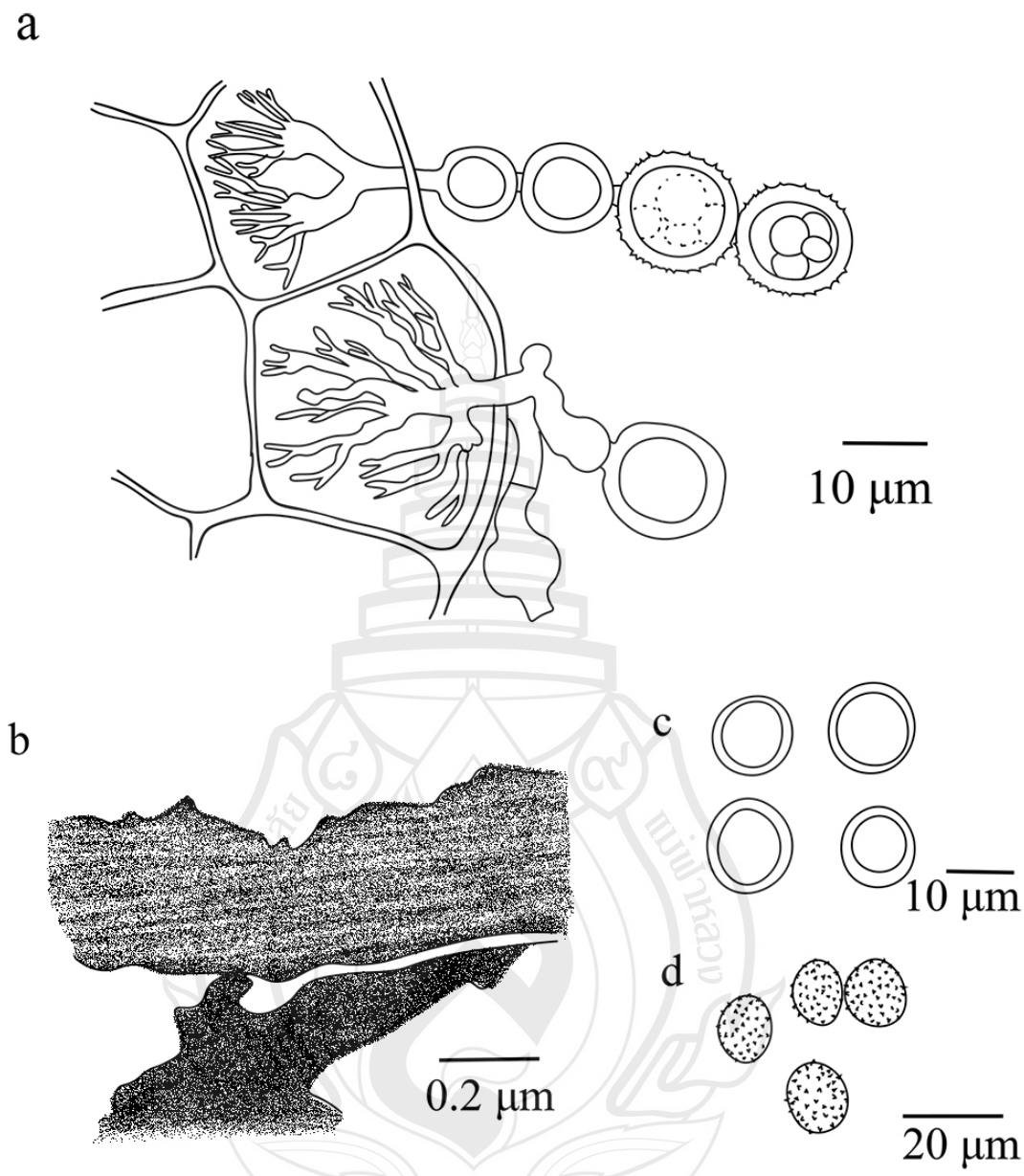
Type species: *Exoteliospora osmundae* (Peck) R. Bauer, Oberw. & Vánky

≡ *Ustilago osmundae* Peck

≡ *Mycosyrinx osmundae* (Peck) Peck

Notes: The genus *Exoteliospora* was introduced in Melanotaeniaceae based on evidence of sporulation, septal pore apparatus, and host-parasite interaction between *E. osmundae* (Bas. *Ustilago osmundae*) and its host of the royal fern *Osmunda regalis*, using light and electron microscopy (Bauer et al., 1999a). *Exoteliospora* comprises a single species, *E. osmundae*, which was originally known as a smut fungus infecting ferns (Peck, 1881), but was reclassified as a hyphomycete (Clinton, 1904). Subsequently, *E. osmundae* was considered a basidiomycete based on the ultrastructure of the hyphal wall and septal pore (Vánky, 1996). Currently, *E. osmundae* is recognized as a smut fungus due to the understanding that smut fungi evolved in different fungal groups (Bauer et al., 1997, 1999a). This conclusion is significant as it provides key evidence for host jumping (the host range of smuts from angiosperms to ferns) (Bauer et al., 1997). It is noteworthy that *E. osmundae* has been found on several collections of *Osmunda* spp. in North America, suggesting that the host range of *Exoteliospora* is likely restricted to the fern genus *Osmunda*.

The monotypic genus exhibits a unique morphology, with thick-walled and thin-walled hyphae forming coralloid haustoria with numerous lobes in epidermal cells, hyphae absent, lacking in intercellular spaces, globose to subglobose teliospores produced in basipetal chains, and septal pores with non-swollen lips and membrane caps, composed of a simple pore with two caps (Peck, 1881; Vánky, 1996; Bauer et al., 1999a). The characteristic external sporulation and absence of intercellular hyphae are prominent features of *Exoteliospora* (Bauer et al., 1999a) in Melanotaeniaceae of Ustilaginomycetes, Basidiomycota (Hyde et al., 2024c).



Note a Coralloid haustoria in epidermal cells from a freehand section and the mode of teliosporogenesis. b Section through a hypha showing the fibrillate wall. c Teliospores (LM). d Teliospores (SEM). Redrawn from Bauer et al. (1999a).

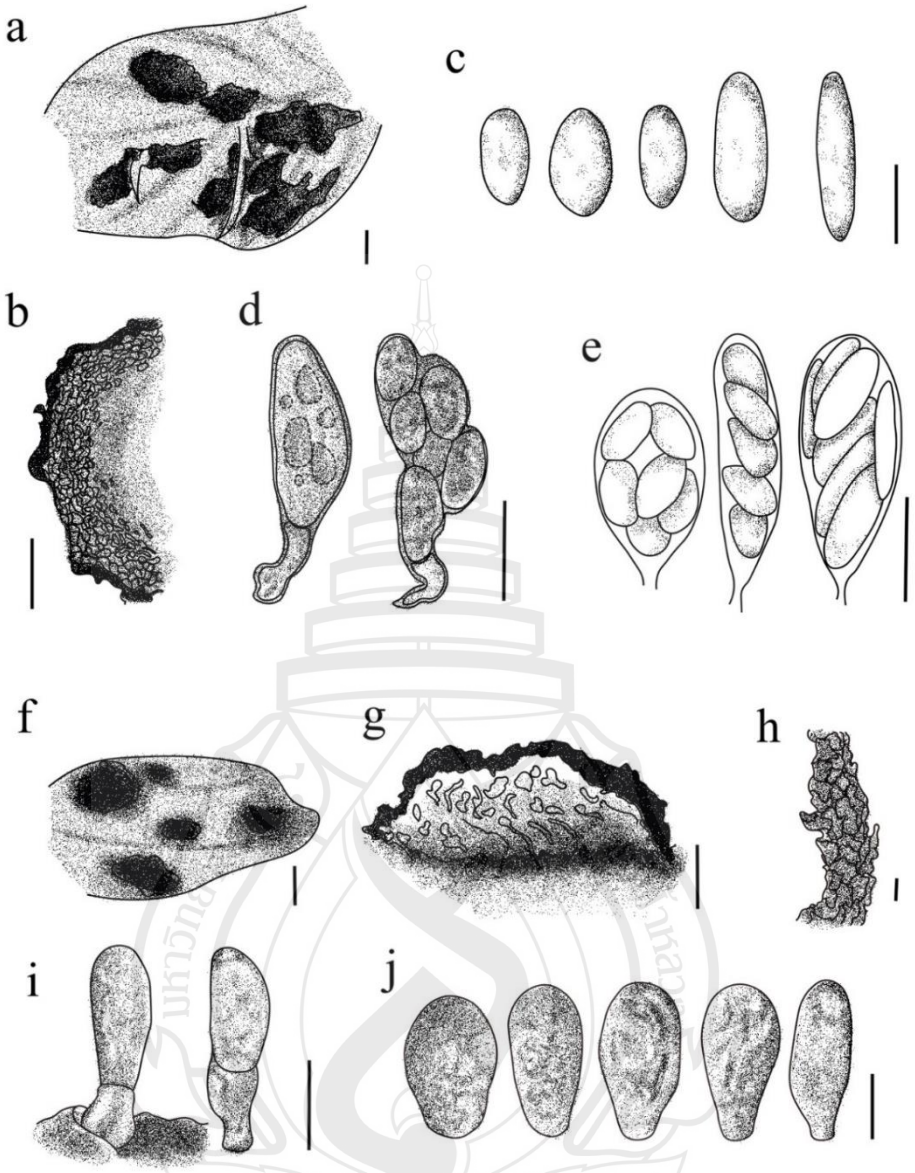
Figure 2.7 *Exoteliospora osmundae*

Griggsia F. Stevens & Dalbey, Bot. Gaz. 68(3): 224 (1919)

Index Fungorum number: IF 2137; one species associated with pteridophytes; Figure 2.8

Type species: *Griggsia cyathea* F. Stevens & Dalbe

Notes: Based on its unique morphology, *Griggsia* was introduced by Stevens and Dalbey (1919) to accommodate a parasite on the leaves of *Cyathea arborea* (Cyatheaceae, tree fern) from Puerto Rico, named *Griggsia cyathea*. The monotypic genus *Griggsia* was initially placed under Dothideomycetes, genera *incertae sedis* due to the mycelial character being in a stroma (Stevens & Dalbey, 1919). However, based on a morphological reexamination of *Griggsia cyathea*, Thambugala et al. (2014) argued that *Griggsia* should be located in Sordariomycetes, genera *incertae sedis*, due to its unitunicate asci (Hyde et al., 2013) and this is also followed in the latest *Outline of Fungi and fungus-like Organisms* (Hyde et al., 2024c). *Griggsia* exhibits both sexual and asexual states. The sexual morph is characterized by superficial ascomata, filamentous, unbranched, septate, pseudoparaphyses, unitunicate, broadly obovoid asci, and broadly oval, hyaline, 1-celled ascospores (Stevens & Dalbey, 1919; Thambugala et al. 2014). The asexual morph is characterized by coelomycetous features, including epidermal, dimidiate conidiomata, phialidic, integrated conidiogenous cells with a short collarette at the tip, and broadly obovoid to pyriform conidia (Stevens & Dalbey, 1919; Thambugala et al., 2014). Molecular data is not available for this genus. Therefore, the type species, *G. cyathea* needs to be restudied and re-analyzed with fresh collections and isolations, epitypified and subjected to phylogenetic analysis. Lastly, it is not meaningful to discuss host preference based on the single specimen. Thus, more samples of *Griggsia* are needed to explore its ecology, as well as its host-specificity or preference.



Note a Appearance of sexual state on host. b Peridium. c Ascospore. d, e Mature asci. f Appearance of asexual state on host. g Section through fruiting body. h Peridium. i Conidiogenous cell with conidia. j Conidia. Scale bars: a, f = 200 µm, b, g = 50 µm, c, h, j = 10 µm, d = 30 µm, e, i = 20 µm. Redrawn from Thambugala et al. (2014).

Figure 2.8 *Griggsia cyathea*

Hyalopsora Magnus, Berichte der Deutschen Botanischen Gesellschaft 19: 582 (1901)

*Index Fungorum numbe*r: IF16164; 23 species associated with pteridophytes.

*Type specie*s: *Hyalopsora aspidiotus* (Peck) Magnus

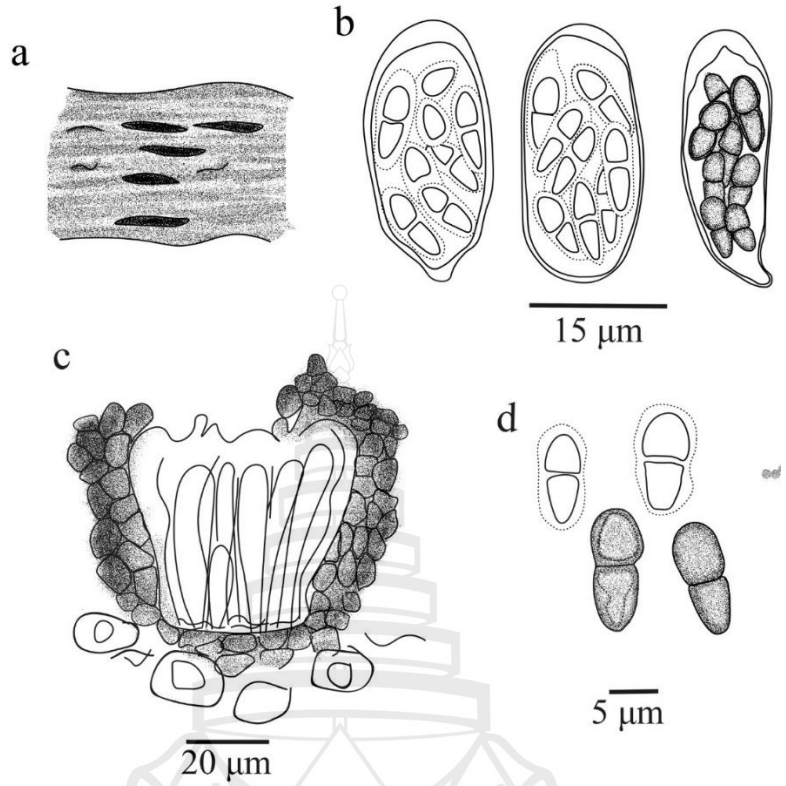
Notes: See below (Result part 2.2) for details.

Hysteropeltella Petr., Annls mycol. 21(1–2): 9 (1923)

Index Fungorum number: IF 2470; 1 species associated with pteridophytes; Figure 2.9

Type species: *Hysteropeltella moravica* Petr.

Notes: Petrak (1923) established the monotypic genus *Hysteropeltella*, typified by *H. moravica* which was collected on *Aspidium filix-mas*. The genus contains a single species, *Hysteropeltella moravica*, known from eight collections related to pteridophytes. All known specimens are from the sexual morph, characterized by elongate apothecial, elongate ellipsoidal ascomata with longitudinal slit-like openings, a thin peridium composed of pseudoparenchymatous cells, bitunicate, fissitunicate asci with a blue plane apical reaction using Melzer's reagent, and clavate-oblong to fusoid, or ellipsoidal ascospores surrounded by a thin, distinct mucilaginous sheath (Petrak, 1923; Holm & Holm, 1978; Ariyawansa et al., 2013). The taxonomic placement of *Hysteropeltella moravica* has long been uncertain. It has been placed in discomycetes due to its hysterothecial morphology and the presence of a longitudinal slit (Holm & Holm, 1978), or Dothideomycetes, genera *incertae sedis* (Lumbsch & Huhndorf, 2010). Ariyawansa et al. (2013) re-examined the type material of *Hysteropeltella,* and transferred this genus to Schizothyriaceae based on its discoid ascomata, composed of isodiametrical or radiating cells. However, Phookamsak et al. (2016) tentatively accepted *Hysteropeltella* in Patellariaceae where it is presently placed (Hyde et al., 2024c) based on the elongated apothecial or hypothecia-like ascomata, advocating new collections with molecular data to confirm its placement.



Note a Appearance of taxon on substrate. b Asci. c Cross section of ascoma. d Ascospores. Redrawn from Ariyawansa et al. (2013).

Figure 2.9 *Hysteropeltella moravica*

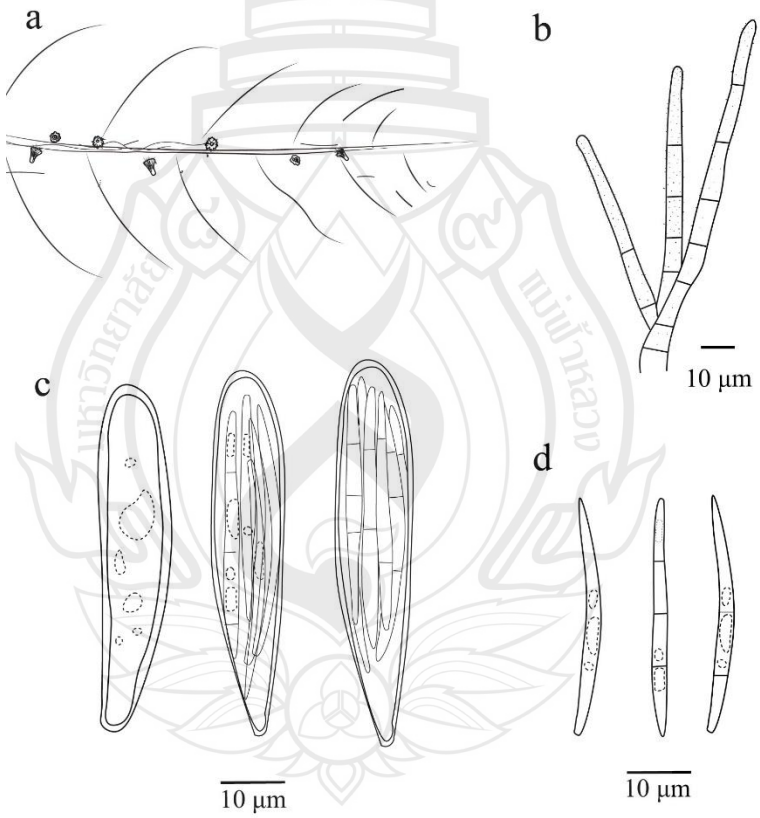
Lachnopsis Guatim., R.W. Barreto & Crous, Mycol. Progr. 15(12): 1257 (2016)

Index Fungorum number: IF 817300; two species associated with pteridophytes; Figure 2.10

Type species: *Lachnopsis catarinensis* Guatimosim, R.W. Barreto & Crous

Notes: Based on both ITS and LSU phylogenies, *Lachnopsis* was established by Guatimosim et al. (2016b) for two lachnum-like taxa, namely *Lachnopsis catarinensis* (the type species) and *L. dicksoniae* Guatim., R.W. Barreto & Crous. These two species were found on frond blight in Brazil (Guatimosim et al., 2016b). *Lachnopsis* species are known only from its sexual morphs, which are characterized by unique host preferences on ferns, and having apothecial, superficial ascomata clothed with hairs, cylindrical asci with euamyloid pores, and fusoid or filiform, hyaline ascospores

(Guatimosim et al., 2016b). *Lachnopsis* has typical characteristics of *Lachnum s.l* and is difficult to distinguish from *Lachnum s.l*. using morphology, but it can be differentiated based on molecular data (ITS, LSU and SSU). Guatimosim et al. (2016b) also pointed out that two fungi (*Lachnopsis* cf. *varians* TNS-F-17631 and *Lachnopsis* cf. *pteridophylli* SAC PR148) widely distributed on tropical ferns may be additional members of *Lachnopsis* (Haines, 1980; Spooner, 1987). These two species need to be recollected, sequenced and epitypified in order to confirm their phylogenetic status (TNS-F-17631 and SAC PR148). The genus is placed in Lachnaceae, Helotiales, Leotiomycetes, Ascomycota (Hyde et al., 2024c).



Note a Apothecia on the leave of *Dicksonia sellowiana*. b Asci. c Ascospores. Scale bars: b, c = 10 µm. Redrawn from Guatimosim et al. (2016b).

Figure 2.10 *Lachnopsis catarinensis*

Massalongina Bubák, Berichte der Deutschen Botanischen Gesellschaft 34: 319 (1916)

Index Fungorum number: IF 8854; one species associated with pteridophytes

Type species: *Massalongina aquilina* (C. Massal.) Bubák

≡ *Leptostromella aquilina* C. Massal.

≡ *Phomopsis aquilina* (C. Massal.) Petr.

Notes: *Massalongina*, a poorly studied genus, was proposed by Bubák (1916) to accommodate a new combination, *Massalongina aquilina* (Bas. *Leptostromella aquilina*), which occurred on the rachis and fronds of *Pteris aquilina* in Italy. The genus is monotypic containing a single species, *Massalongina aquilina* characterized by polystomatous, dimidiato-scutelliform perithecium, oblongish, applanate hypodermis, parietal membranacea, oblong to fusoid, hyaline spores, and bacillary sporophore (Massalongo, 1889; Bubák, 1916). Currently, *Massalongina* is placed in *Ascomycota* genera *incertae sedis* (Wijayawardene et al., 2022; Hyde et al., 2024c). Furthermore, this species was reported without any photoplates (Massalongo, 1889; Bubák, 1916). Therefore, the type species, *M. aquilina* needs to be restudied and re-analyzed with fresh collections and isolations, epitypified, and subjected to phylogenetic analysis, and the morphology should be documented with color photoplates.

Melaniella R. Bauer, Vánky, Begerow & Oberw., Mycologia 91(3): 482 (1999)

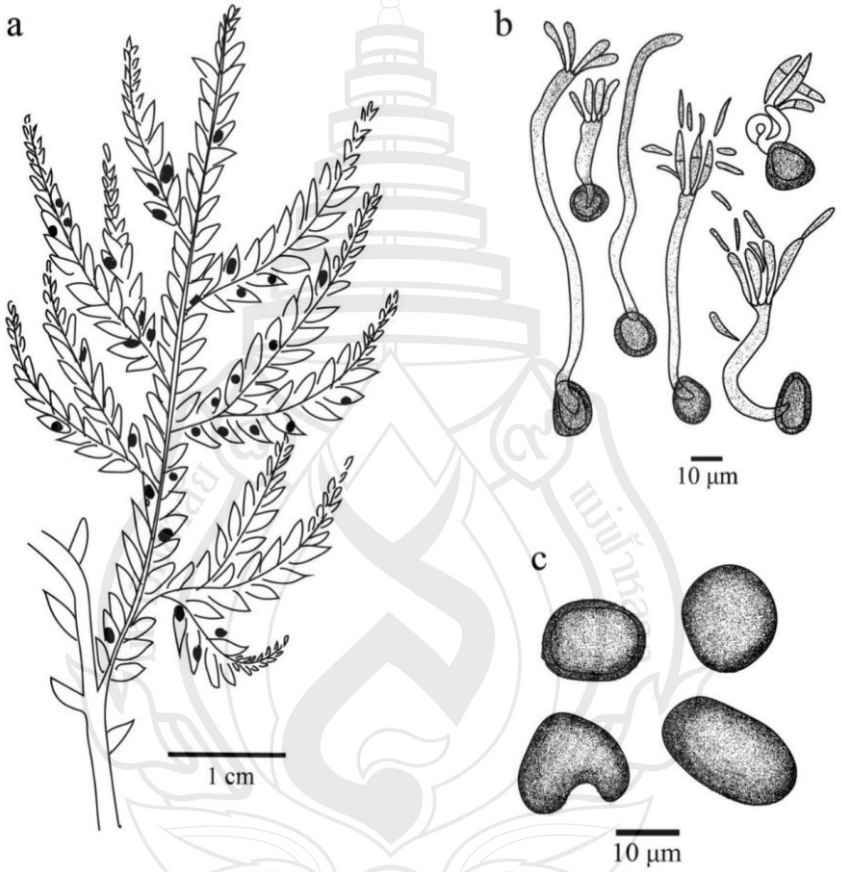
Index Fungorum number: IF 28346; two species associated with pteridophytes; Figure 2.11

Type species: *Melaniella oreophila* (Syd.) R. Bauer, Vánky, Begerow & Oberw.

≡ *Melanotaenium oreophilum* Syd.

Notes: *Melaniella* was established in the monotypic family Melaniellaceae, Doassansiales, Exobasidiomycetes, Ustilaginomycotina, Basidiomycota (He et al., 2024) to accommodate two new combinations, *M. oreophila* and *M. selaginellae*, with the former serving as the type species (Bauer et al., 1999b). The genus features hyphae with clamps; simple septal pores with membrane caps, smooth spores embedded in the

host tissue, holobasidia produced by single, pigmented teliospores, and spore germination with four ballistosporic basidiospores on sterigmata at the apex and two-celled basidiospores when mature (Warburg, 1900; Sydow, 1935; Bauer et al., 1999b; Vánky, 2008). The two accepted species of *Melaniella* are reported as smut fungi causing leaf /stem damage to several collections of *Selaginella* spp. (Selaginellaceae) in India, Indonesia and Zimbabwe (Bauer et al., 1999b; McClymont et al., 2013b).



Note a Sori of *Melaniella oreophila* as black, small spots on the leaves of *Selaginella tenera*. b Germinating spores of *M. oreophila*. c Spores. Redrawn from Vánky (2008).

Figure 2.11 *Melaniella oreophila*

Milesina Magnus, Berichte der Deutschen Botanischen Gesellschaft 27: 325 (1909)

Index Fungorum number: IF 16217; 70 species including one unidentified species associated with pteridophytes

Type species: *Milesina kriegeriana* (Magnus) Magnus

≡ *Melampsorella kriegeriana* Magnus, Berichte der Deutschen Botanischen Gesellschaft 19: 581 (1901)

≡ *Milesia kriegeriana* (Magnus) Arthur

Notes: See below (Result part 2.2) for details.

Mixia C.L. Kramer, Mycologia 50: 924 (1959)

= *Phytoceratiomyxa* Sawada, Trans. Nat. Hist. Soc. Formosa 19: 31 (1929)

Index Fungorum number: IF3225; one species associated with pteridophytes; Figure 2.12

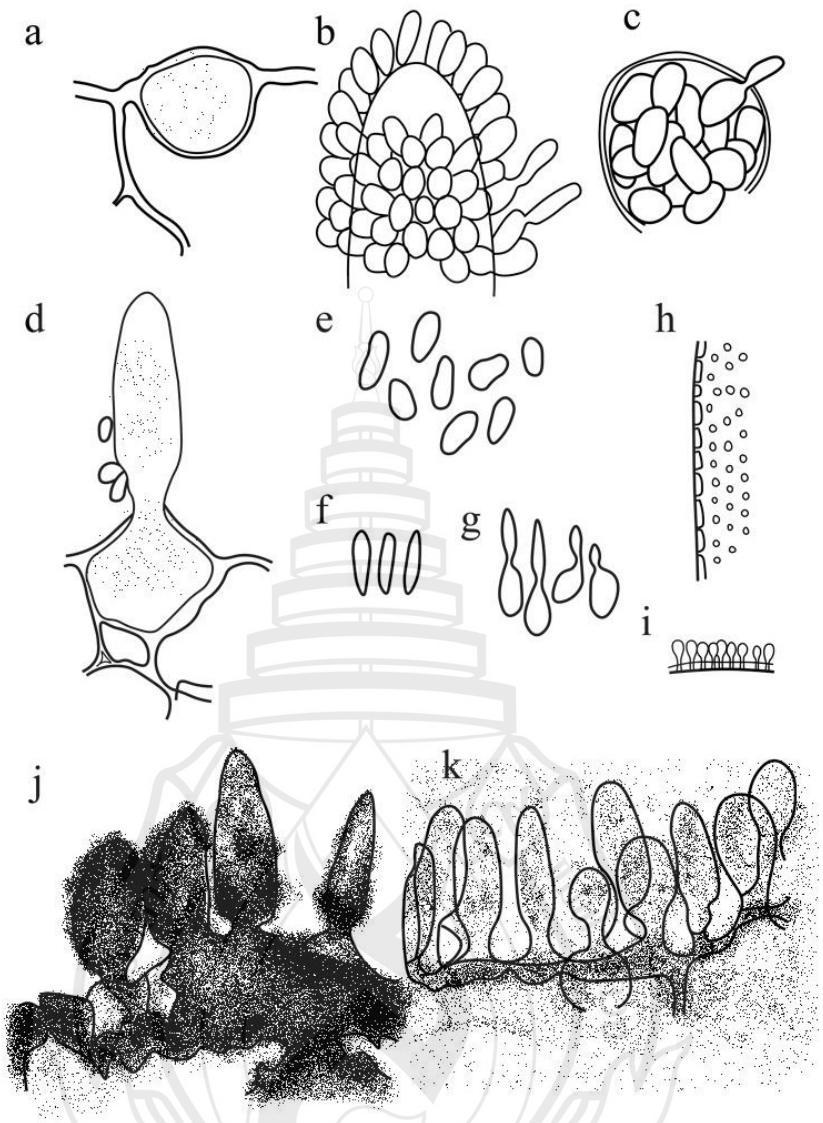
Type species: *Mixia osmundae* (Nishida) C.L. Kramer

≡ *Taphrina osmundae* Nishida

≡ *Phytoceratiomyxa osmundae Sawada*, Transactions of the Natural History Society of Formosa 19: 31 (1929)

Notes: *Mixia* was introduced by Kramer (1958) to accommodate a new combination, *M. osmundae*, which was first described as *Taphrina osmundae*. *Mixia* was previously placed in the families Protomycetaceae or Mixiaceae within Ascomycota (Kramer, 1958, 1987). Later, *Mixia* was placed in Mixiomycetes within Basidiomycota (Schell et al., 2011, Aime et al., 2014, Toome et al., 2014, Wang et al. 2015), and was considered to occupy a rather basal position among basidiomycetes based on the phylogeny and morphological characters (Nishida et al., 1995; Wang et al., 2015; Kirschner et al., 2019). The latest studies place the genus in Mixiaceae, Mixiales, Mixiomycetes (He et al., 2024; Hyde et al., 2024c) Currently, only one species, *M. osmundae*, is accepted in this genus. It is an intracellular parasite on *Osmunda* species, including *O. cinnamomea*, *O. japonica*, and *O. regalis* var. *japonica*, found in

China, Japan, and the United States (Sawada, 1929; Kramer, 1958; Toome et al., 2014). *Mixia osmundae* is a unique fungus due to its host preference for *Osmunda* spp. (Osmundaceae), its sporogenous structure, and its manner of spore formation. It is characterized by having small, yellow or brown lesions that develop a powdery white layer of spores; exogenous and simultaneous spores are produced on the surface of a large sac-like cell that forms from an enlarged swelling within the host epidermal cell wall (Sawada, 1929; Mix, 1947; Sugiyama & Katumoto, 2008; Toome et al., 2014). Studies on the genome of *Mixia osmundae* have been provided (Nishida et al., 2011; Toome et al., 2014). The peculiar and enigmatic genus *Mixia* has been intensively studied, and is considered a "primitive" fungus that grows on "primitive" hosts (Nishida et al., 2012; Sugiyama et al., 2018). A systematic review of *Mixia osmundae*, including its historical background, distributional data, phylogeny, and phylogenomics was provided by Sugiyama et al. (2018).



Note a Early stage of fructification formation. b Formation of endogenous spores. c Formation of endogenous spores and microspores. d Fructification after endogenous spore abscission. e Endogenous spores. f Microspores. g Microspore germination from endogenous spores. h Sporogenous cells after endogenous spore abscission. i Early stage of endogenous spore formation. j Formation of endogenous spores. k Fructification after spore abscission. Redrawn from Sugiyama and Katumoto (2008).

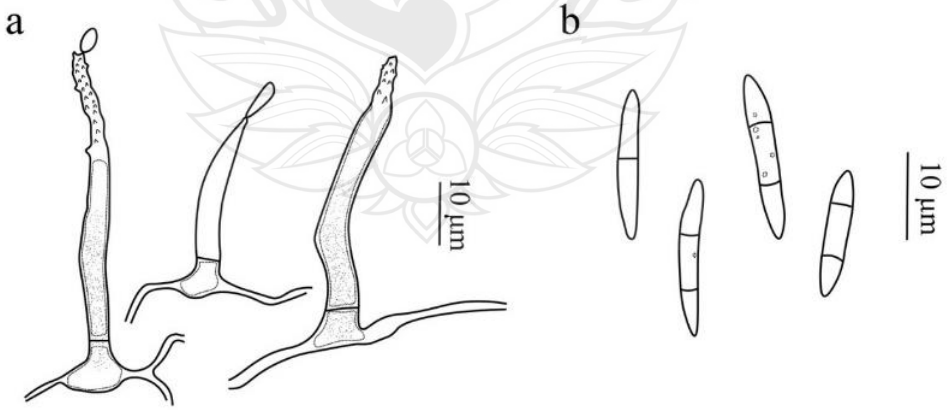
Figure 2.12 *Mixia osmundae*

Nothodactylaria Crous, in Crous et al., Persoonia 43: 297 (2019)

Index Fungorum number: IF 833023; 5 species associated with pteridophytes (including 4 species newly described in this study); Figure 2.13

Type species: *Nothodactylaria nephrolepidis* M.J. D'souza, Boonmee & K.D. Hyde.

Notes: *Nothodactylaria* was designated as the type genus of Nothodactylariaceae (Amphisphaeriales, Sordariomycetes) based on morphology and phylogenetical analysis of LSU sequence (Crous et al., 2019b). *Nothodactylaria* was typified with *N. nephrolepidis*, which was isolated from the leaves of *Nephrolepis exaltata*, a fern in the family Lomariopsidaceae, in South Africa. The morphological characteristic of the genus was represented using the single species *N. nephrolepidis,* produced in the culture, which featured solitary or aggregated, unbranched, septate, hyaline to pale brown conidiophores, subcylindrical, polyblastic, sympodial conidiogenous cells, and smooth and septate, hyaline conidia (Crous et al., 2019b). In this study, we acquired eight new collections representing four new species isolated from ferns, confirming that *Nothodactylaria* species exhibit a preference for ferns, particularly those in the Blechnaceae. Additionally, morphological comparison of the five accepted species of *Nothodactylaria* was provided in this study.



Note a Conidiophores and conidiogenous cells. b Conidia. Redrawn from Crous et al. (2019b).

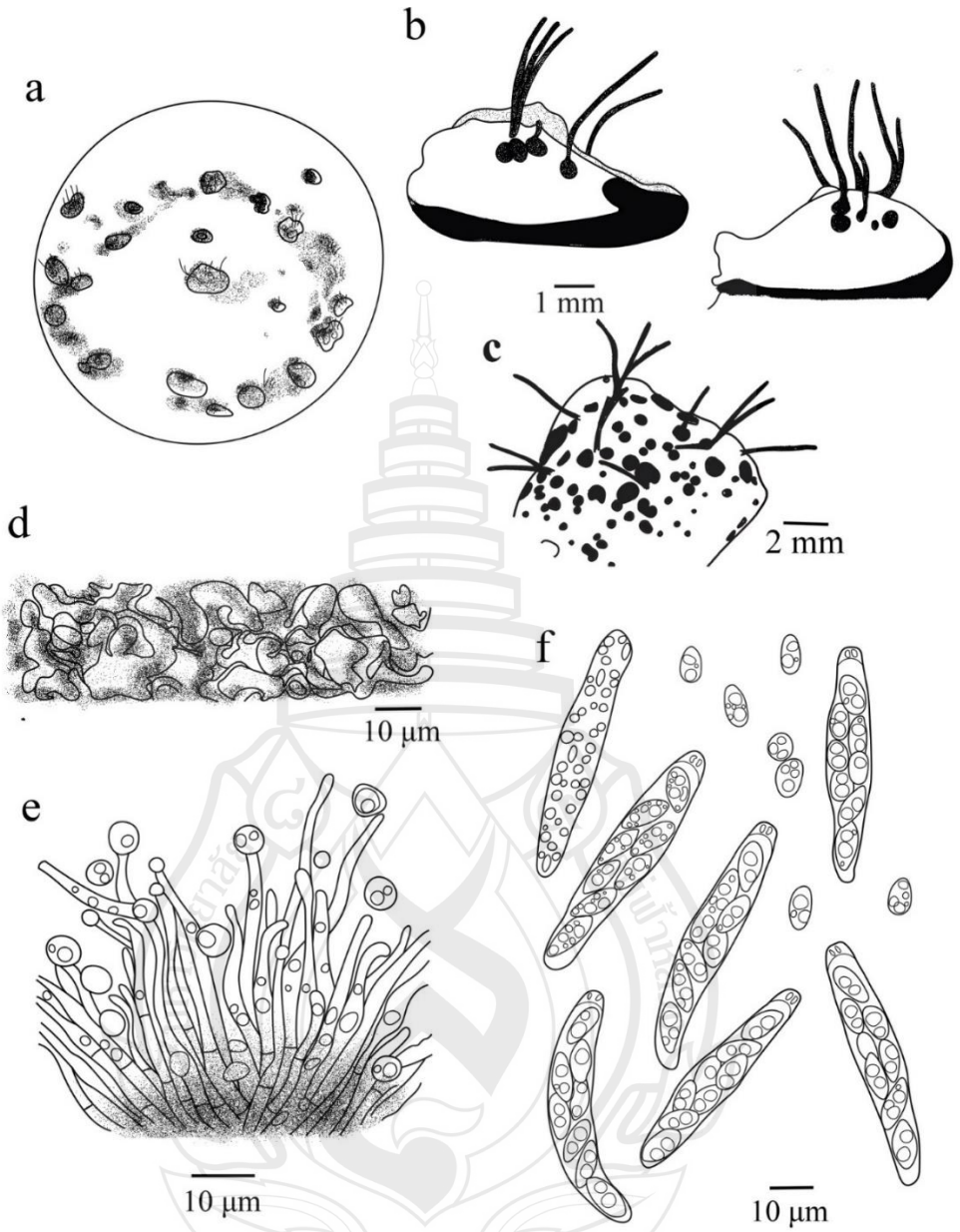
Figure 2.13 *Nothodactylaria nephrolepidis*

Ophiodiaporthe Y.M. Ju, H.M. Hsieh, C.H. Fu, C.Y. Chen & T.T. Chang, Mycologia 105(4): 866 (2013)

Index Fungorum number: IF 801562; one species associated with pteridophytes; Figure 2.14

Type species: *Ophiodiaporthe cyatheae* Y.M. Ju, H.M. Hsieh, C.H. Fu, Chi Y. Chen & T.T. Chang

Notes: The monotypic genus *Ophiodiaporthe* was introduced by Fu et al. (2013) and is typified by *O. cyatheae* based on its unique characteristics. Phylogenetically, the genus is a closely related to *Diaporthe* in Diaporthaceae, Diaporthales, Sordariomycetes (Fu et al., 2013) where it is presently placed (Hyde et al., 2024c). *Ophiodiaporthe cyatheae* was reported as a pathogen responsible for causing a devastating wilt disease of *Cyathea lepifera* (Cyatheaceae, a tree fern) at high frequencies, as demonstrated by pathogenicity tests (Fu et al., 2013). The genus is charactered by its host preference for *Cyathea lepifera* and unique anamorph characteristics, producing a single type of conidia, which distinguishes it from the similar genus *Diaporthe* (Fu et al., 2013).



Note a Colony on PDA. b Sections of stromata with embedded perithecia. c Stromata with long ostioles emerging from immersed perithecia. d Tissue of perithecial wall. e Conidiophores and conidia. f Asci and ascospores. Redrawn from Fu et al. (2013).

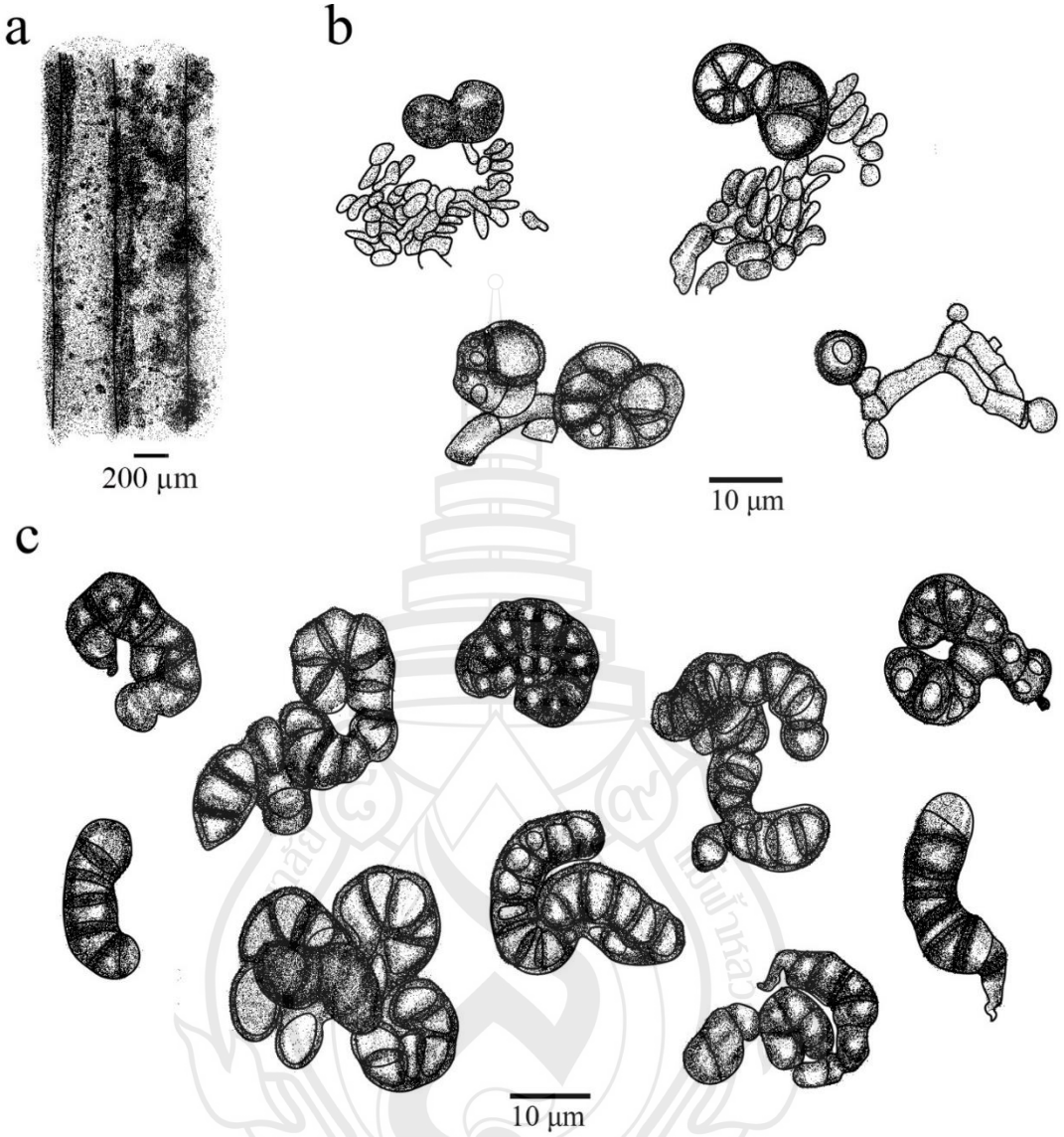
Figure 2.14 *Ophiodiaporthe cyatheae*

Paratrimmatostroma Jayasiri, Phookamsak, D.J. Bhat & K.D. Hyde, in Phookamsak et al., Fungal Diversity 95: 43 (2019)

Index Fungorum number: IF 556153; one species associated with pteridophytes; Figure 2.15

Type species: *Paratrimmatostroma kunmingense* Jayasiri, Phookamsak, D.J. Bhat & K.D. Hyde

Notes: *Paratrimmatostroma* was introduced as a monotypic genus in Parabambusicolaceae (Pleosporales, Dothideomycetes, Ascomycota) by Phookamsak et al. (2019) based on multi-gene phylogenetic analysis. The single species, *P. kunmingensis*, was reported as saprobic on dead fronds of an unidentified fern in China (Phookamsak et al., 2019). The genus resembles *Trimmatostroma* in having effuse to confluent sporodochia, semi-macronematous, mononematous conidiophores, integrated, terminal conidiogenous cells, and branched, pigmented conidia that are variable in shape. However, they are phylogenetically distinct (Crous et al., 2007a; Wijayawardene et al., 2018; Phookamsak et al., 2019; Hongsanan et al., 2020a; Pem et al., 2024). Based on a single record, the conclusion that the fern host preference of this genus is too arbitrary. Therefore, further studies with larger collections are needed for verification of ecology.



Note a Appearance of sporodochia on host substrate. b Conidiophores with attached conidia. c Conidia. Redrawn from Phookamsak et al. (2019).

Figure 2.15 *Paratrimmatostroma kunmingensis*

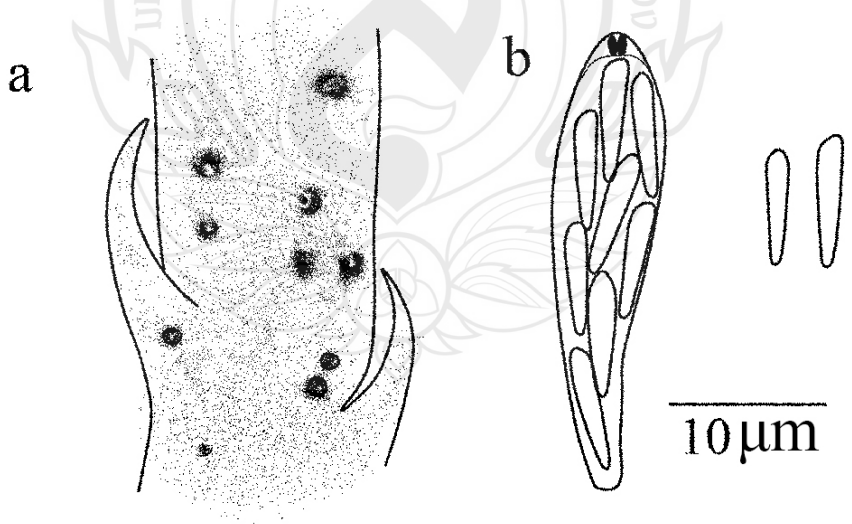
Phacidina Höhn., Annls mycol. 15(5): 324 (1917)

Index Fungorum number: IF 3870; one species associated with pteridophytes; Figure 2.16

Type species: *Phacidina gracilis* (Niessl) Höhn.

≡ *Phacidium gracile* Niessl

Notes: *Phacidina* was established by Höhnel (1917) as a monotypic genus. The single species, *P. gracilis* (Bas. *Phacidium gracile*), is characterized by scattered ascocarps with pseudoparenchymatous shield; unitunicate, J^+, clavate asci with aseptate, rod-like, hyaline spores (Voss, 1882; Holm & Holm, 1981a; Höhnel, 1917). *Phacidina* has an uncertain taxonomic placement among Dothideomycetes genera *incertae sedis* in Ascomycota (Wijayawardene et al., 2022; Hyde et al., 2024c), but presents an interesting and unique ecology that presume ably co-extensive with *Lycopodium* species (Voss, 1882; Holm & Holm, 1981a; Höhnel, 1917). *Phacidina gracilis* is an encountered fungus that has only been collected from ferns belonging to *Lycopodium* (Lycopodiaceae), including *L. alpinum*, *L. clavatum*, *L. complanatum*, *L. obscurum* and *L. tristachyum* (Lind, 1934; Cooke, 1977; Holm & Holm, 1981a).



Note a Apothecia on the host substratum. b Asci and ascospores. Redrawn from Holm and Holm (1981a).

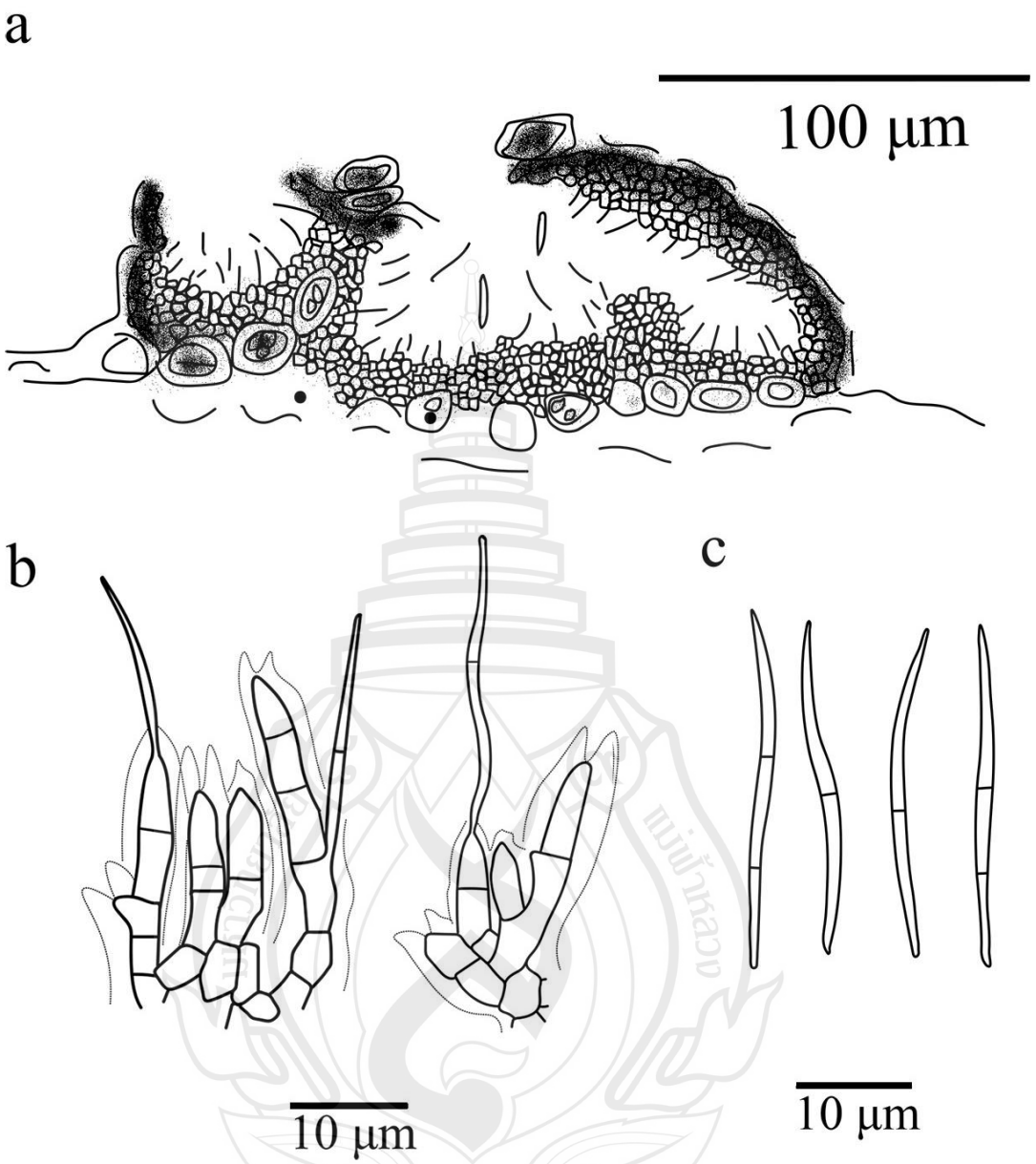
Figure 2.16 *Phacidina gracilis*

Placothyrium Bubák, Ber. dt. bot. Ges. 34(3): 302 (1916)

Index Fungorum number: IF 9426; one species associated with pteridophytes; Figure 2.17

Type species: *Placothyrium athyrinum* Bubák

Notes: *Placothyrium* was erected by Bubák (1916) as a monotypic genus represented by *Placothyrium athyrinum*. There are no available molecular data to determine its taxonomic status, and it is currently placed in Ascomycota genera *incertae sedis* (Lumbsch & Huhndorf, 2007; Li et al., 2020b; Wijayawardene et al., 2022; Hyde et al., 2024c). The single species, *Placothyrium athyrinum*, exhibits a Coelomycetous asexual morph, characterized by being stromatic, mostly unilocular (or occasionally multilocular), pycnidial conidiomata with indistinct ostiole; branched, hyaline conidiophores invested in mucus; holoblastic, integrated conidiogenous cells; 0–2-septate, filiform, hyaline conidia (Sutton, 1980; Li et al., 2020b). This conidial trait is similar to some species in *Pleurothyrium*, *Septoria* and *Sphaerulina*.However, they can be distinguished from each other by the absent of conidiophores in *Septoria* and *Sphaerulina* (Sutton, 1980; Li et al., 2020b). The conidiophores of *Pleurothyrium* do not have a gelatinous sheath, while *Placothyrium athyrinum* does (Sutton, 1980; Li et al., 2020b). *P. athyrinum* was described as a saprobe on *Athyrium filix-femina* in Germany based on one specimen. Fresh collections are expected to explore its ecology, host relationship, as well as its phylogenetic affiliation with molecular data.



Note a Vertical section of conidioma. b Conidiophores, conidiogenous cells and developing conidia. c Conidia. Redrawn from Sutton (1980).

Figure 2.17 *Placothyrium athyrinum*

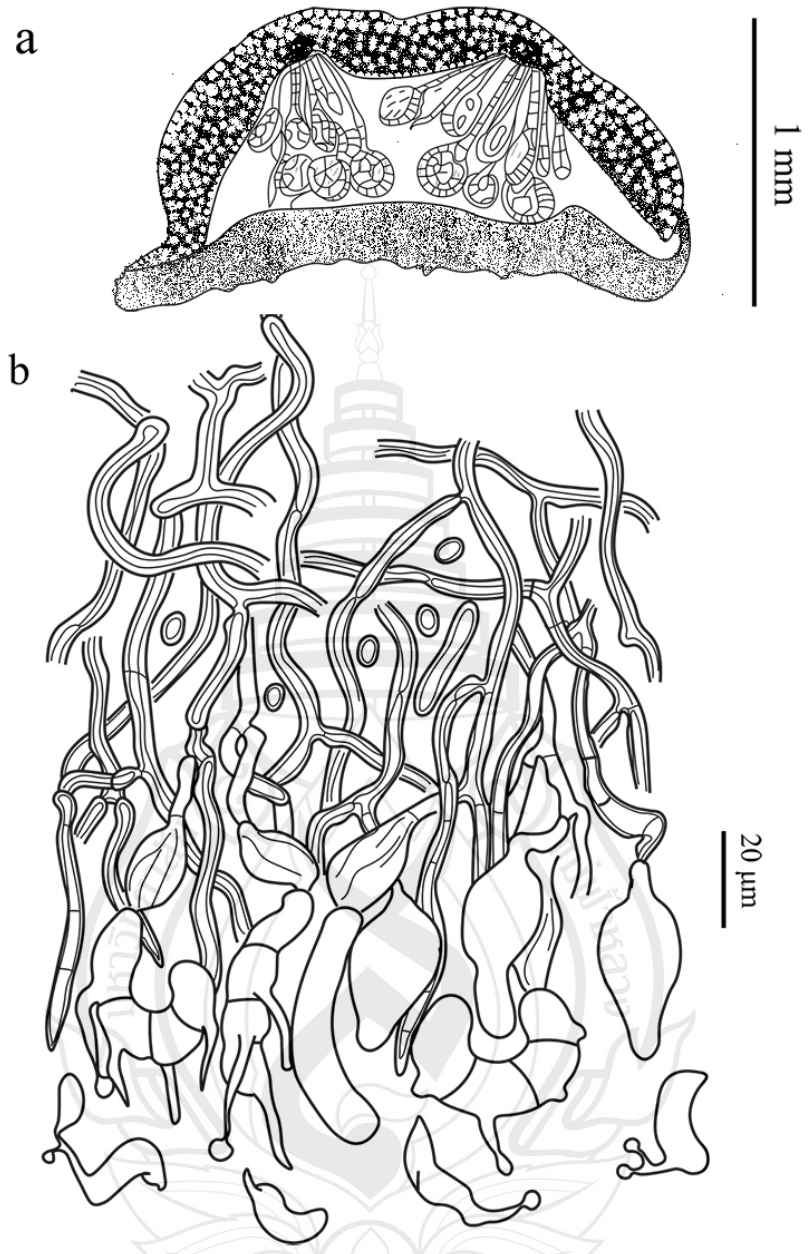
Platycarpa Couch, Mycologia 41(4): 427 (1949)

Index Fungorum number: IF 18297; one species associated with pteridophytes; Figure 2.18

Type species: *Platycarpa polypodii* (Couch) Couch

≡ *Septobasidium polypodii* Couch

Notes: *Platycarpa* was established by Couch (1949) to accommodate two species: *Platycarpa boliviensis* and *P. polypodii*. *Platycarpa boliviensis* was later synonymized under *Ptechetelium cyatheae*, the type genus of *Ptechetelium*, based on parasitic patterns and morphological characteristics (Oberwinkler & Bandoni, 1984). Currently, only the type species of *Platycarpa polypodii* is accepted in this genus without available molecular data, and it is placed in Eocronartiaceae of the order Platygloeales (Pucciniomycetes, Basidiomycota) based on morphology (Bauer et al., 2006; Wijayawardene et al., 2022; Hyde et al., 2024c). *Platycarpa polypodii* (Bas. *Septobasidium polypodii*) was excluded from *Septobasidium* due to the distinctive feature that all *Septobasidium* species live with scale insects (Boedijn & Steinmann, 1931; Couch, 1938, 1949). *Platycarpa polypodii* is known only from its type material (Couch, 1949; Oberwinkler & Bandoni, 1984), which were reported as parasites in fern sporangia, with effused, flattened basidiocarps (fruit bodies) as small whitish to cream-colored patches covering the sori; thick-walled, interwoven hyphae without gelatinization; subglobose, hyaline probasidia with thickened walls; and cylindric or curved, 1-septate basidiospores (Oberwinkler & Bandoni, 1984; Couch, 1949). More collections with isolations, along with identification of their host are needed to provide molecular data, and clarify host relationships.



Note a Diagrammatic section of fertile leaflet of *Polypodium* sp. showing sporangial sorus, and fructification of *Platycarpa Polypodii*. b Section through basidiocarp showing thick-walled hyphae, probasidia, basidia in different developmental stages and basidiospores germinating by repetition. Redrawn from Couch (1949), and Oberwinkler and Bandoni (1984).

Figure 2.18 *Platycarpa polypodii*

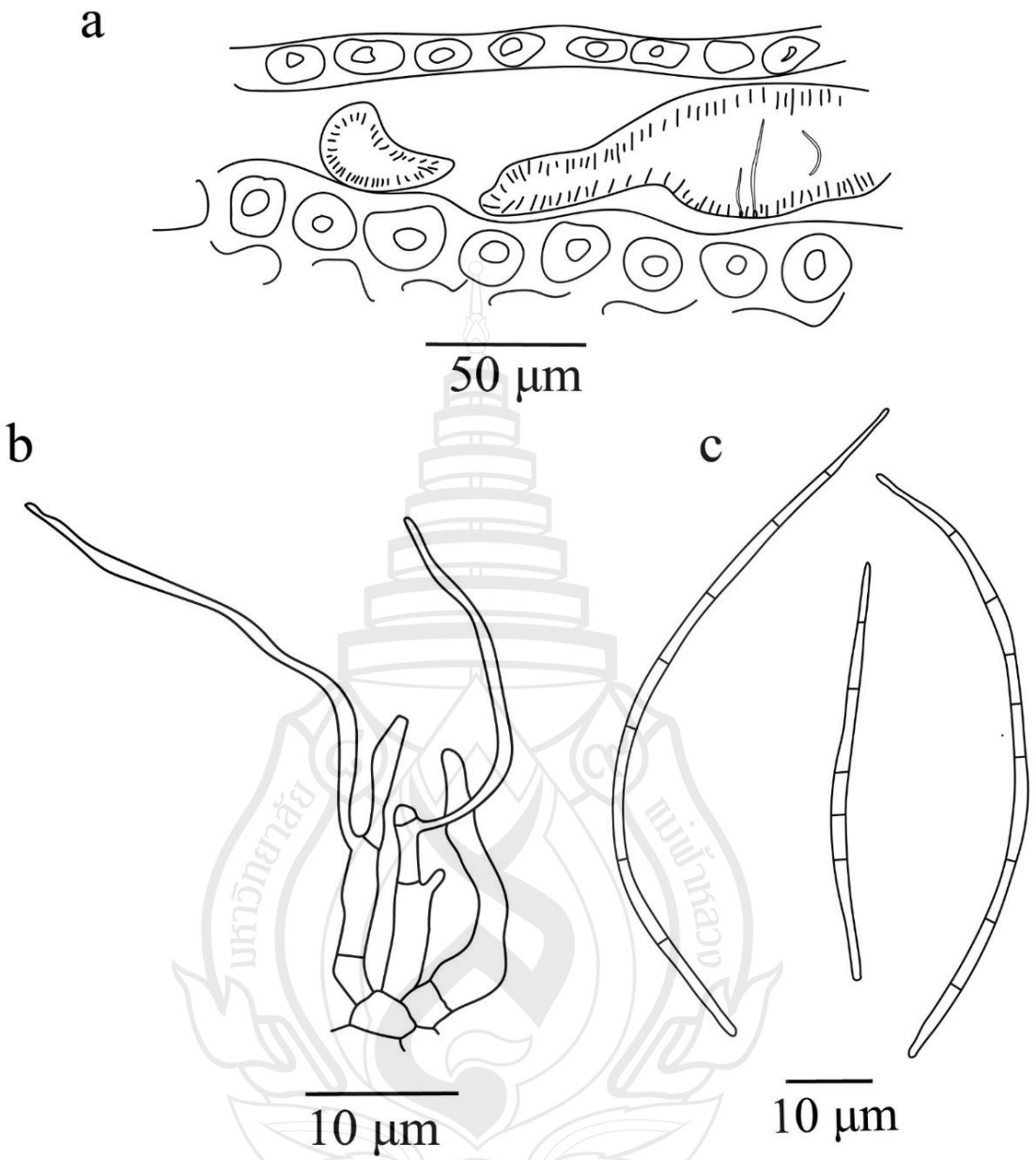
Pleurothyrium Bubák, Ber. dt. bot. Ges. 34: 322 (1916)

Index Fungorum number: IF 9477; one species associated with pteridophytes; Figure 2.19

Type species: *Pleurothyrium longissimum* (Lib.) Bubák

≡ *Leptostroma longissimum* Lib.

Notes: *Pleurothyrium* was introduced by Bubák (1916) as a monotypic genus to accommodate a new combination, *P. longissimum* (Syn. *Leptostroma longissimum*). *Pleurothyrium* contains a single species, *P. longissimum*, with an asexual morph. It is characterized by stromatic, pycnidial conidiomata with an indistinct ostiole, septate, branched, hyaline conidiophores arising from the basal cells of inner conidiomata wall, holoblastic conidiogenous cells, and septate, filiform, and hyaline conidia (Bubák, 1916). *Pleurothyrium* is phylogenetically uncertain due to the absent of molecular data, thus it has been placed in Ascomycota genera *incertae sedis* (Li et al., 2020b). *Pleurothyrium longissimum* has been reported as a saprobic fungus based on several collections of *Athyrium* spp. including Athyrium filix-femina, and its allies, as well as an unidentified *Athyrium* sp., likely restricted to the fern host of *Athyrium filix-femin*a (Bubák, 1916; French, 1989). Fresh collections are needed to place it within a natural group and to confirm the obligate host of *Athyrium filix-femina*.



Note a Vertical section of conidioma. b Conidiophores, conidiogenous cells and developing conidia. c Conidia. Redrawn from Sutton (1980).

Figure 2.19 *Pleurothyrium longissimum*

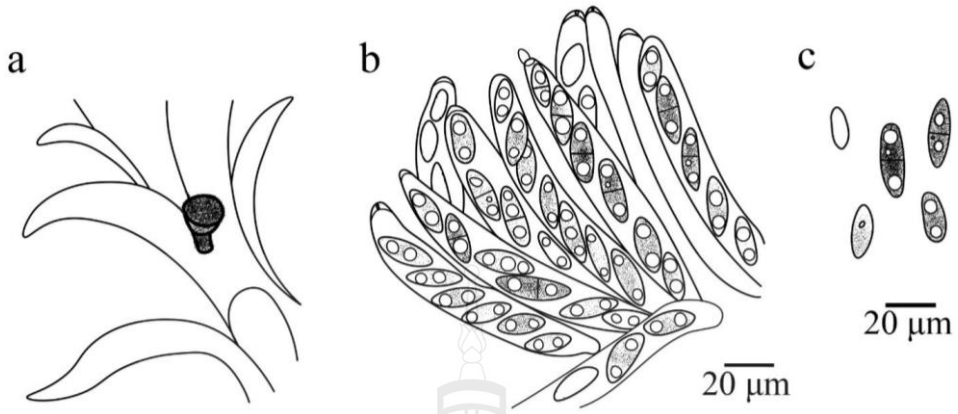
Poculopsis Kirschst., Annls mycol. 33(3/4): 204 (1935)

Index Fungorum number: IF 4270; one species associated with pteridophytes; Figure 2.20

Type species: *Poculopsis ogrensis* Kirschst.

≡ *Allophylaria ogrensis* (Kirschst.) Dennis

Notes: The monotypic genus *Poculopsis* was introduced by Kirschstein (1935), containing the single species *P. ogrensis* (Holm & Holm, 1981a; Lumbsch & Huhndorf, 2007). Based on the similarity with the Ciborioideae of the new collection, Dennis (1963) synonymized *P. ogrensis* as *Allophylaria ogrensis* without re-examining the type material, suggesting the affinity of this species associated with Sclerotiniaceae (as Ciborioideae). However, Holm and Holm (1981a) clarified that the defining characteristic of taxonomic status of this genus is the spore characteristics, which eventually turn dark brown and develop a septum. This was overlooked by the study of Dennis (1963). Currently, *Poculopsis* is accepted in Helotiaceae (Helotiales, Leotiomycetes, Ascomycota), with epiphyllous, distinctly, yellow to darkening with age subgelatinous when wet, stipitate apothecia; unitunicate, J^+, cylindrico-clavate asci with a minute ring, and ellipsoid, 0–1-septate, hyaline to dark brown ascospores with guttules (Dennis, 1963; Holm & Holm, 1981a; Lumbsch & Huhndorf, 2007; Hyde et al., 2024c). *Poculopsis ogrensis* was reported as a common saprobic fungus restricted to *Lycopodium* spp. (Lycopodiaceae), including *L. annotinum* and *L. clavatum*, with 17 samples from Sweden and one collection from Norway (Dennis, 1963; Holm & Holm, 1981a).



Note a Apothecium on the host. b Unitunicate asci. c Ascospores. Redrawn from Holm and Holm (1981a).

Figure 2.20 *Poculopsis ogrensis*

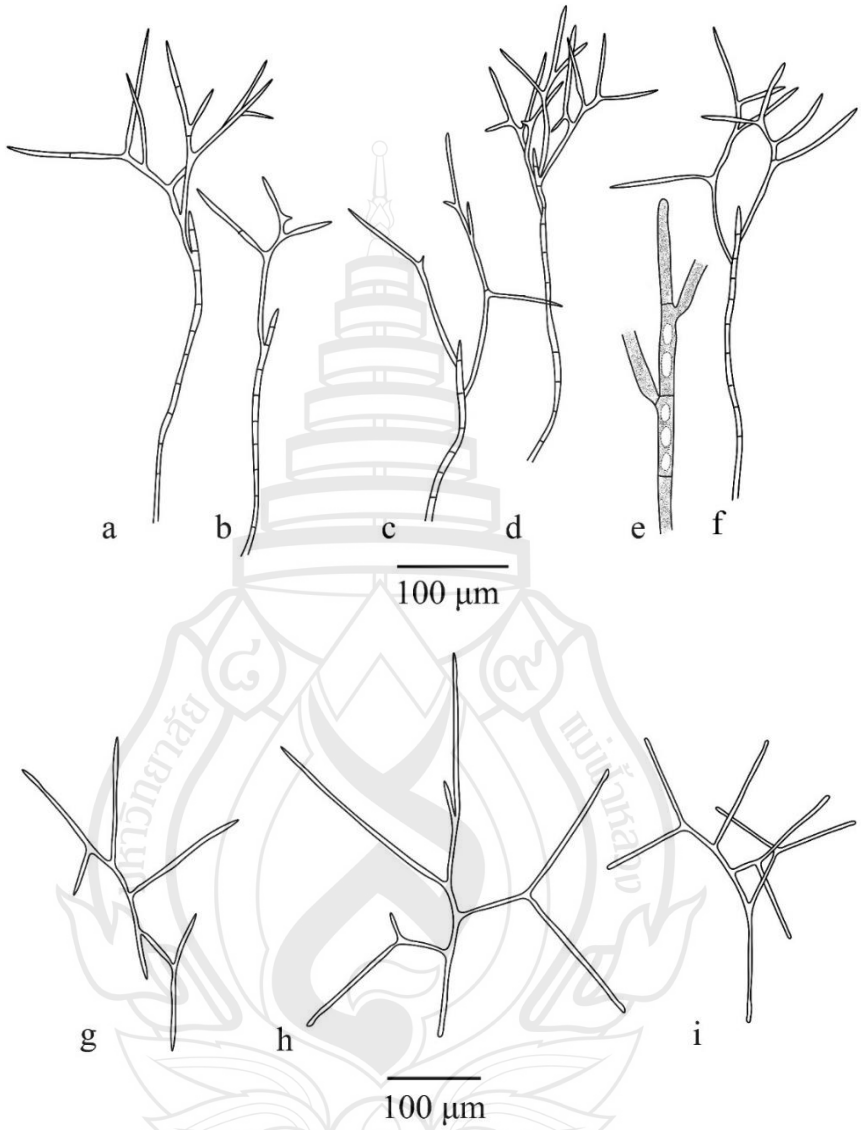
Polycladium Ingold, Trans. Br. mycol. Soc. 42(1): 114 (1959)

Index Fungorum number: IF 9496; one species associated with pteridophytes; Figure 2.21

Type species: *Polycladium equiseti* Ingold, Trans

Notes: The hyphomycetous genus *Polycladium* was introduced by Ingold (1959) to accommodate the type species *P. equiseti* based on its unique morphology and comparison with two most similar genus, *Tricladium* and *Varicosporium*. *Polycladium* is characterized by unbranched, simple conidiophore arising from a persistent apical cell, as well as sessile and lateral conidia consisting of a long filamentous main axis bearing 2–4 lateral branches, one or two lower members of which may secondarily branch (Ingold, 1959). *Polycladium equiseti* was considered to be placed in *Tricladium* and *Varicosporium* based on its conidial characteristics, but was excluded from *Tricladium* due to the lack of secondary laterals of conidia, and from *Varicosporium* due to the position of conidia to the conidiophores (Ingold, 1942, 1943, 1959). Currently, *Polycladium*, including the species *P. equiseti*, was found on natural substrates of submerged, disarticulated, bleached internodes of *Equisetum fluviatile* in an aquatic habitat (Ingold, 1959). *Polycladium* is currently treated as Ascomycota genera *incertae*

sedis (Wijayawardene et al., 2022; Hyde et al., 2024c). Fresh collections are needed to place *Polycladium* in a natural grouping, and clarify its host relationship.



Note a–d, f Conidiophores bearing conidia. e Small part of "f" at higher magnification. g–i Liberated conidia. Redrawn from Ingold (1959).

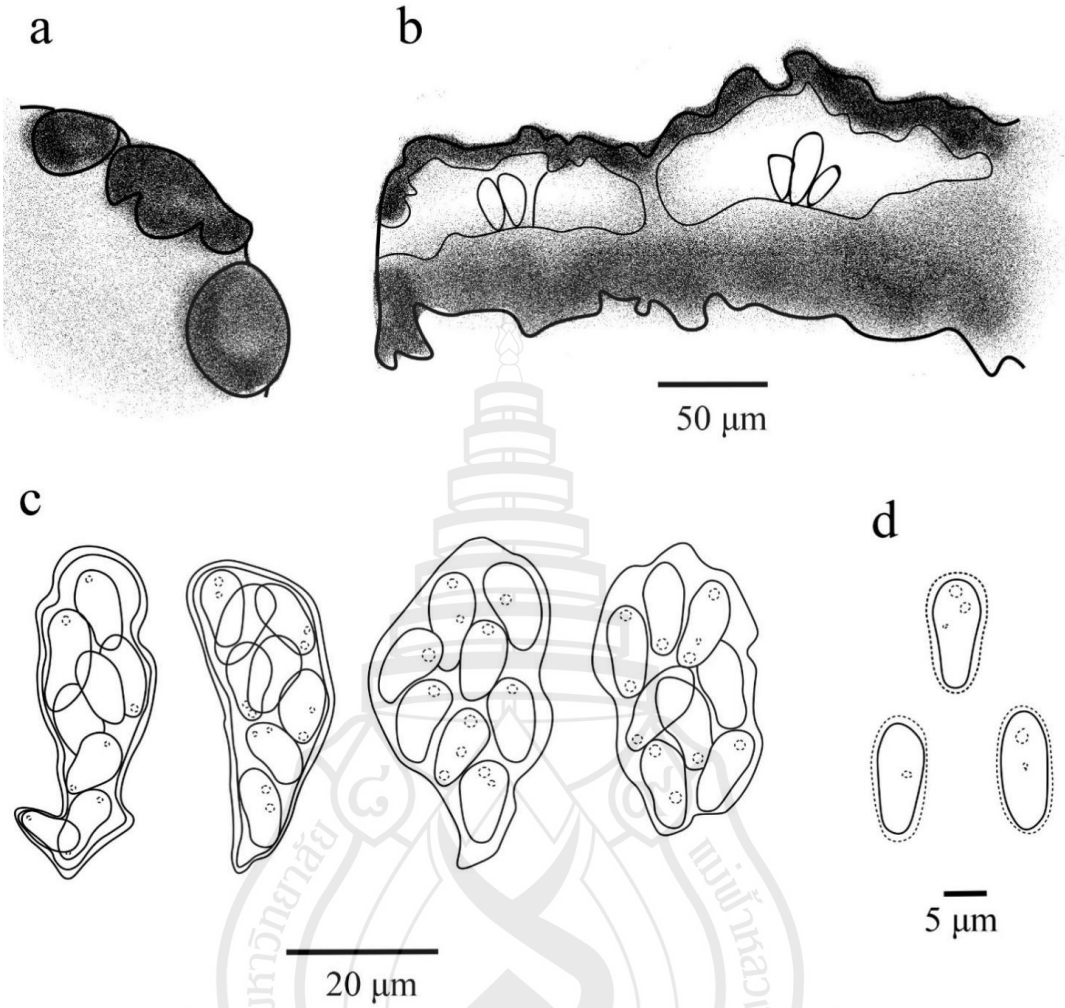
Figure 2.21 *Polycladium equiseti*

Polycyclina Theiss. & Syd., Annls mycol. 13(3/4): 212 (1915)

Index Fungorum number: IF 4310; one species associated with pteridophytes; Figure 2.22

Type species: *Polycyclina rhytismoides* (Speg.) Theiss. & Syd., Annls mycol. 13(3/4): 212 (1915)

Notes: *Polycyclina* was established by Theissen and Sydow (1915) as a monotypic genus represented by *P. rhytismoides*. The genus is characterized by sexual and asexual morphs, with lacking superficial hyphae (Theissen & Sydow, 1915; Marasinghe et al., 2023). The sexual morph processes epiphyllous, circular ascomata that are presented as a black circular patch and easily separate from the host surface; with brown to dark collaroid haustoria inside the ascomata; pseudoparaphyses lacking; bitunicate, fissitunicate asci with or without a pedicel; and verrucose, hyaline oblong to ellipsoid, ellipsoid to ovate, aseptate ascospores covered by a thin sheath (Theissen & Sydow, 1915; Marasinghe et al., 2022, 2023). The asexual morph is characterized by hyaline, unicellular, rod-shaped conidia (Theissen & Sydow, 1915). The single species of *Polycyclina rhytismoides* is reported as a pathogen infecting living leaves of *Lomaria imperalis*. Currently, the genus is placed in the family Parmulariaceae, Parmulariales, Dothideomycetes, Ascomycota without molecular data (Theissen & Sydow, 1915; Marasinghe et al., 2023; Hyde et al., 2024c). Fresh collections and molecular data are needed to verify its phylogenetic position, and host relationships.



Note a Colony on the surface of host leaf. b Section through ascomata. c Asci. d Ascospores. Redrawn from Marasinghe et al. (2023).

Figure 2.22 *Polycyclina rhytismoide*

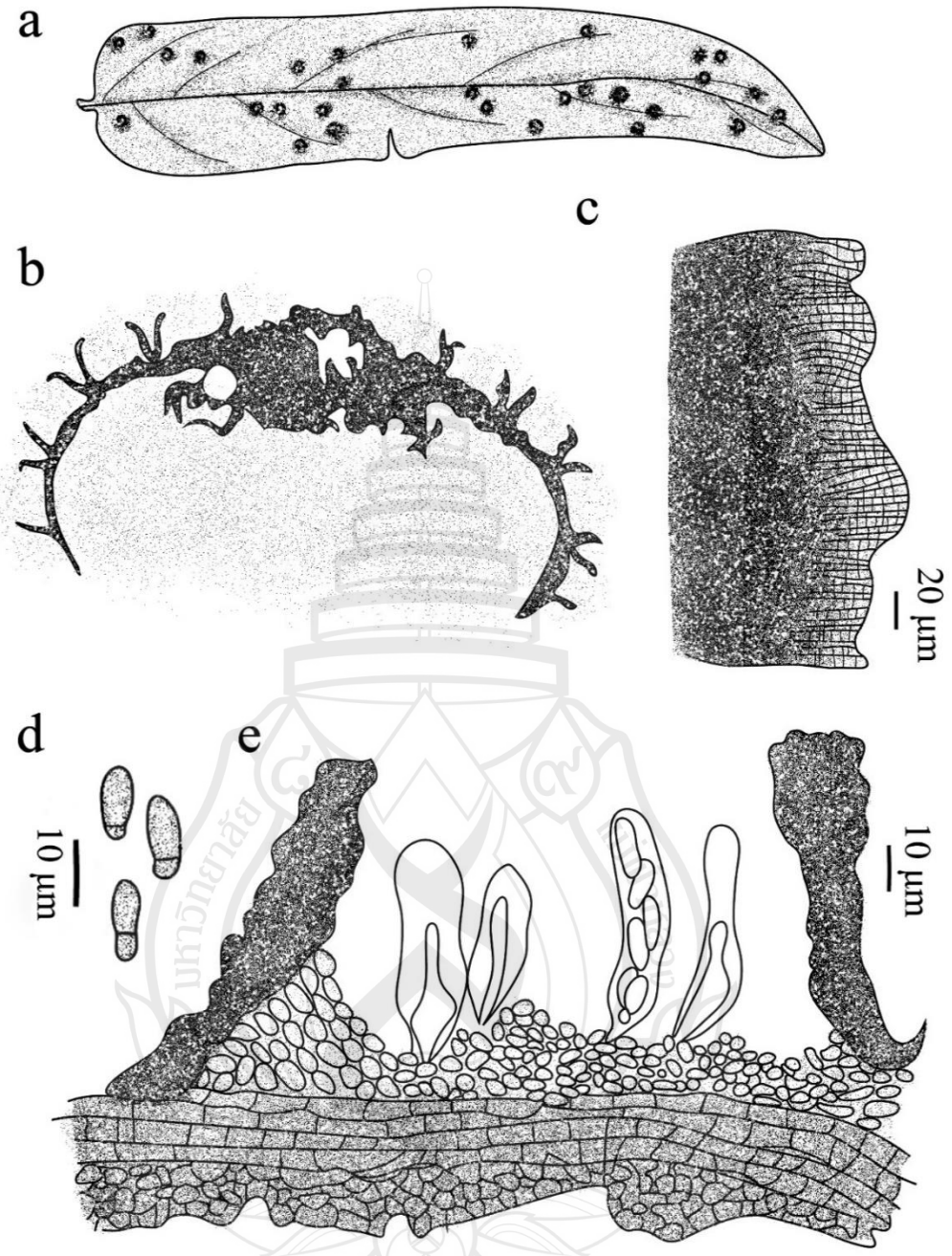
Polycyclus Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 118: 1542 (1909)

Index Fungorum number: IF 4312; two species associated with pteridophytes; Figure 2.23

Type species: *Polycyclus andinus* (Pat.) Theiss. & Syd., Annls mycol. 13(3/4): 210 (1915).

≡ *Hysterostomella andina* Pat., in Patouillard & Lagerheim, Bull. Herb. Boissier 3(1): 73 (1895).

Notes: von Höhnel (1909) established the genus *Polycyclus* without designating a type species, but Theissen and Sydow (1915) selected *P. andinus* as the type species. Currently, *P. andinus* and *P. marginalis*, two pathogenic species found on ferns, have been accepted under *Polycyclus* in Parmulariaceae (Parmulariales, Dothideomycetes, Ascomycota) without available molecular data (Inácio & Cannon, 2008; Hongsanan et al., 2020b; Hyde et al., 2024c). However, Inácio and Cannon (2008) provided a morphological comparison between *P. andinus* and *P. marginalis*, indicating the likely conspecifics of these two species. Isolations with molecular data are needed to verify the phylogenetic affiliation of these two species. *Polycyclus* is known only from its sexual morph, and is characterized by black, roundish or elliptic, disc-like, epiphyllous stromata with 1–5 ascomatal locules arranged in concentric rings, cylindric-clavate; sessile or short stipitate, 8-spored, aparaphysate asci and lengthened-ellipsoid, uniseptate, irregularly distichous, hyaline to brown ascospores (Petrak, 1950a; Batista & Vital, 1960; Inácio & Cannon, 2008).



Note a Colonies on the host substratum. b The longitudinal section of an ascostroma, showing the central hypostroma and the locule. c The margins of the superior wall of the stromata. d Ascospores. e A Locule, showing peridium, asci and ascospores. Redrawn from Batista and Vital (1960).

Figure 2.23 *Polycyclus andinus*

Ptechetelium Oberw. & Bandoni, Trans. Br. mycol. Soc. 83(4): 645 (1984)

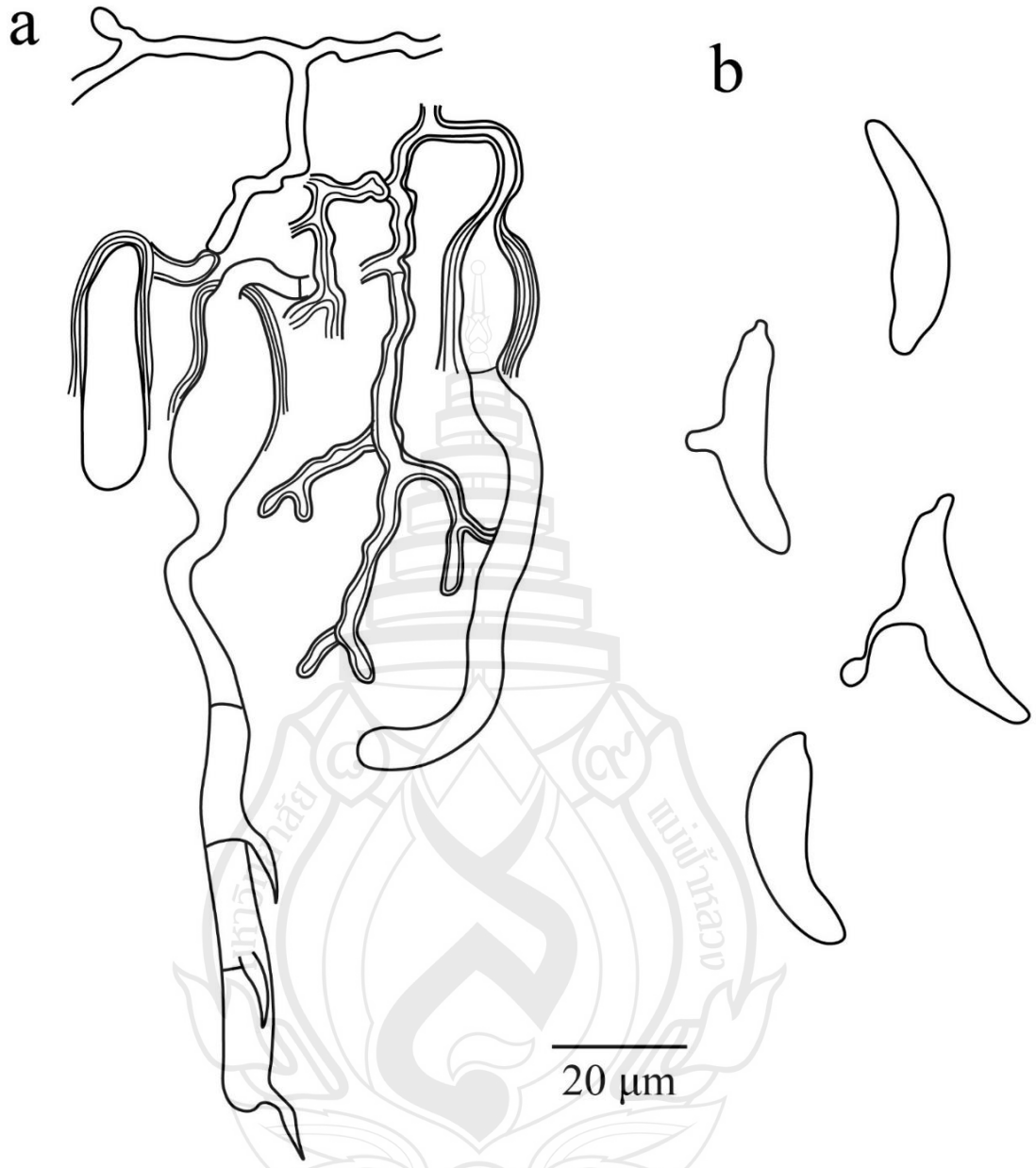
Index Fungorum number: IF 25665; one species associated with pteridophytes; Figure 2.24

Type species: *Ptechetelium cyatheae* (Syd.) Oberw. & Bandoni

≡ *Herpobasidium cyatheae* Syd.

= *Platycarpa boliviensis* Couch

Notes: The monotypic genus *Ptechetelium* was proposed to accommodate the new combination of *P. cyatheae* (Bas. *Herpobasidium cyatheae*) by Oberwinkler and Bandoni (1984). Currently, the genus is placed in *Eocronartiaceae* within Platygloeales (Pucciniomycetes, Basidiomycota) based on morphological characteristics alone (Wijayawardene et al., 2022; Hyde et al., 2024c). *Ptechetelium* is characterized by hyphae emerging through a stoma with dendrohyphidia, generative hyphae, probasidia and basidia; stalked, globose to elongate-pyriform probasidia; cylindrical basidia with 4-celled when mature; and hyaline, irregularly sickle-shaped basidiospores with oblique apiculi (Oberwinkler & Bandoni, 1984). *Ptechetelium cyatheae* can be distinguished from the similar species *Platycarpa polypodii* (the type species of *Platycarpa*) based on differences of the parasite develops, basidial development, basidiospores shapes, and the intercellular hyphae in mesophyll cells and basidiocarps (Oberwinkler & Bandoni, 1984). The only known species in *Ptechetelium* has been reposted as a parasite on fern sporophylls of *Cyathea stuebelii* and an unidentified fern, but not on sporangia, in Bolivia and Ecuador (Couch, 1949; Oberwinkler & Bandoni, 1984).



Note a Dendrohyphidium, probasidium, young basidium and basidium with sterigmata. b Basidiospores, one germinating by repetition. Redrawn from Oberwinkler and Bandoni (1984).

Figure 2.24 *Ptechetelium cyatheae*

Radiciseta Sawada & Katsuki, in Imazeki et al., Publ. Coll. Agric. Nat. Taiwan Univ. 8: 205 (1959)

Index Fungorum number: IF 9684; one species associated with pteridophytes.

Type species: *Radiciseta blechni* Sawada & Katsuki

Notes: *Radiciseta* was introduced as a monotypic genus to accommodate the type species *R. blechni*, a fern-inhabiting fungus described without photoplates (Sawada, 1959). *Radiciseta* is a poorly studied genus, known only from its type material of *R. blechni*, which was reported as fern pathogen causing leaf spot of *Blechnum orientale* in Taiwan Province, China (Sawada, 1959). The genus is characterized by yellowish brown to gray leaf spots; fasciculate, 2–3-septate, dark brown conidiophores; acrogenous, lunate, curved, 1–4- septate, and hyaline phragmoconidia, lacking details of conidiogenesis (Sawada, 1959; Seifert et al., 2011). Currently, *Radiciseta* is placed in Ascomycota genera *incertae sedis* without available molecular data (Hyde et al., 2011). This species is suspected to be a member of the *Cercospora* complex based on morphology (Seifert et al., 2011) The type species of *Radiciseta blechni* therefore needs to be recollected and restudied, with an epi-type and subject to phylogenetic analysis, and updated morphology with color photoplates.

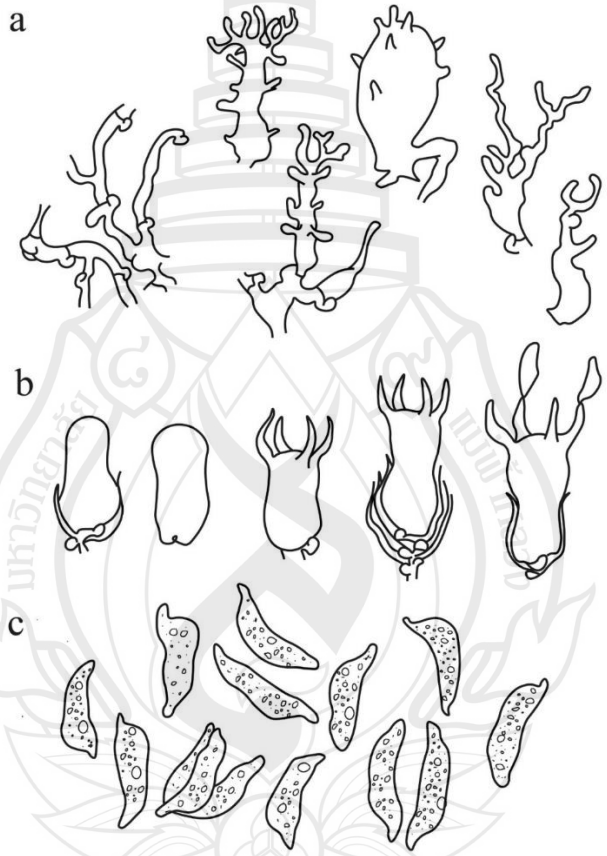
Repetobasidiellum J. Erikss. & Hjortstam, in Eriksson, Hjortstam & Ryvarden, Cortic. N. Eur., 6 (Oslo): 1247 (1981)

Index Fungorum number: IF 25481; one species associated with pteridophytes; Figure 2.25

Type species: *Repetobasidiellum fusisporum* J. Erikss. & Hjortstam

Notes: The monotypic genus *Repetobasidiellum* was established by Eriksson et al. (1981), and was phylogenetically placed in Hydnaceae (Cantharellales, Agaricomycetes, Basidiomycota) based solely on morphology (Kirk et al., 2008; Wijayawardene et al., 2022; Hyde et al., 2024c). *Repetobasidiellum* is represented by the single species *R. fusisporum*, which is characterized by resupinate, adnate, effused, ceraceous to crustaceous basidiomes, smooth, continuous conidiophores, monomitic

hyphal system with clamps, uniform, 4-sterigmate basidia produced by internal repetition from old basidia, and subfusiform and smooth, acyanophilous basidiospores. It differs from the morphologically similar genus *Repetobasidium* in having uniform basidia and dendrohyphidia (Eriksson et al., 1981). *Repetobasidiellum fusisporum* was found on several fern hosts, including *Athyrium filix-femina* (Woodsiaceae), *Dryopteris dilatata* (Dryopteridaceae), *Dryopteris* sp. (Dryopteridaceae), *Matteuccia struthiopteris* (Woodsiaceae) in northern Europe (Kirk et al., 2008; Farr et al., 2021).



Note a Hyphae and fruit body. b Basidia and basidioles. c Basidiospores. Redrawn from the website of Natura Mediterraneo (https://www.naturamediterraneo.com/forum/topic.asp?TOPIC_ID=68179&whichpage=2).

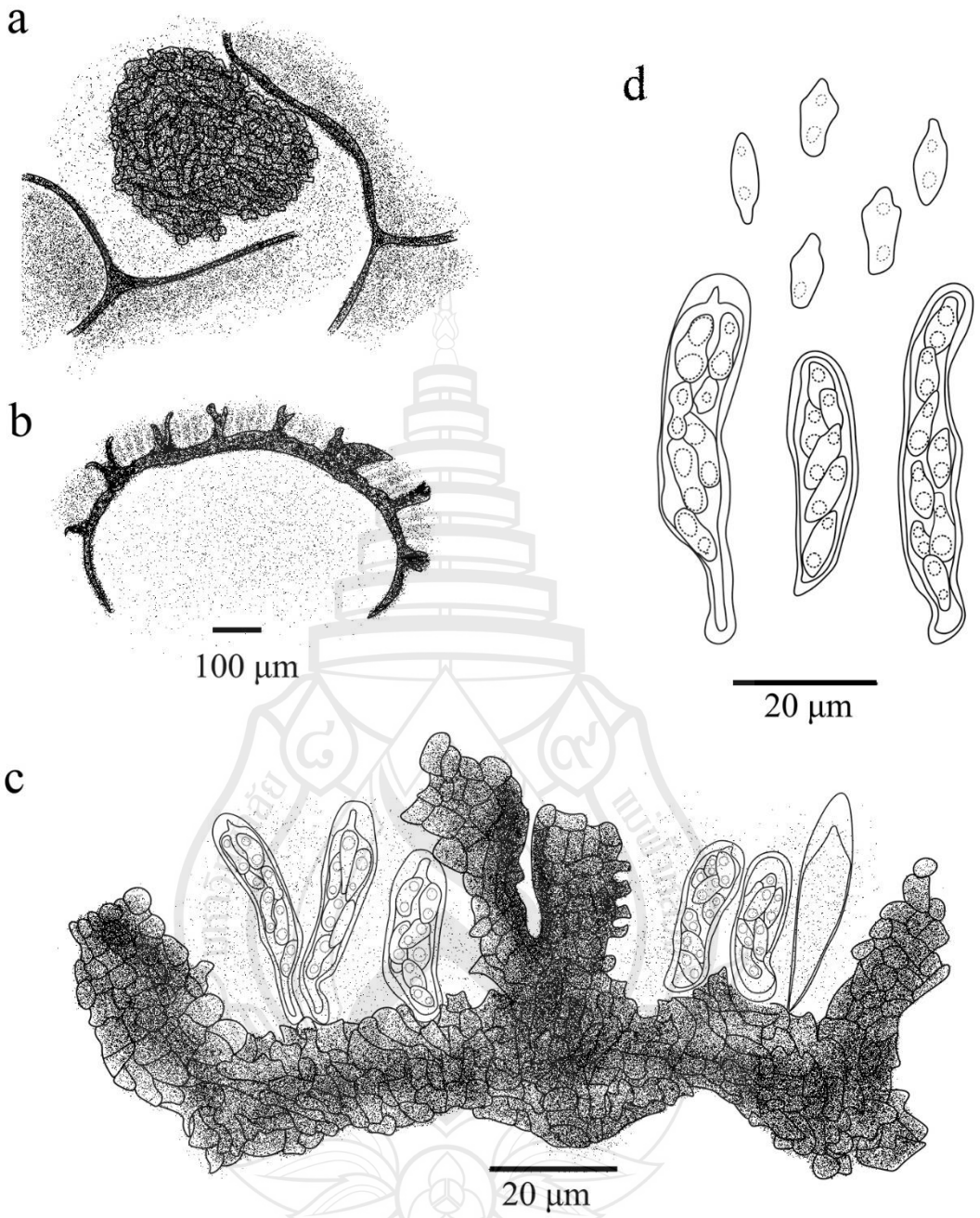
Figure 2.25 *Repetobasidiellum fusisporum*

Rhagadolobiopsis Guatim. & R.W. Barreto, Mycologia 106(2): 277 (2014).

Index Fungorum number: IF 802297; one species associated with pteridophytes; Figure 2.26

Type species: *Rhagadolobiopsis thelypteridis* Guatim. & R.W. Barreto, Mycologia 106(2): 277 (2014).

Notes: Guatimosim et al. (2014) established a new genus, *Rhagadolobiopsis* in Parmulariaceae (Parmulariales, Dothideomycetes, Ascomycota) to accommodate the type species *R. thelypteridis*, based solely on morphology (Pem et al., 2024). *Rhagadolobiopsis* is characterized by superficial, scattered, black stromata occurring on ellipsoid tar spot-like colonies, internal, branched, subhyaline hyphae developed as coralloid hyaline haustoria in the epidermal cells, multiloculate, dark brown to black ascomata opening by radiating fissures, bitunicate, non-amyloid, cylindrical-clavate to clavate asci, and biguttulate, aseptate, hyaline ascospores, with fusiform, rounded at one end and apiculate on the other end (Guatimosim et al., 2014a; Pem et al., 2024). The genus is distinct from the morphologically similar genus *Rhagadolobium* in having colorless, aseptate ascospores and a hymenial gel that does not turn blue with iodine. In contrast, *Rhagadolobium* possesses aseptate, colorless ascospores that become light brown to brown and 1-septatum when mature (Inácio & Cannon, 2008). Additionally, a dichotomous key for the identification of six genera (*Inocyclus*, *Pachypatella*, *Polycyclus*, *Polycyclina*, *Rhagadolobium* and *Rhagadolobiopsis*) in Parmulariaceae associated with ferns was provided by Guatimosim et al. (2014a). *Rhagadolobiopsis thelypteridis* is a pathogenic fungus that causes tar spot-like symptoms on leaves of *Thelypteris serrata* (Thelypteridaceae) in Brazil, without any sequence data available (Guatimosim et al., 2014a). Fresh collections are expected to further investigate the ecology with host interactions, and to verified phylogenetic relationships with molecular data.



Note a Mature colony on host substrate. b Vertical section of a detached ascoma with several fertile locules. c Locules, showing peridium, asci and ascospores. d Asci and ascospores. Redrawn from Guatimosim et al. (2014a).

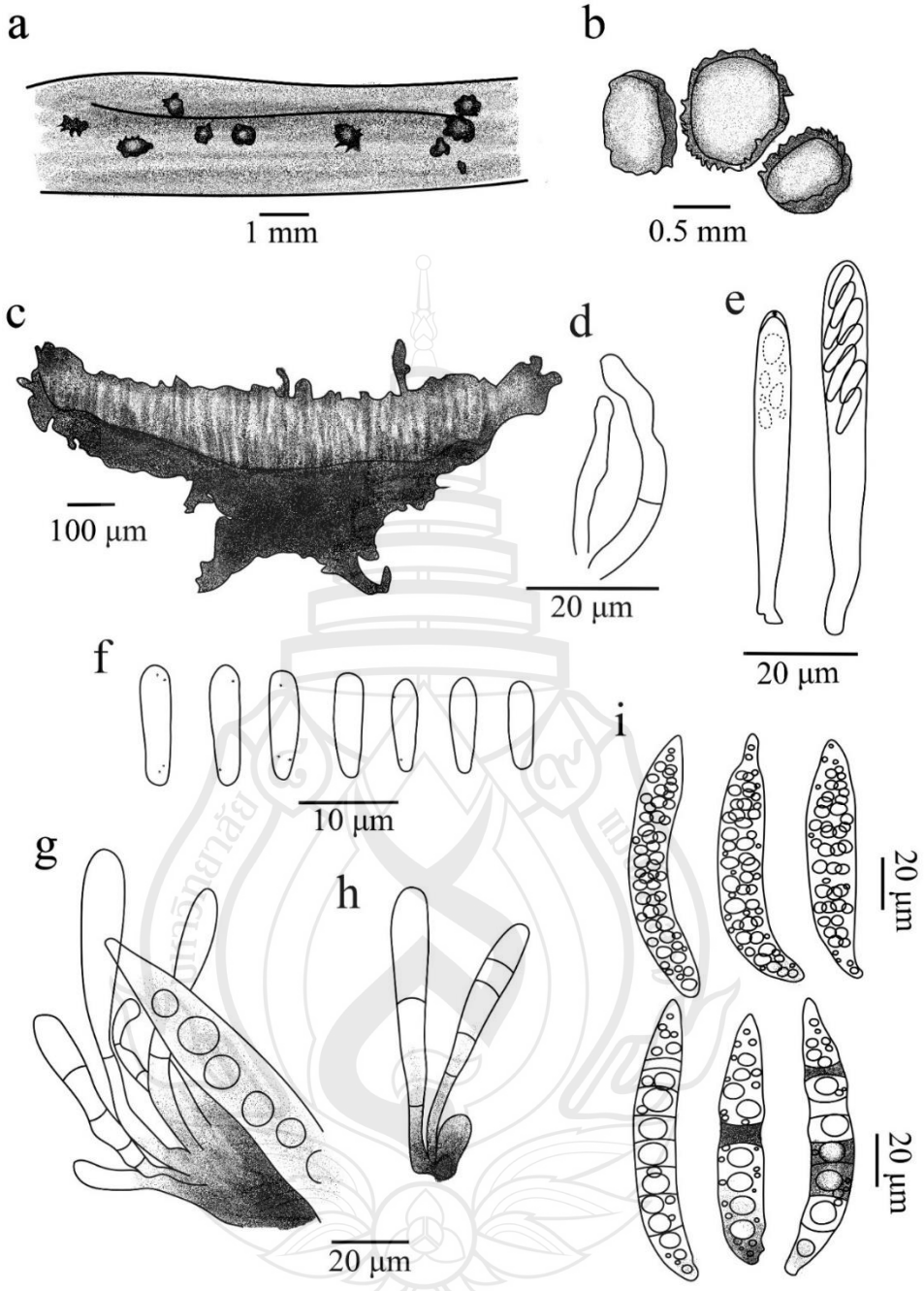
Figure 2.26 *Rhagadolobiopsis thelypteridis*

Rommelaarsia Baral & Haelew., in Baral & Haelewaters, Ascomycete.org 7(6): 323 (2015)

Index Fungorum number: IF 814656; one species associated with pteridophytes; Figure 2.27

Type species: *Rommelaarsia flavovirens* Baral, Tanchaud & Romm.

Notes: Based on phylogenetic analysis of ITS and LSU sequence data, *Rommelaarsia* was established as Helotiales genus *incertae sedis* (Leotiomycetes, Ascomycota) by Baral and Haelewaters (2015), with *R. flavovirens* selected as the type species. The morphology of *Rommelaarsia* was represented by the single species, *R. flavovirens*, which exhibits both sexual and asexual morphs. *Rommelaarsia* has a psilachnum-like sexual morph, characterized by round, non-gelatinous apothecia, a light greenish yellow ectal excipulum, irregular texture, a hyaline medullary excipulum, obliquely biseriate asci with J^+ apical ring, and subcylindrical to fusoid or often clavate-cuneate ascospores (Baral & Haelewaters, 2015). The asexual morph has pulvinate, sessile sporodochia producing large multiguttulate, holoblastic phragmoconidia (Baral & Haelewaters, 2015). The trait of short hairs on the superficially growing apothecium suggests a potential phylogenetic relationship to Hyaloscyphaceae. However, the phylogeny is uncertain due to insufficient evidence (Baral & Haelewaters, 2015). Fresh collections are therefore needed to assign this genus to a more appropriate natural fungal group. *Rommelaarsia flavovirens* has been found on dead stems of *Equisetum arvensis* with three collections (one collection not studied) in Western Europe, including France and Netherlands (Baral & Haelewaters, 2015). This species appears to be limited to *Equisetum arvensis* (Baral & Haelewaters, 2015).



Note b Apothecia in fresh state. c Apothecium in median section. d Smooth marginal hairs. e Asci with J^+ apical ring. f Ascospores. a, g–i Asexual state. a Conidiomata (sporodochia) on natural substrate. g, h Conidiophores with young, eguttulate conidia. i Mature conidia. Redrawn from Baral and Haelewaters (2015).

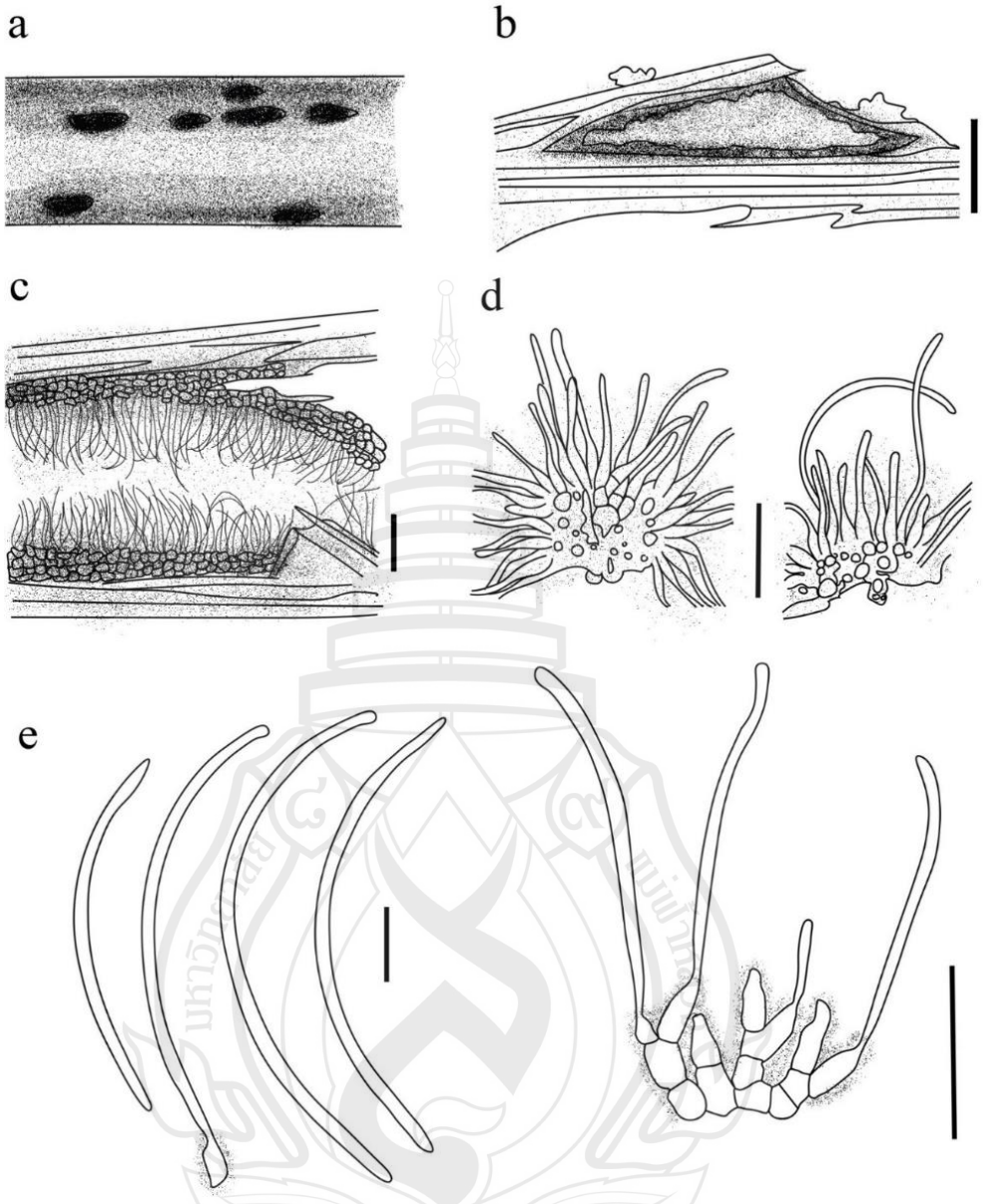
Figure 2.27 *Rommelaarsia flavovirens*

Scolecoleotia H.B. Jiang, Phookamsak & K.D. Hyde, Fungal Diversity 111: 160 (2021)

Index Fungorum number: IF558192; one species associated with pteridophytes; Figure 2.28

Type species: *Scolecoleotia eriocamporesi* H.B. Jiang, Phookamsak & K.D. Hyde

Notes: *Scolecoleotia* was introduced as a coelomycetous genus *incertae sedis* in Leotiales (Leotiomycetes, Ascomycota) by Boonmee et al. (2021) to accommodate the type species *Scolecoleotia eriocamporesi*, based on evidence from morphology and phylogenetic analysis of combined ITS, LSU, SSU and *rpb2* sequence data. Morphologically, the genus is characterized by immersed, uniloculate, black, pycnidial conidiomata; pycnidial walls composed of pseudoparenchymatous cells arranged in *textura angularis* to *textura globulosa*; hymenium composed of polygonal cells; phialidic, discrete, hyaline, ampulliform to subcylindrical conidiogenous cells; and acrogenous, scolecosporous, solitary, cylindrical to filiform, curved, hyaline, aseptate conidia (Boonmee et al., 2021). *Scolecoleotia* is most similar to *Gelatinosporium* in having phialidic conidiogenous cells and conidial features, but it differs from the latter by having distinct ascomata (Funk, 1979). The various shapes of ascomata are present in *Gelatinosporium*, while the ascomata of *Scolecoleotia* are elongate subsphaerical conidiomata (Funk, 1979; Boonmee et al., 2021). *Scolecoleotia* is monotypic, containing the single species *S. eriocamporesi*, which was reported as saprobe isolated from dead aerial fronds of *Pteridium aquilinum* (an eagle fern) in Italy (Boonmee et al., 2021). Fresh collections are needed to provide insight into its ecology with host relationships.



Note a Appearance of conidiomata on host surface. b Section through conidioma. c Section through pycnidial wall. d Conidiogenous cells with attached conidia. e Conidia. Scale bars: b = 500 µm, c = 50 µm, d = 20 µm, e = 10 µm. Redrawn from Boonmee et al. (2021).

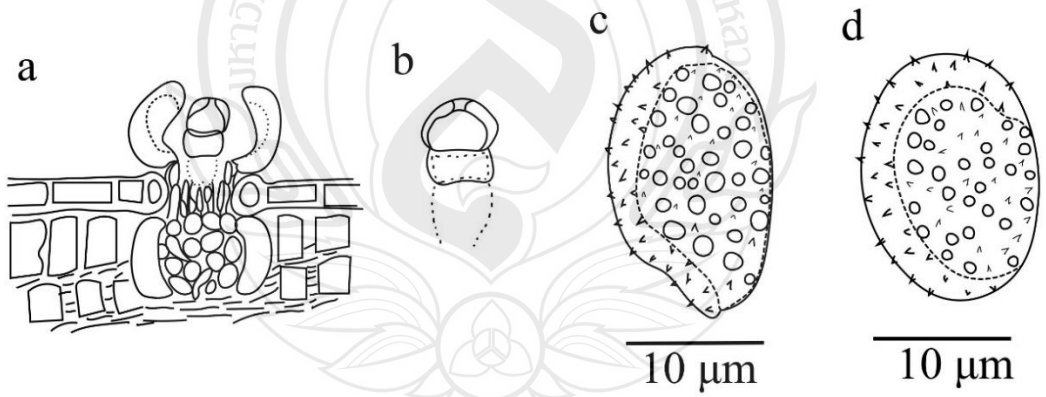
Figure 2.28 *Scolecoleotia eriocamporesi*

Uncol Buriticá & P.A. Rodr., Revta Acad. colomb. cienc. exact. fís. nat. 24(no. 90): 112 (2000)

Index Fungorum number: IF 28482; one species associated with pteridophytes; Figure 2.29

Type species: *Uncol diazii* Buriticá & P.A. Rodr.

Notes: *Uncol* was introduced by Buritica and Rodriguez (2000) as a monotypic genus in Uncolaceae (Pucciniales, Pucciniomycetes, Basidiomycota) (Hyde et al., 2024c). The only known species in the genus is *Uncol diazii*, which is characterized by powdery colonies in chlorotic-necrotic, angular-rectangular areas, abundant paraphyses; globose, ellipsoid urediniospores; and holoblastic, catenulate, obovoid, or campanulate, hyaline teliospores. (Buritica & Rodriguez, 2000; Cummins & Hiratsuka, 2003). *Uncol diazii* is a biotrophic fungus that is confined to pteridophytes, including the host families Cyatheaceae, Dennstaedtiaceae, Polypodiaceae and Thelypteridaceae in Brazil and Colombia (Buritica & Rodriguez, 2000; He et al., 2019; Salazar-Yepes, 2021). Sequence data is unavailable for this genus.



Note a Spermatogonia. b Urediniospores chain. c, d Urediniospores. Redrawn from Buritica and Rodriguez (2000), and Salazar-Yepes (2021).

Figure 2.29 *Uncol diazii*

Uredinopsis Magnus, Atti Congr. Bot. Intern. di Genova, 1892: 167 (1893)

Index Fungorum number: IF 16378; 31 species including 2 unidentified species associated with pteridophytes.

Type species: *Uredinopsis filicina* (Niessl) Magnus

≡ *Protomyces filicinus* Niessl

Notes: See below (Result 2.2) for details.

Woldmaria W.B. Cooke, Beih. Sydowia 4: 29 (1961)

Index Fungorum number: IF 18749; one species associated with pteridophytes; Figure 2.30

Type species: *Woldmaria filicina* (Peck) Knudsen

≡ *Solenia filicina* Peck

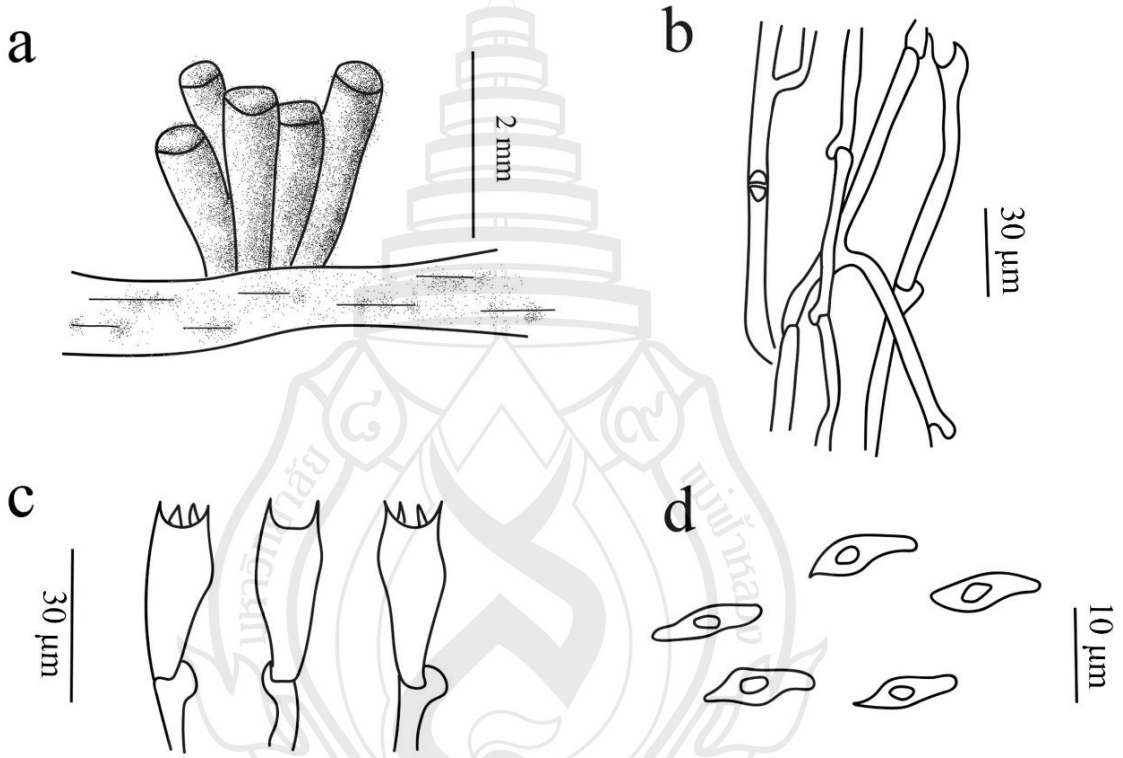
= *Woldmaria crocea* (P. Karst.) W.B. Cooke

= *Solenia crocea* P. Karst.

= *Cyphella struthiopteridis* Pilát

Notes: *Woldmaria*, a cyphelloid genus, was introduced by Cooke (1961) and was typified by *Woldmaria filicina* (Knudsen & Hansen, 1996). Bodensteiner et al. (2004) established a phylogenetic relationship of cyphelloid genera, including *Woldmaria* and related six genera, as well as a corticioid genus *Dendrothele*, demonstrating that *Woldmaria* is closely related to *Nia* clade (= Cyphellopsidaceae, Agaricales, Basidiomycota). Silva-Filho et al. (2023) introduced a new genus, *Eoscyphella*, which is phylogenetically sister to *Woldmaria* in Cyphellopsidaceae (Vlasenko & Vlasenko, 2013), a family containing largest number of cyphelloid genera. The monotypic genus *Woldmaria* is characterized by basidiocarps with filamentous basis, golden-brown subicles with conspicuous long hairs on the surface, smooth hymenium and fusiform, hyaline basidiospores (Cooke, 1961; Agerer, 1973; Bodensteiner et al., 2004; Piatek & Bujakiewicz, 2004; Vlasenko & Vlasenko, 2013). *Woldmaria filicina* is a common species worldwide and has been found in many countries, including Europe (Austria, Belgium, Denmark, Estonia, Finland, Germany,

Norway, Poland, Russia, Sweden, Ukraine, United Kingdom) and North American (Canada, USA) (Table 2.1). This species is notably characterized by its unique ecology of host preference, as it is confined to a fern species, *Matteuccia struthiopteris* (Onocleaceae), although there is a record of this species being found on *Pteretis* sp. (Onocleaceae) (Cooke, 1961; Piatek & Bujakiewicz, 2004; Vlasenko & Vlasenko, 2013).



Note a Group of basidiocarps the host. b Hyphae. c Basidia. d Basidiospores. Redrawn from Piatek and Bujakiewicz (2004).

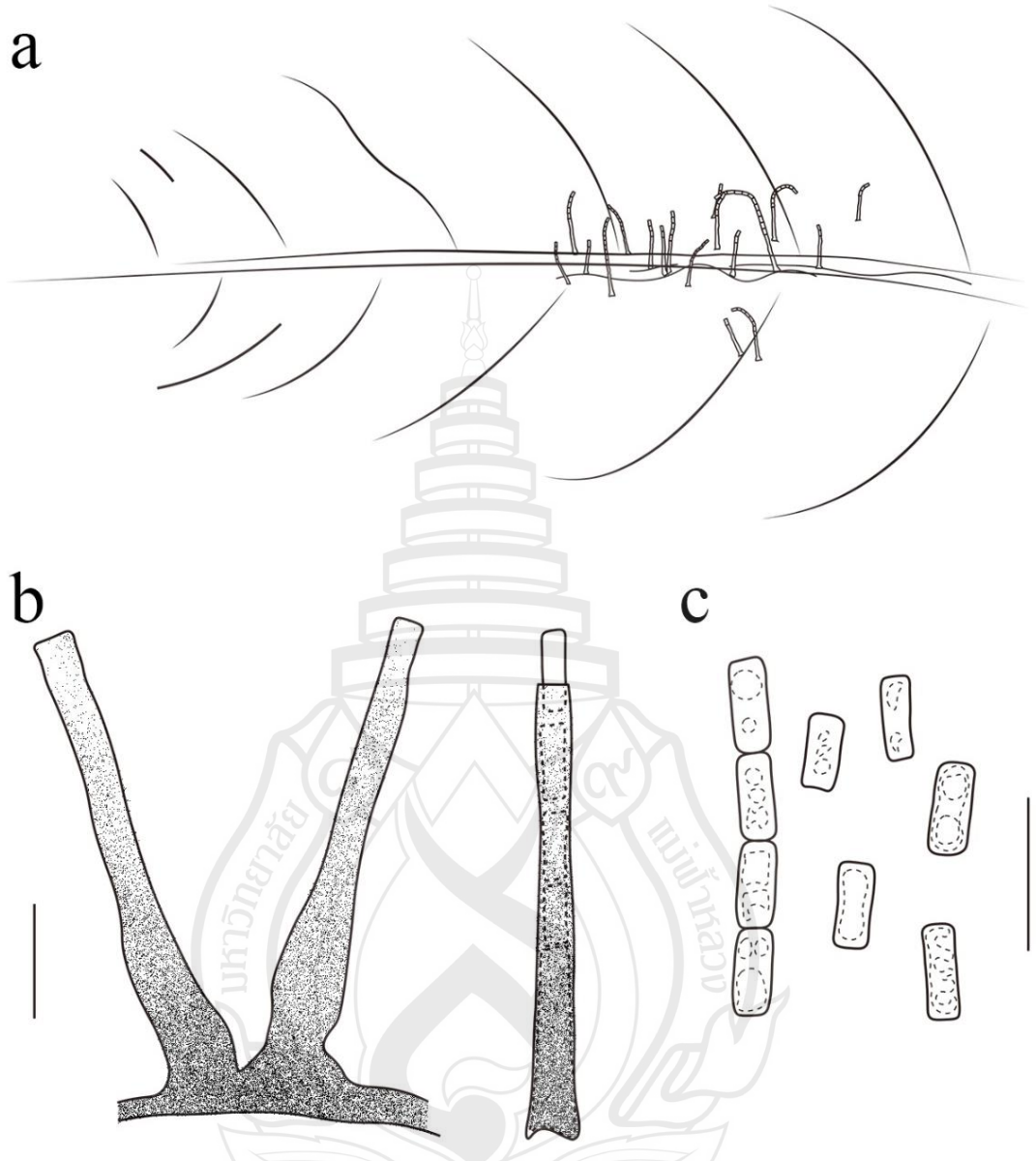
Figure 2.30 *Woldmaria filicina*

Zymochalara Guatim., R.W. Barreto & Crous, Mycol. Progr. 15(12): 1261 (2016)

Index Fungorum number: IF815563; two species associated with pteridophytes; Figure 2.31

Type species: *Zymochalara cyatheae* Guatim., R.W. Barreto & Crous

Notes: Based on phylogenetic analyses of ITS and LSU sequence data, Guatimosim et al. (2016b) introduced a chalara-like genus *Zymochalara* within Pezizellaceae (Helotiales, Leotiomycetes, Ascomycota) to accommodate two species, *Z. cyatheae* and *Z. lygodii*. Both species were reported as frond pathogens on ferns in Brazil (Guatimosim et al., 2016b). *Zymochalara* species are only known from their sexual state and are characterized by the yeast-like growth of colonies, unbranched, lageniform phialides with pedicellate or apedicellate, endogenous, basipetal, cylindrical and aseptate phialoconidia (Guatimosim et al., 2016b; Wu & Diao, 2023). *Zymochalara* is difficult to distinguish from *Chalara sensu lato*. based on morphological characteristics. However, their phylogenetic position was distinct, and they have different colony growth forms inculture (Guatimosim et al., 2016b; Wu & Diao, 2023). *Zymochalara* species display a yeast-like colony in culture, while the latter exhibits filamentous growth (Guatimosim et al., 2016b).



Note a Colony on the leave of *Cyathea delgadii*. b conidiophores and conidiogenous cells. c phialoconidia. Scale bars: = 10 µm. Redrawn from Guatimosim et al. (2016b).

Figure 2.31 *Zymochalara cyatheae*

2.4.2 The Most Speciose Genera Reported Among Fungi Associated with Pteridophytes

In this section, we provide notes that elucidate taxonomic classification, life-patterns, morphological characteristics, and phylogenetic relationships for each genus. The numbers of known species occurring on pteridophytes has been the primary criterion for selecting genera, considering the considerable uncertainty surrounding undetermined species. However, as we provide a complete checklist of fungi on pteridophytes, these undetermined species will still be documented in the checklist (Table 2.1).

Table 2.3 The most speciose genera reported among fungi associated with pteridophytes

Most speciose genera	Num. of species	Known species	Unidentified species
Milesina	70	69	1
Pseudocercospora	43	40	3
Ramularia	44	31	13
Uredinopsis	31	29	2
Cercospora	54	28	26
Taphrina	28	25	3
Hyalopsora	23	23	0
Lachnum	23	19	4
Uredo	19	17	2
Phaeosphaeria	16	16	0

Note The numbers of species in each genus are provided. For example: *Milesina* 70-66-1 denotes 70 *Milesina* species including one unidentified species and 66 known species are associated with pteridophytes.

Cercospora Fresen. ex Fuckel, Hedwigia 2(15): 133 (1863)

= *Virgasporium* Cooke, Grevillea 3: 182. 1875

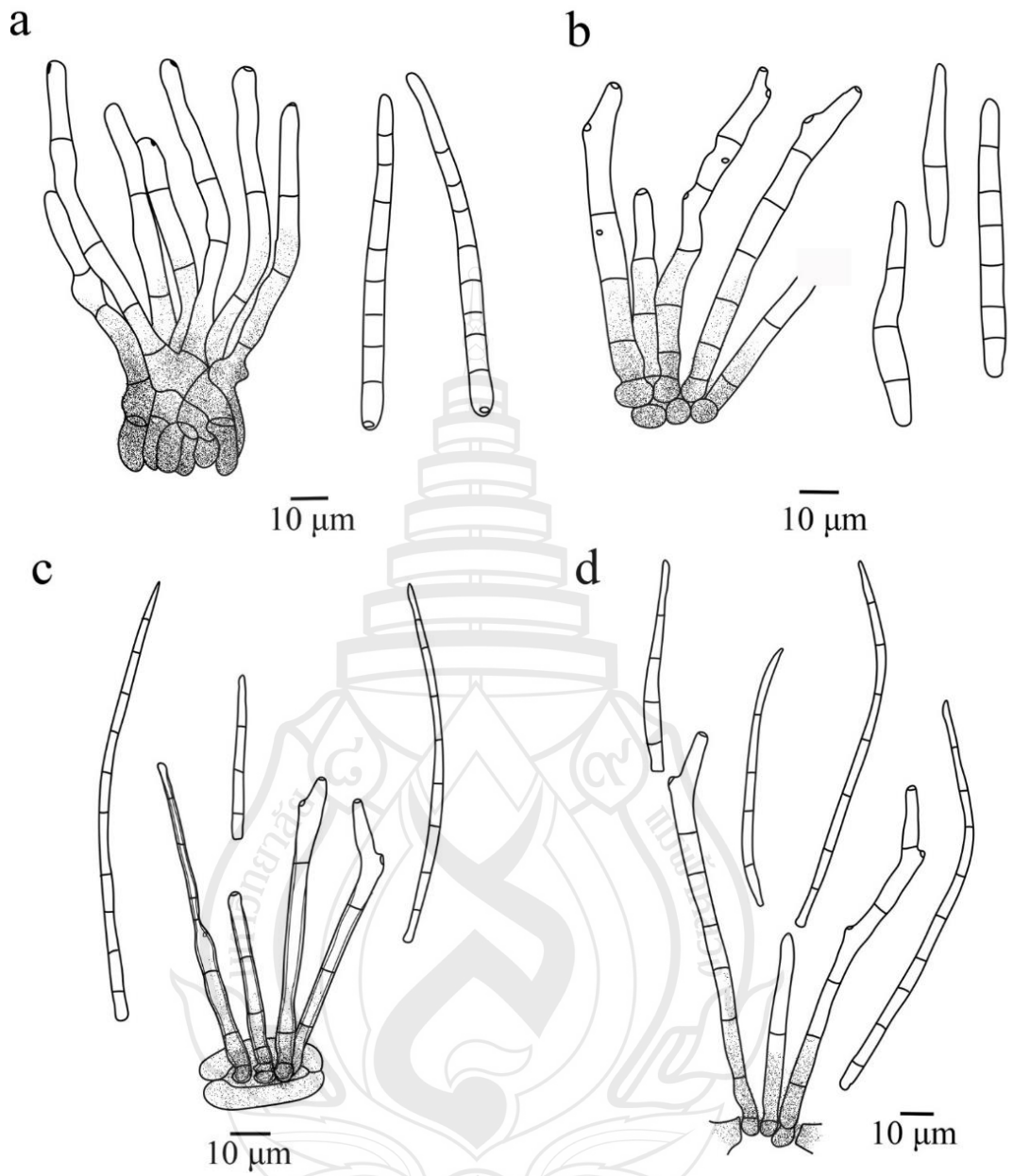
= *Cercosporina* Speg., Anales Mus. Nac. Buenos Aires 3, 13: 424.1911

Index Fungorum number: IF7545; 54 species including 26 unidentified species associated with pteridophytes; Figure 2.32

Type species: *Cercospora apii* Fresen.

Notes: García et al. (1996) introduced the genus *Cercospora* for *passalora*-like fungi with pluriseptate conidia. *Cercospora*, one of the largest and extensively studied genera (Chupp, 1954; Pollack, 1987; Groenewald et al., 2013), encompasses over 3,000 epithets in Index Fungorum (August, 2024). The generic concept had been amended based on conidiogenous loci and hila, as well as the pigmentation in the conidiophores and conidia (Chupp, 1954; Pollack, 1987; Braun, 1991; Crous & Braun, 2003; Phengsintham et al., 2013). The first monograph of *Cercospora* was provided by Chupp (1954), followed by subsequent comprehensive studies on this genus (Braun, 2002, 2013; Braun et al., 2015a, 2015b, 2016). *Cercospora* is characterized by hyaline to pigmented hyphae; intra-epidermal or immersed stromata ranging from absent to well-developed; mononematous, macronematous, solitary or fasciculate conidiophores in small to large fascicles; integrated, terminal or intercalary, monoblastic to mostly polyblastic, proliferation sympodial conidiophores with conspicuous, planate with minute central pore, thickened and darkened-refractive conidiogenous loci (scars); mostly solitary, mostly scolecosporous, sometimes obclavate, or cylindrical, or acicular, or filiform, multi-euseptate, hyaline conidia with thickened and darkened hila (Ellis, 1971; Crous & Braun, 2003; Braun et al., 2013; Groenewald et al., 2013; Phengsintham et al., 2013; Chen et al., 2022; Pem et al., 2024). *Cercospora* species are similar and challenging to distinguish based on morphology alone (Chen et al., 2022). The DNA barcodes for the genus *Cercospora* include the LSU, ITS, and *rpb2* genes. Additionally, *actA*, *cmdA*, *gapdh*, *his3*, *tef1-α*, and *tub2* genes are used for distinguishing between *Cercospora* species (Chen et al., 2022).

Cercospora is a particularly significant genus of plant pathogenic fungi, causing extensive damage in agriculture with leaf spots, necrotic lesions of flowers, fruits and seeds or fruit rot disease observed worldwide, particularly in humid, tropical and subtropical climates (Agrios, 2005; Silva & Pereira, 2008; Skaracis et al., 2010; To-Anun et al., 2011; Groenewald et al., 2013; Rehman et al., 2021; Chen et al., 2022). It is universally pathogenic to a broad range of plants, affecting nearly all dicotyledonous plants, most monocotyledonous plants, some gymnosperms and ferns across the globe (Pollack, 1987; Crous et al., 2006a; Braun et al., 2015b; Abeywickrama et al., 2023). Additionally, this genus exhibits host-specificity, with each plant genus or family often having its own endemic species (Chupp, 1954; Pollack, 1987; Crous et al., 2006a; Phengsintham et al., 2013). Our survey revealed 54 *Cercospora* species (including 26 unidentified species) associated with various pteridophytes in 17 families (Table 2.1), demonstrating the widespread occurrence of *Cercospora* species in ferns and their allies. Furthermore, cercosporoid fungi on pteridophytes were summarized by Braun et al. (2013), with a tabular key to *Cercospora* species on ferns.



Note a Fasciculate conidiophores, conidiogenous cells and conidia of *C. apii*. b *Cercospora adiantigena* found on *Adiantum philippense*. c *Cercospora abacopteridis* on *Abacopteris urophylla*. d *Cercospora adianticola* on *Adiantum venustum*. Redrawn from Braun et al. (2013) and Bakhshi et al. (2018).

Figure 2.32 *Cercospora* species

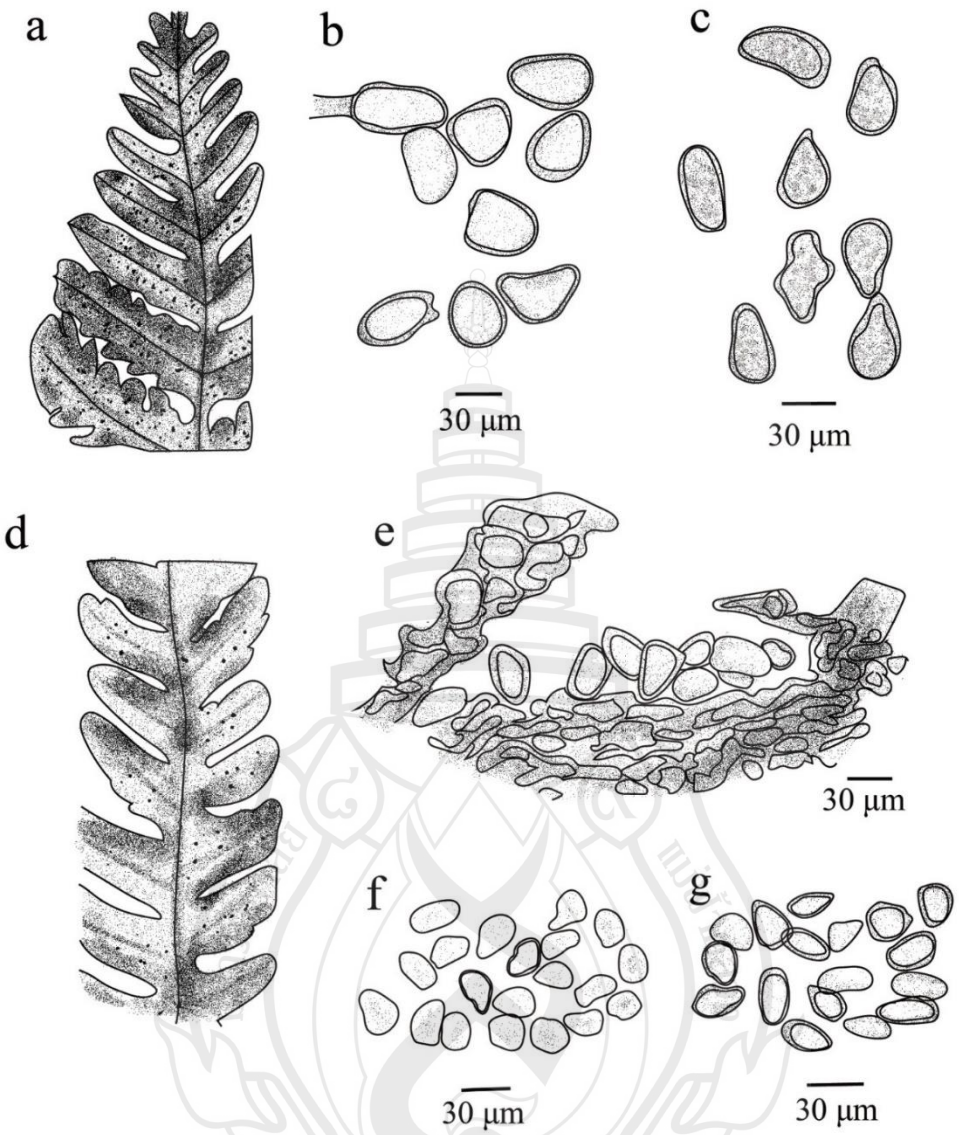
Hyalopsora Magnus, Berichte der Deutschen Botanischen Gesellschaft 19: 582 (1901)

Index Fungorum number: IF16164; 23 species associated with pteridophytes; Figure 2.33

Type species: *Hyalopsora aspidiotus* (Peck) Magnus

Notes: *Hyalopsora* was introduced by Magnus (1901) and is one of three rust fungi restricted to ferns with alternate hosts (Berndt, 2008). *Hyalopsora* is similar to the other two genera of fern rust fungi (*Milesina* and *Uredinopsis*) in their life mode, but it can be distinguished from them (Berndt et al., 1994; Berndt, 2008; Smith, 2015). Morphologically, *Hyalopsora* differs from the other two genera due to its echinulate or verrucose urediniospores with hyaline walls and orange pigmented cytoplasm, presentation of amphispores, and a vesicular haustorium (Hiratsuka, 1936; Cummins & Hiratsuka, 2003; Helfer, 2006). Phylogenetically, *Hyalopso*ra constitutes a monophyletic clade within Pucciniastraceae, forming a separate lineage from *Milesina* and *Uredinopsis*, which are located in Milesinaceae (Aime & McTaggart, 2021; Wang et al., 2021). Furthermore, it is noteworthy that the only genus in the family Pucciniastraceae that infects fern plants is *Hyalopsora* (Aime & McTaggart, 2021).

All known *Hyalopsora* species have been found associated with pteridophytes in their dikaryotic phase (Hiratsuka, 1936; Berndt et al., 1994), and these members are mainly distributed in temperate to cold areas, especially where their alternate hosts (*Abies* species) are found (Hiratsuka, 1958; Cummins & Hiratsuka, 2003; Ji et al., 2018). The most recent taxonomic study of *Hyalopsora* was conducted by Wang et al. (2021), introducing two species and a new geographical record for China, as well as providing an updated phylogenetic relationship of *Hyalopsora* species and related taxa based on ITS and LSU sequence data. Furthermore, a checklist of *Hyalopsora* on ferns and their allies was provided in this study, along with their hosts and distribution (Table 2.1).



Note a–c Type species of *Hyalopsora aspidiotus*; d–g A case of *Hyalopsora hakodatensis* found on fern. a Uredinia on lower leaf surface of *Gymnocarpium jessoense*. b Amphispores on *G. jessoense*. c Urediniospores on *G. disjunctum*. d Uredinia on lower leaf surface of *Deparia orientalis*. e Vertical section of a sorus of amphispores on *Lunathyrium* sp. f Urediniospores on *D. orientalis*. g Amphispores on *Lunathyrium* sp. Redrawn from Ji et al. (2018).

Figure 2.33 *Hyalopsora* species on ferns

Lachnum Retz., Floræ Scandinaviæ prodromus; enumerans: plantas Sveciae, Lapponiae, Finlandiae, Pomeraniae, Daniae, Norvegiae, Holsatiae, Islandiae & Groenlandiae: 256 (1779)

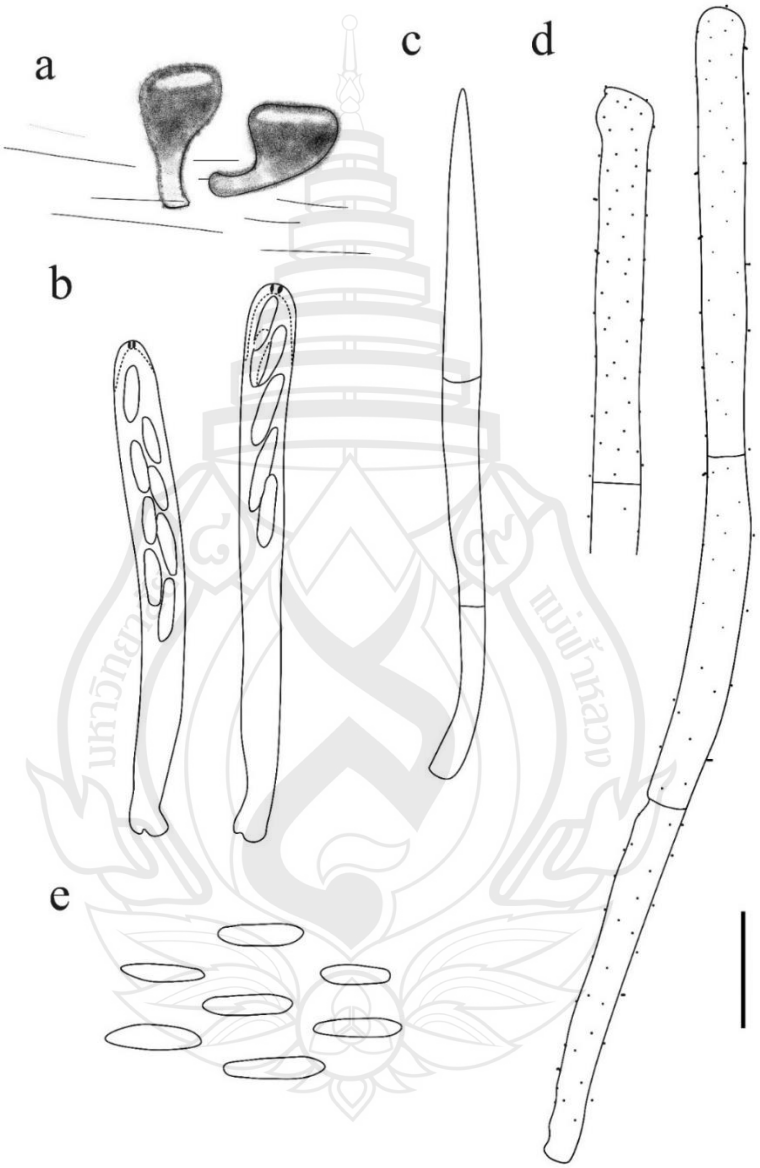
Index Fungorum number: IF2619; 23 species including four unidentified species associated with pteridophytes; Figure 2.34

Type species: *Lachnum virgineum* (Batsch) P. Karst.

Notes: *Lachnum* has traditionally been assigned to Hyaloscyphaceae (Cantrell & Hanlin, 1997; Hosoya et al., 2010), until the tribe Lachneae was raised to the familial rank of Lachnaceae based on their morphological distinctions (Raitviir, 2004). This treatment was supported by subsequent studies (Ekanayaka et al., 2019; Wijayawardene et al., 2022). Moreover, ITS and *rpb2* was proposed as significant DNA barcodes for delimitation of *Lachnum* species phylogenetically (Hosoya et al., 2010; Zhao & Zhuang, 2011). Morphologically, *Lachnum* is characterized by small, discoid, stipitate or casually sessile apothecia covered by totally granulate, hyaline or brown hairs equipped with crystals or resinous matters at their apices; ectal excipulum composed of hyaline or brownish cells *textura prismatica* usually or sometime *textura angularis*; pure white to yellow or reddish hymenium; lanceolate to subcylindrical paraphyses which extending over the asci at various degrees usually; subcylindrical to clavate asci with an amyloid apical ring; and ascospores with diverse shapes (Nannfeldt, 1932; Spooner, 1987; Ye et al., 2006; Hosoya et al., 2010; Hongsanan et al., 2015). As several genera within Lachneae, such as *Albotricha*, *Lachnum*, *Trichopeziza* and *Trichopezizella*, share similar morphology in hairs, asci, paraphyses, and ectal structures, molecular data is significant for species taxonomy (Nannfeldt, 1932; Spooner, 1987; Raitviir, 2004; Hosoya et al., 2010). Hosoya et al. (2010) provided a key to the lachnoid genera based on phylogeny using diagnostic characters.

The genus *Lachnum* has a worldwide distribution, occurring on various plant substrates including ferns, herbs, and coniferous or broadleaved trees from temperate and tropical regions (Dennis, 1961; Haines, 1980; Haines, 1984; Wu, 1998; Zhuang &

Hyde, 2001; Ye et al., 2006; Wu & Su, 2007; Hosoya et al., 2010). Index Fungorum (2024) has listed 532 epithets under *Lachnum*, and 50 species were accepted in this genus (Wijayawardene et al., 2022). Among these, 19 species of *Lachnum* and four unidentified *Lachnum* species are associated with pteridophytes worldwide.



Note a Apothecia. b Asci. c Lanceolate paraphyses with subacute tips. d Cylindrical hairs with enlarged apices. e Ascospores. Scale bars: b–e = 10 µm. Redrawn from Sukova (2005).

Figure 2.34 *Lachnum virgineum*

Milesina Magnus, Berichte der Deutschen Botanischen Gesellschaft 27: 325 (1909)

Index Fungorum number: IF16217; 70 species including one unidentified species associated with pteridophytes; Figure 2.35

Type species: *Milesina kriegeriana* (Magnus) Magnus

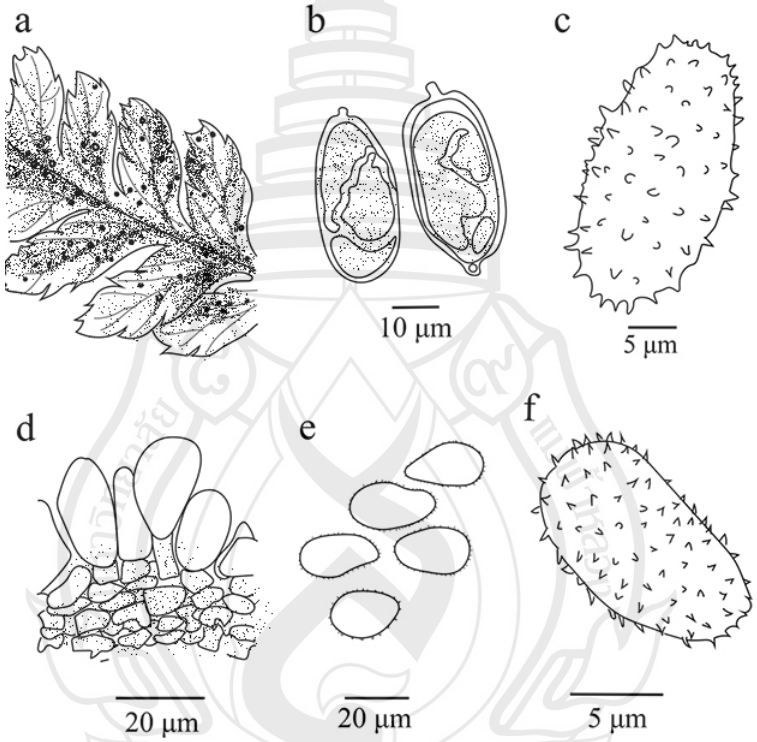
≡ *Melampsorella kriegeriana* Magnus

≡ *Milesia kriegeriana* (Magnus) Arthur

Notes: *Milesina* was introduced by Magnus (1909) with *Milesina kriegeriana* (Magnus) Magnus 1909 as the type species. The taxonomic placement of *Milesina* has been placed in Pucciniastraceae due to the characteristics of teliospore being embedded in the host tissue and the peridermium-type aecia (Cummins & Hiratsuka, 1983). However, it was finally verified as the type genus of Milesinaceae (Pucciniales, Pucciniomycetes), and shares a close relationship with *Milesia*, *Naohidemyces* and *Uredinopsis* (Aime & McTaggart, 2021). Moreover, ITS, nad6, 28S are barcode loci for molecular phylogenetic analyses (Geiger et al. 2016; Bubner et al., 2019). *Milesina* is characterized by white sori and no pigment in all spore stages; mostly heteroecious uredinia covered by the epidermis; teliospores that are not resting spores, but form during the winter and germinate in the spring; usually presence of abundant amphispores and white, powdery urediniospores on the underside of fronds (Cummins & Hiratsuka, 2003; Smith, 2015; Bubner et al., 2019). Furthermore, host taxonomy, uredinia, and urediniospore morphology of size, shape, and ornamentation were used for delimitation of *Milesina* species (Ya & Hayova, 2015; Bubner et al., 2019; Kabaktepe & Akata, 2023). A monograph of *Milesina* was provided by Faull (1932).

Milesina species are a common group of fern pathogens, and the most speciose genus associated with pteridophytes (Helfer, 2006). They are heteroecious and parasitic species that alternate between hosts of *Abies* spp. and fronds of ferns in the order Polypodiales (Faull, 1932; Tănase & Negrean, 2007; Bubner et al., 2019). Aeciospores from needles in *Milesina*, a genus comprising species also known as fir-fern rust fungi,

infect ferns, causing needle browning or even defoliation. This development manifests as pale green to yellow spots on the leaves, which later become necrotic, often restricted by veins (Sinclair & Lyon, 2005; Bubner et al., 2019). Index Fungorum has listed 73 epithets under *Milesina*, mostly found in the temperate climates of the Northern Hemisphere, especially in Europe (Berndt, 2008; Klenke & Scholler, 2015; Bubner et al., 2019), with occasional occurrences in the Southern Hemisphere (Liu, 1971; Berndt, 2008).



Note a–c The type species, *Milesina kriegeriana*, on *Dryopteris carthusiana* (a Uredinia; b, c Urediniospores, c using scanning electron micrograph). d–f *Milesina thailandica* on *Lygodium flexuosum* (d Urediniospores are singly produced from basal sporogenous cells; e Urediniospores; f Echinulate urediniospore surface with using scanning electron micrograph). Redrawn from Ya and Hayova (2015) and Ono et al. (2020).

Figure 2.35 Two *Milesina* species found on ferns

Ramularia Unger, Exanth. Pflanzen (Wien): 119 (1833)

= *Mycosphaerella* Johanson, Öfvers. K. Svensk. Vetensk.-Akad. Förhandl. 41(no. 9): 163 (1884) [1884–1885]

Index Fungorum number: IF 9691; 44 species including 37 species as *Mycosphaerella* (13 unidentified species) and seven species as *Ramularia* associated with pteridophytes; Figure 2.36

Type species: *Ramularia endophylla* Verkley and U. Braun

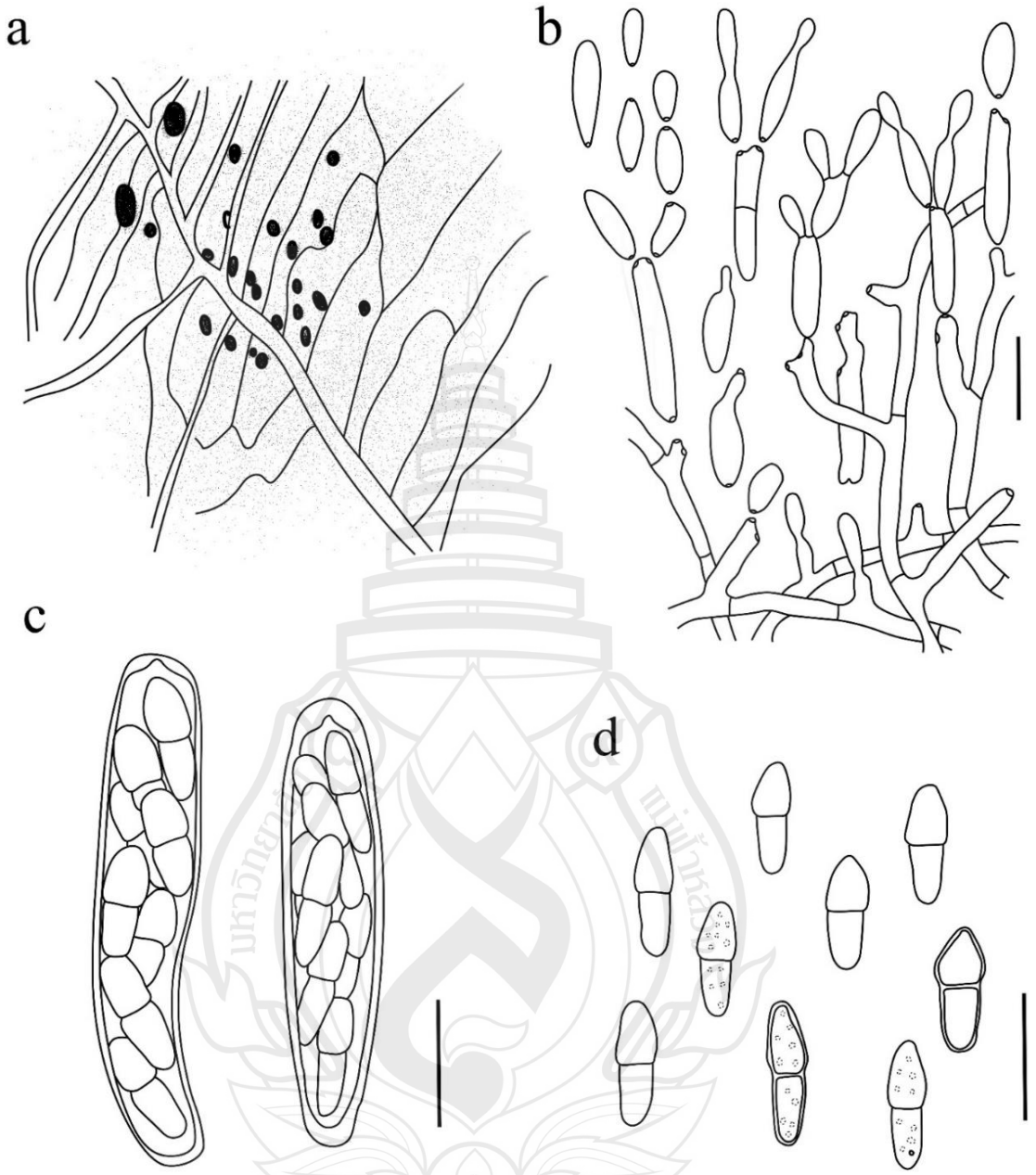
= *Sphaeria punctiformis* Pers.

= *Mycosphaerella punctiformis* (Pers.) Starbäck

Notes: *Mycosphaerella* was introduced by Johanson (1884) and typified by *M. punctiformis.* With over a thousand species, *Mycosphaerella* displays a remarkable diversity, making it one of the largest genera of ascomycetes and encompassing more than 30 genera of anamorphs (Crous & Wingfield, 1996; Aptroot & Crous, 2006; Crous et al., 2007a; Crous et al., 2011c). Based on the polythetic and problematic phylogenetic placement, combined with morphological characteristics, many new genera were proposed from *Mycosphaerella sensu lato*, such as *Dissoconium*, *Phaeophleospora*, *Pseudocercospora*, *Ramularia, Stenella*, etc. (Crous & Braun, 2003; Aptroot & Crous, 2006; Crous et al., 2006b, 2007b). Due to the generic name of *Mycosphaerella* being considered a "convenient name" rather than an indication of a taxonomic unit, *Mycosphaerella* was synonymized under *Ramularia* following the "One Fungus One Name" (1F1N) principle, with the latter being older (Crous et al., 2009; Videira et al., 2015b; Videira et al., 2016). A recent study provided by Hongsanan et al. (2020a) followed this treatment. However, many species of *Mycosphaerella* listed in IF and SF have not undergone a systematic study to be placed into *Ramularia* or a specific genus. Our list retains this treatment of generic names until more comprehensive research are conducted.

Ramularia (Mycosphaerellales, Dothideomycetes, Ascomycota) was established by Unger (1833) and includes over 1000 species being phytopathogenic, saprobic, endophytic and even hyperparasitic (Videira et al., 2015b). A monograph was provided by Braun (1998). Based on molecular markers of ITS, LSU, SSU, *Actin*, *Tub2*, *Calmodulin*, *Chs*, *GAPDH*, *Histone*, *rpb2* and *tef1-α*, phylogenetic relationship was used to further clarify their taxonomic placements of *Ramularia* and allied genera (Videira et al., 2015a, 2015b, 2016; Bakhshi et al., 2021). *Ramularia* is characterized by its mycosphaerella-like sexual morphs, and asexual morphs processing solitary to fasciculate, hyaline conidiophores, distinct, thickened, darkened and refractive conidiogenous loci, and aseptate to transversely septate hyaline conidia with thickened, darkened, refractive scars, and absent appressoria (Crous & Wingfield, 1996; Braun, 1998, 1988; Aptroot & Crous, 2006; Crous et al., 2009; Videira et al., 2015b, 2016). Hongsanan et al. (2020a) accept 1,662 morphological species, with 1,252 species as *Mycosphaerella* and 410 species as *Ramularia*. Among them, 154 species (71 species as *Mycosphaerella* and 83 species as *Ramularia*) have molecular data available.

Based on our checklist of fungi on pteridophytes, there are 44 species including 37 species as *Mycosphaerella* and seven species as *Ramularia*. These members are important pathogens associated with various plants, especially *Corymbia* and *Eucalyptus* (Crous et al., 2004, 2006b; Hunter et al., 2006; Andjic et al., 2007; Carnegie et al., 2007), casing leaf spots, necrosis, or chlorophyll reduction that can lead to early defoliation under high air humidity and low temperatures (Braun, 1988; Verkley et al., 2004; Crous et al., 2009; Videira et al., 2015b). Ferns and their allies also serve as suitable substrates for these species (Holm & Holm, 1981b; Braun, 2000), with the fungi parasitising pteridophytes from 18 families (Table 2.1).



Note a Colony on the host. b Conidiogenous cells and conidia. c Asci. d Ascospores. Scale bars: = 10 μm. Redrawn from Verkley et al. (2004).

Figure 2.36 *Ramularia endophylla*

Phaeosphaeria I. Miyake, Bot. Mag., Tokyo 23: 93 (1909).

= *Phaeoseptoria* Speg., Revta Mus. La Plata 15(2): 39 (1908)

Index Fungorum number: IF 3951; 16 species as *Phaeosphaeria* associated with pteridophytes; Figure 2.37

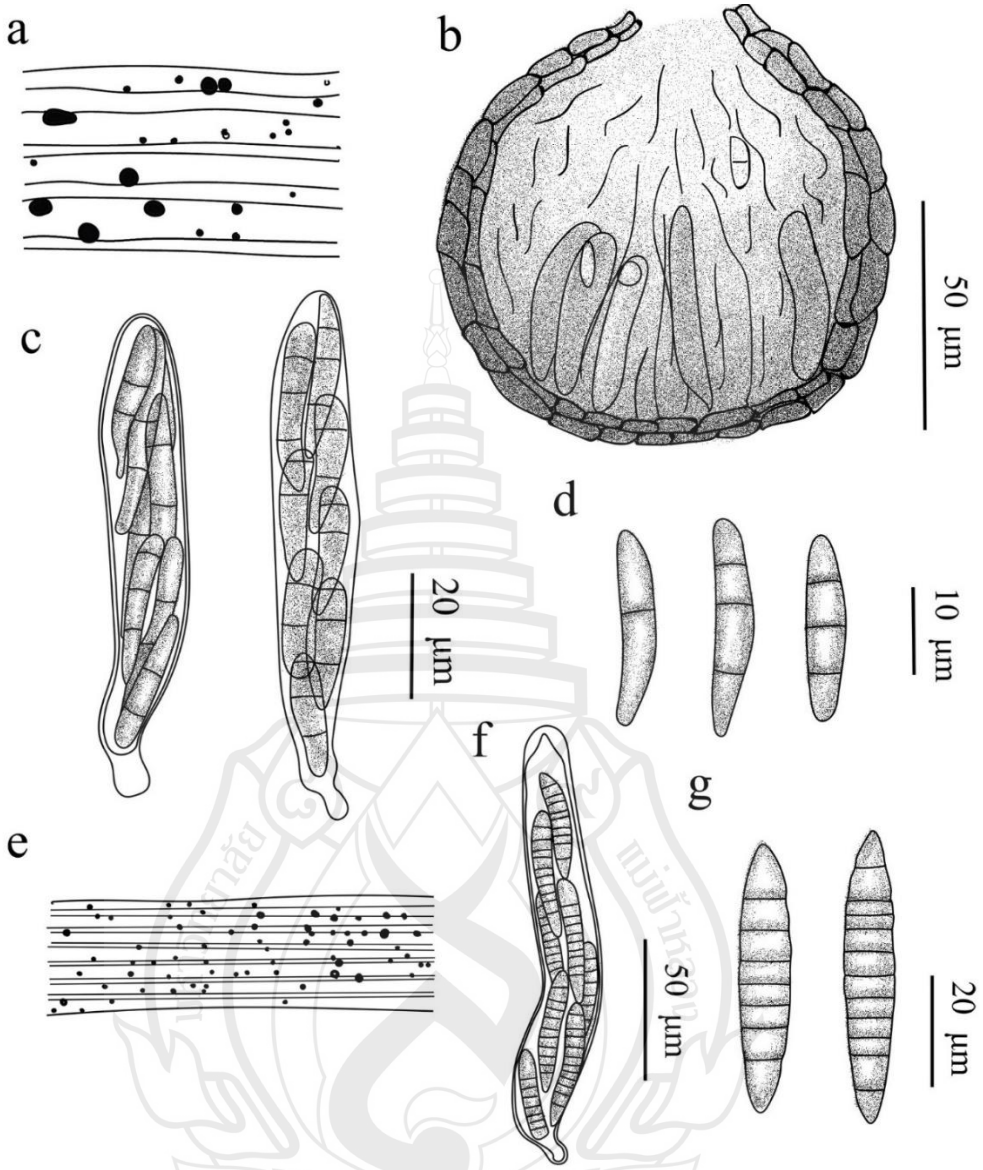
Type species: Phaeosphaeria oryzae I. Miyake

Notes: Miyake (1909) established the genus *Phaeosphaeria* within the family Mycosphaerellaceae. However, *Phaeosphaeria* was treated as a synonym of *Leptosphaeria* for a long time due to the morphological similarities (Müller, 1950; Zhang et al., 2012). Holm (1957) found the existence of pseudoparaphyses in *P. oryzae*, the type species of *Phaeosphaeria*, leading to the reassignment of *Phaeosphaeria* to the generic level to accommodate 17 predominantly graminicolous species characterized by somewhat small ascomata. Currently, *Phaeosphaeria* is recognized as a separate genus (Leuchtmann, 1984; Fukuhara, 2002; Câmara et al., 2002), as well as the generic type within Phaeosphaeriaceae (Barr, 1979), with *P. oryzae* as the type species (Eriksson, 1967; Quaedvlieg et al., 2013). Later, Eriksson (1981) re-evaluated the generic concept of *Phaeosphaeria*, emphasizing the characteristics of small ascomata, dictyospores, and a host preference on monocotyledons (Eriksson, 1967; Zhang et al., 2012; Phookamsak et al., 2014).

Morphologically, six subgenera, *viz*., *Fusispora*, *Ovispora*, *Phaeosphaeria*, *Sicispora*, *Spathispora* and *Vagispora*, were proposed based on ascospore shape and septation (Shoemaker & Babcock, 1989). The sexual morph is characterized by foliicolous form, glabrous, immersed ascomata with central ostiole; septate pseudoparaphyses encased in mucous; stipitate, biseriate asci and narrowly fusiform, septate, brown conidia enclosed in a mucoid sheath or not (Leuchtmann, 1984; Shoemaker & Babcock, 1989; Fukuhara, 2002; Tanaka & Harada, 2004; Quaedvlieg et al., 2013; Pem et al., 2024). The asexual morphs have hyphomycetous and coelomycetous forms. The hyphomycetous morph is processed by hyaline, ampulliform to subcylindrical or doliiform conidiogenous cells and euseptate, subcylindrical to

narrowly obclavate, pale brown conidia, while the septoria-like coelomycetous morph forms hyaline to brown, subglobose to cylindrical to subcylindrical conidia (Quaedvlieg et al., 2013; Phookamsak et al., 2014; Hyde et al., 2017; Jayawardena et al., 2019). Phylogenetically, the position of *Phaeosphaeria sensu stricto* is problematic and polyphyletic, with many species being transferred to other genera, such as *Amarenomyces*, *Juncaceicola*, *Loratospora*, *Neosetophoma*, *Parastagonospora*, *Phaeopoacea*, *Pseudophaeosphaeria*, *Septoriella*, or even other families in Pleosporales (Quaedvlieg et al., 2013; Phookamsak et al., 2014; Hongsanan et al., 2020a). Furthermore, the four genes of LSU, ITS, SSU, and *tef1-α* are used as molecular markers for *Phaeosphaeria* (Phookamsak et al., 2014). Recently, Hongsanan et al. (2020a) recognized 210 morphological species (171 species as *Phaeosphaeria*, 39 species as *Phaeoseptoria*), with sequence data available for 19 species. Fresh collections are warranted, alongside molecular data, to confirm the phylogenetic status of these species.

Members of *Phaeosphaeria* are commonly reported as pathogens on various hosts globally, especially on monocotyledonous plants, but have also record as endophytes or saprobes (Hedjaroude, 1969; Shoemaker & Babcock, 1989; Phookamsak et al., 2014; Hongsanan et al., 2020a). Based on our checklist of fungi on pteridophytes (Table 2.1), sixteen species of *Phaeosphaeria* were associated to pteridophytes. Of these, 41 records represented 15 species that were related to the pteridophytes host families of Equisetaceae and Lycopodiaceae, and only one species, Phaeosphaeria *lycopodiicola* var. *major*, was found on *Selaginella helvetica*, belonging to Selaginellaceae.



Note a–d Type species of *Phaeosphaeria oryzae*, redrawn from Phookamsak et al. (2014); e–g An example of a fungus was found on a fern: Phaeosphaeria berlesei on Equisetum sp., redrawn from Holm and Holm (1981b). a Appearance of ascomata on host substrate. b Section through ascoma. c Asci with ascospores. d Ascospores. e Appearance of ascomata of Phaeosphaeria berlesei on Equisetum sp. f Asci. g Ascospores.

Figure 2.37 *Phaeosphaeria* species

Pseudocercospora Speg., Anal. Mus. nac. B. Aires, Ser. 3 13: 437 (1910).

Index Fungorum number: IF 9559; 43 species including three unidentified species associated with pteridophytes; Figure 2.38

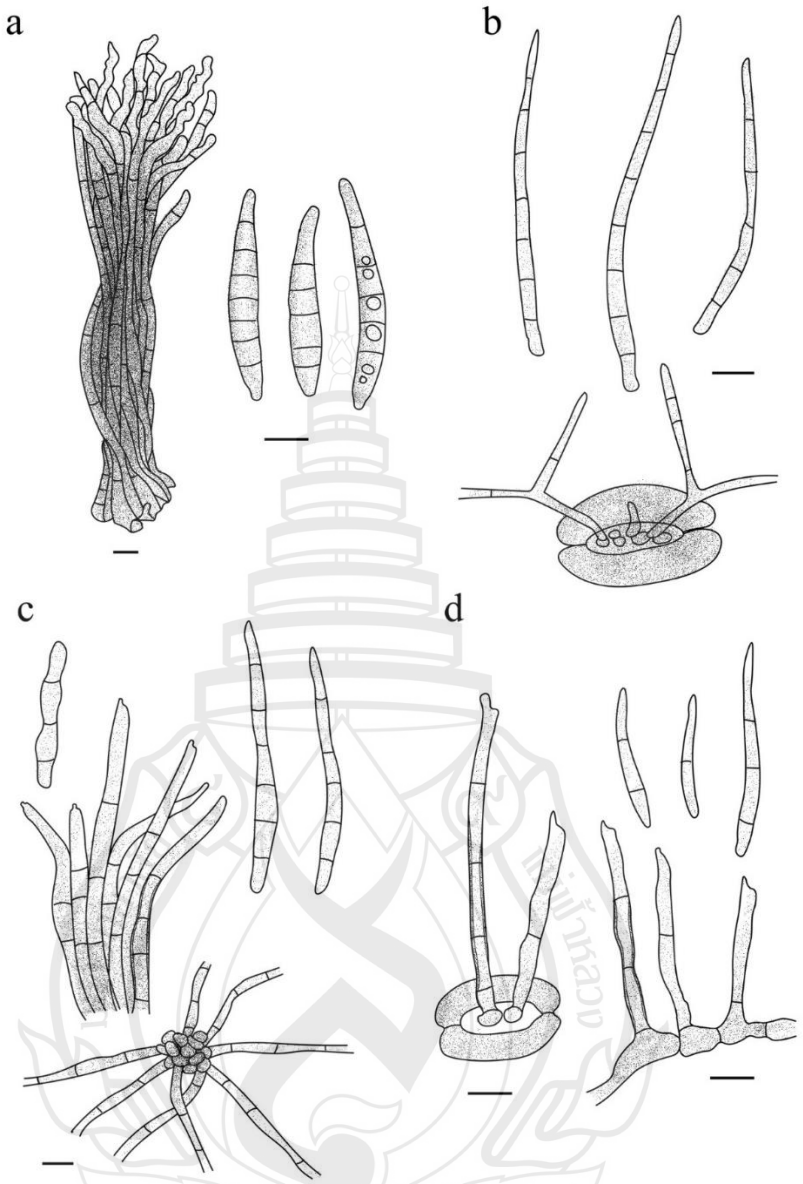
Type species: *Pseudocercospora vitis* (Lév.) Speg.

≡ *Septonema vitis* Lév.

Notes: *Pseudocercospora* was introduced by Spegazzini (1910) and typified by *P. vitis*, which is a foliar pathogen of grapevines (Zhou et al., 2023). Initially, *Pseudocercospora* was treated as an asexual morph of *Mycosphaerella*, but subsequent research recognized it as a distinct and monophyletic genus within Mycosphaerellaceae, Capnodiales, Dothideomycetes, Ascomycota (Deighton, 1976; Crous, 2009; Crous et al., 2013b; Bakhshi et al., 2014; Videira et al., 2017; Hyde et al., 2024c). Four gene regions, namely ITS, *tef1-α*, *actA*, and *rpb2*, were found to be suitable for species delimitation within *Pseudocercospora* (Nakashima et al., 2016; Silva et al., 2016), with *rpb2* being confirmed as the preferred gene region for delineating genera within Mycosphaerellaceae (Nakashima et al., 2016). Morphologically, *Pseudocercospora* exhibits cercospora-like asexual morphs being synnematous, fasciculate or solitary conidiophores, and multiform, scolecosporous usually, subhyaline or pigmented conidia with unthickened or slightly thickened and integrated, mono- to polyblastic, sympodial conidiogenous cells with proliferating percurrently via inconspicuous or darkened, irregular annellations, or only thickened along the rim, or flat, and unthickened loci, but never pronounced (Chupp, 1954; Crous et al., 2000; Crous & Braun, 2003; Braun et al., 2013; Crous et al., 2013b; Bakhshi et al., 2014; Silva et al., 2016; Pem et al., 2024).

Pseudocercospora is the second largest cercosporoid genus with over 1,700 epithets listed in Index Fungorum (August, 2024). Hongsanan et al. (2020a) accepted 1,498 morphological species under *Pseudocercospora*. These species are known to be important plant pathogens associated with various plant hosts worldwide, with a preference for subtropical and tropical regions (Chupp, 1954; Deighton, 1976;

Deighton, 1987; Silva et al., 2016; Videira et al., 2017). They can cause leaf spot, blight, fruit spot, rot, canker and other symptoms, particularly Sigatoka disease on banana (Waterman, 1954; Pretorius et al., 2003; Arzanlou et al., 2007a; Arzanlou et al., 2010; Chang et al., 2016; Alakonya et al., 2018; Crous et al., 2021). Some *Pseudocercospora* species also act as endophytes and saprobes (Chupp, 1954; van den Breeijen et al., 2006; Braun et al., 2013). Furthermore, certain *Pseudocercospora* species have significance in quarantine and biological control, such as *P. borreriae*, *P. fijiensis* and *P. palicoureae* (Pereira & Barreto, 2005, 2006; Churchill, 2011). During an investigation of fungi on pteridophytes, *Pseudocercospora* emerged as the third most species-rich fungal group associated with pteridophytes (Table 2.1). Additionally, the list and the key to the species of *Pseudocercospora* on ferns was provided by Braun et al. (2013), as well as the Tabular key to *Pseudocercospora* species on ferns. This study also provides an updated list of *Pseudocercospora* associated with ferns and their allies (Table 2.1).



Note a The type species of *Pseudocercospora vitis*, redrawn from Bakhshi et al. (2014). b–d Some examples of *Pseudocercospora* species associated with ferns, redrawn from Braun et al. (2013)). b *Pseudocercospora abacopteridicola* on *Abacopteris urophylla.* c *Pseudocercospora adianti* on *Adiantum tetraphyllum.* d *Pseudocercospora lygodii* on *Lygodium japonicum*. Scale bars: = 10 µm

Figure 2.38 *Pseudocercospora* species

Taphrina Fr., Syst. mycol. 3(2): 520 (1832)

Index Fungorum number: IF5354; 28 species including three unidentified species associated with pteridophytes; Figure 2.39

Type species: *Taphrina populina* Fr.

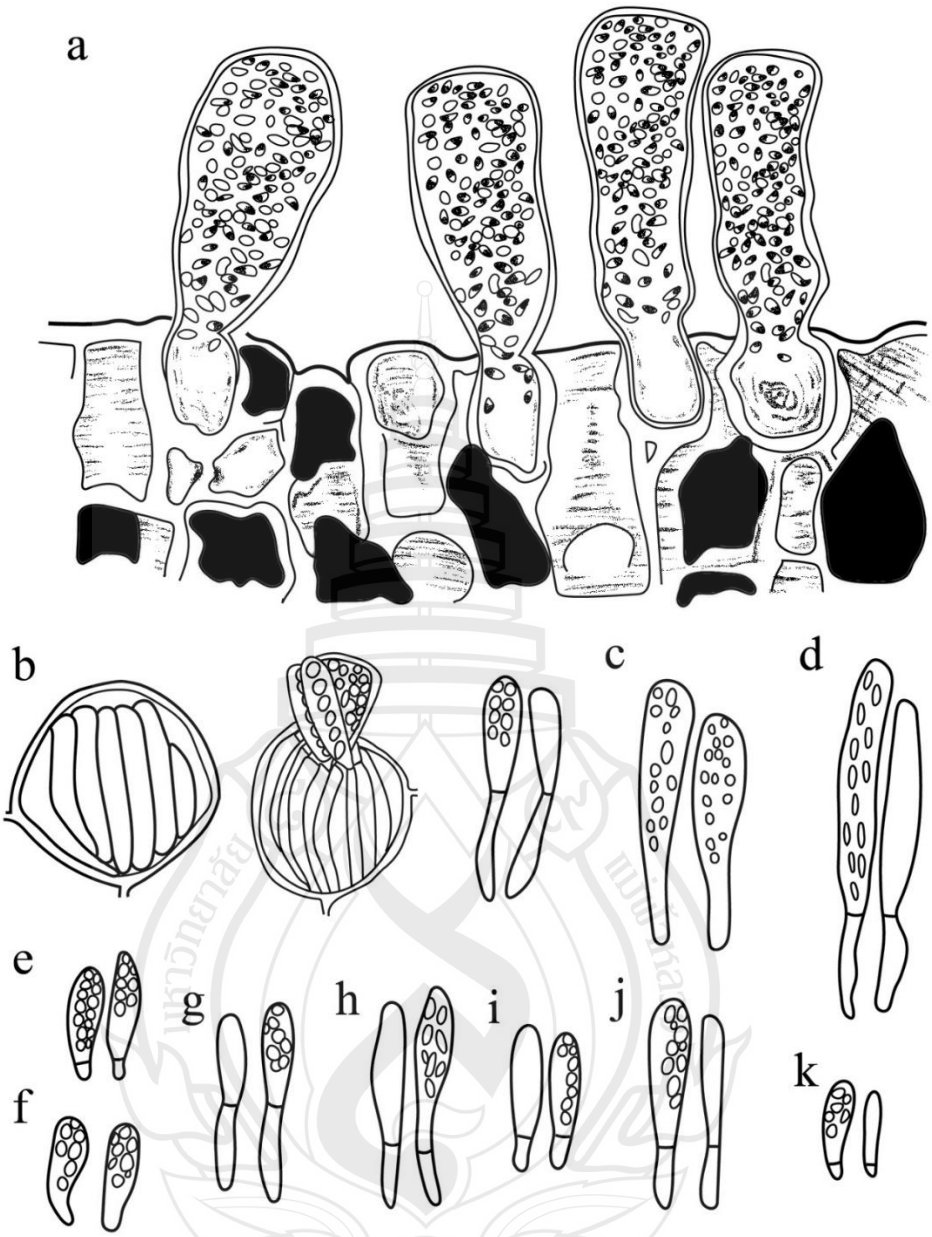
≡ *Erineum aureum* Pers.

Notes: *Taphrina* was described by Fries (1832) (fide. in Mix, 1949) to accommodate the teleomorphic yeast state of *T. populina*. The first monograph for this genus was provided by Sadebeck (1893), discussing the differences among these three closely related genera (*Exoascus*, *Magnusiella*, and *Taphrina*) in Taphrinaceae. The most recent monograph of *Taphrina* was provided by Mix (1949), which accepted the single genus *Taphrina* in Taphrinaceae (Taphrinales, Taphrinomycetes, Ascomycota) (Kramer, 1987; Wijayawardene et al., 2022; Hyde et al., 2024c). Additionally, the phylogenetic relationships of *Taphrina* were confirmed based on the DNA sequence data of SSU, LSU (26S) and ITS (Nishida & Sugiyama, 1993; Sjamsuridzal et al., 1997; Bacigálová et al., 2003; Petrýdesova et al., 2013).

All the species of *Taphrina* exhibit dimorphic states, including a parasitic, filamentous sexual states and a saprobic, yeast-like asexual states. The sexual morph is characterized by phytoparasitic, filamentous, strictly biotrophic, forming dikaryotic mycelium and asci with ascospores in infected tissue, resulting in hypertrophy or typical morphological changes in host plant tissue (Mix, 1938, 1939; Bacigálová, 1994, 2003; Petrýdesova et al., 2013, 2016). The yeast-like asexual morph is a saprobic yeast state produced by germinating ascospores, colonizing both organic and inorganic substrates, and usually colonizes organic and inorganic substrates even in the absence of a potential hosts (Mix, 1949; Gjaerum, 1964; Rodrigues & Fonseca, 2003; Fonseca & Rodrigues, 2011; Petrýdesova et al., 2013, 2016). The traits of the parasitic stage (sexual morph) of *Taphrina* species, including host symptoms and anatomical and morphological characteristics of the sexual stage in infected tissues, are important for species identification, while the yeast-like asexual form is used for preservation and study as

all *Taphrina* species can be cultivated in vitro on artificial yeast media (Mix, 1949, 1954c; Bacigálová, 1994; Rodrigues & Fonseca, 2003; Inácio et al., 2004; Fonseca & Rodrigues, 2011; Petrýdesova et al., 2013). Moreover, biochemical, morphological and physiological characteristics, as well as geographical distribution and molecular data, are pivotal factors for the recognition of *Taphrina* species (Mix, 1938, 1949; Gjaerum, 1964; Prillinger et al., 2000; Rodrigues & Fonseca, 2003).

Currently, 189 epithets are listed under *Taphrina* in Index Fungorum (August, 2024), while approximately 95 species are accepted (Bacigálová et al., 2003; Wijayawardene et al., 2022). These species are known for their plant pathogenicity, causing specific infections in various vascular plants, including ferns and higher plants. The associated symptoms include “leaf curl”, “witches’ brooms”, tongue-like outgrowths from female catkins, spots on leaves or deformed fruits (Sydow et al., 1911; Mix, 1938, 1949, 1954c; Bacigálová et al., 2003; Petrýdesova et al., 2013). Notably, *Taphrina* is speculated to represent early divergence of higher fungi (Nishida & Sugiyama, 1993). Most previous research has focused on the diseases affecting economically important fruit trees such as peach, plum, and cherry (Selbmann et al., 2014). However, there is an increasing need to pay more attention to fern hosts associated with *Taphrina* species (Kirschner et al., 2019; Mix, 1938). A report detailing the known species of *Taphrina* on North American ferns was provided (Mix, 1938), including detailed descriptions, host infection characteristics, and distribution of each species. Further study of ferns and their related fungi is anticipated to yield interesting findings, as they are closely related to the early evolution of fungi (Guatimosim et al., 2016b; Hudson et al., 2019).



Note a The type species *Taphrina populina*; b–k Some examples of *Taphrina* species found on ferns. b Ascogenous cells, asci in epidermal locules of host and asci of *Taphrina californica*. c–k Asci of *Taphrina lutescens*, *T. faulliana*, *T. hiratsukae*, *T. filicina*, *T. fusca*, *T. gracilis T. cystopteridis*, *T. polyspora*, *T. struthiopteridis*. Redrawn from the website of Alamy, and Mix (1938).

Figure 2.39 *Taphrina* species on ferns

Uredinopsis Magnus, Atti Congr. Bot. Intern. di Genova, 1892: 167 (1893)

Index Fungorum number: IF16378; 31 species including two unidentified species associated with pteridophytes; Figure 2.40

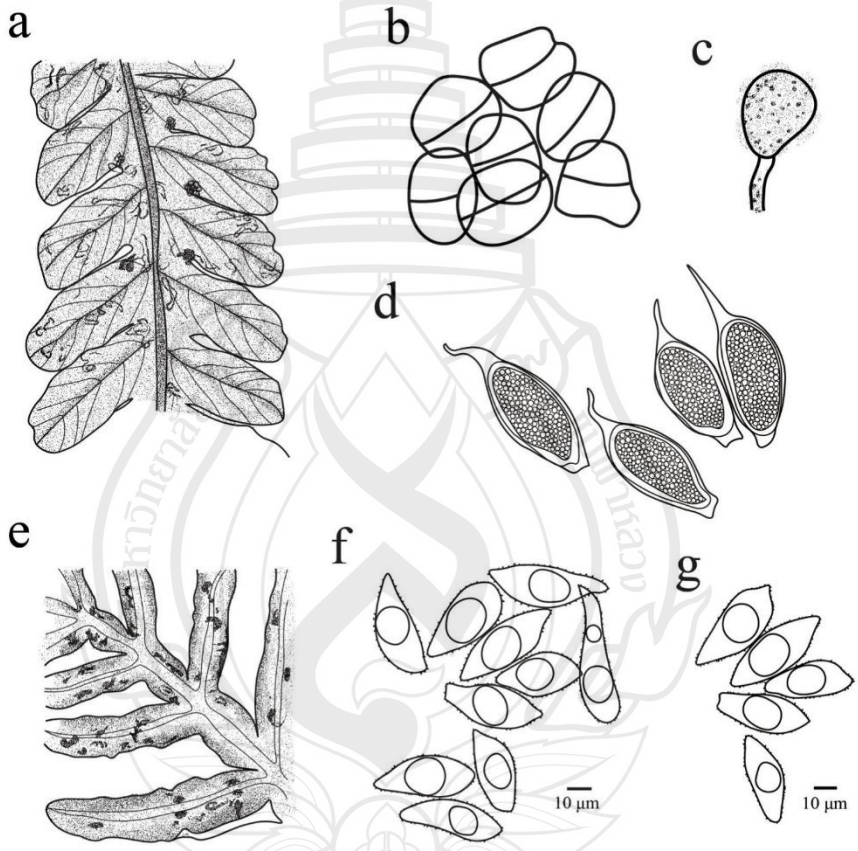
Type species: *Uredinopsis filicina* (Niessl) Magnus

≡ *Protomyces filicinus* Niessl

Notes: *Uredinopsis* was described by Muang (1893) based on *U. filicina* found on a fern host of *Phegopteris vulgaris*. *Uredinopsis* was traditionally located in Pucciniastraceae, Uredinales, Basidiomycetes (Bennell & Henderson, 1985; Helfer, 2006; Berndt, 2008), but it was re-assigned to Milesinaceae (Pucciniales, Pucciniomycetes, Basidiomycota) based on morphology, life cycle and molecular data of three concatenated loci of 28S, 18S, and *CO3* (Aime & McTaggart, 2021). The phylogenetic relationship demonstrates that *Uredinopsis* formed a well-supported clade and is closely related to *Milesina* (McTaggart et al., 2014; Ono et al., 2020). *Uredinopsis* was described as occurring solely on ferns, characterized by being heteroecious with *Abies* as alternate hosts, the presence of teliospores formed inside host epidermal cells and smooth or with a few lines of cog-like warts, more or less lanceolate, ellipsoid, clavate or subfusiform urediniospores, usually with a longitudinal band of warts and a generally smooth surface (Fraser, 1914; Bell, 1924; Faull, 1938a, 1938b; Helfer, 2006; Berndt, 2008). *Uredinopsis* differs from the similar *Milesina* (both called fir-fern rust) in having more or less lanceolate urediniospores, while *Milesina* presents echinulate or verrucose urediniospores usually, without pigment produced in cytoplasm (Helfer, 2006). Additionally, a monograph was provided by Faull (1938b), and a more recent overview of *Uredinopsis* species was provided by Hiratsuka (1958b), as well as its closely related genera, *Hyalopsora* and *Milesina*.

*Uredinopsis*is one of the most common genera of fir-fern rust fungi known to parasitize ferns, particularly Aspidiales (Bennell & Henderson, 1985), casing disease characterized by the appearance of yellowish spots or blotches on the upper side of infected needles, which later become necrotic and are typically confined by veins (Bell,

1924; Faull, 1938a, 1938b; Kuprevich & Transchel, 1957; Ziller, 1959). The alternate stages (aecial stage) of these members occur exclusively on the needles of the conifer genus *Abies* (Fraser, 1912; Bennell & Henderson, 1985). *Uredinopsis* is also an ancient genus with a cosmopolitan distribution (Berndt, 2008; McTaggart et al., 2014), with no new species have been discovered in the last 60 years (Index Fungroum August 2024), likely due to the neglect of fern fungi and the insignificance of rust fungi (Bennell & Henderson, 1985; Berndt, 2008).



Note a–d Type species of *Uredinopsis filicina*, redrawn from the website of iNaturalist Ecuador (https://ecuador.inaturalist.org/) and Ellis (2001–2024) e–g *Uredinopsis pteridis*, redrawn from McTaggart et al. (2014). a Abaxial leaf symptoms. b Teliospores. c, d Two types of urediniospores. e Abaxial leaf symptoms. f, g Urediniospores.

Figure 2.40 Two *Uredinopsis* species on ferns

Uredo Pers., Syn. meth. fung. (Göttingen) 1: 214 (1801)

Index Fungorum number: IF92327; 19 species including two unidentified species associated with pteridophytes; Figure 2.41

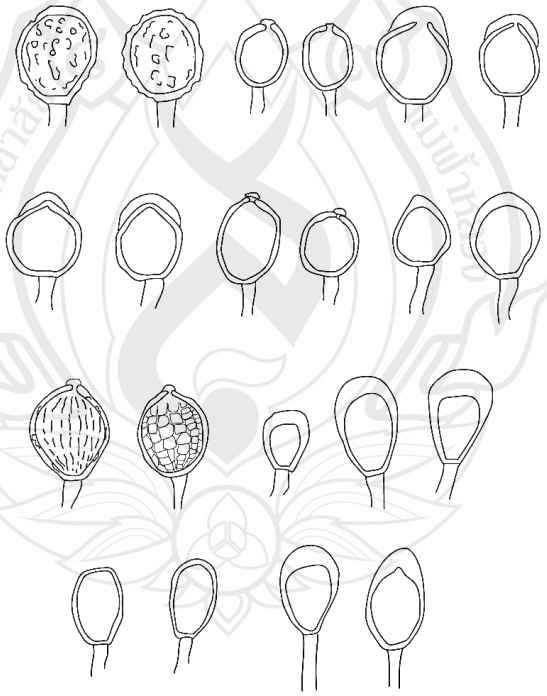
Type species: *Uredo betae* Pers.

Notes: *Uredo* was described by Persoon (1794) to accommodate three species, namely *U. betae*, *U. euphorbiae-helioscopiae* and *U. fabae*. Later, *Uredo* was validly established by Persoon (1801) without designing the type species, and accepted 30 species. *Uredo betae*, *U. euphorbiae-helioscopiae* and *U. fabae* have all been the lectotype of *Uredo* (Laundon, 1965, 1967; Hennen et al., 2005). The history of the typification was reviewed by Laundon (1970), who proposed *U. betae* as the type species of *Uredo*.

The generic name *Uredo* was established and used for uredinial anamorphs of rust fungi belonging to many families, such as Melampsoraceae and Pucciniaceae (Simpson et al., 2006; Aime et al., 2018). Many members of the asexual genus *Uredo* have subsequently been shown to link with various asexual genera and have been reduced to synonymy, such as *Anthracoidea*, *Mycosarcoma*, *Ustilago* and *Tilletia* (Aime et al., 2018; Aime & McTaggart, 2021). The phylogenetic affinity of this genus is uncertain, and, for a time, it was considered as Pucciniales *incertae sedis* in Pucciniomycetes (Aime et al., 2018; He et al., 2019). Aime et al. (2018) recommended using the generic name *Uromyces* instead of *Uredo* due to its problematic phylogenetic affinity and the common usage of the generic name "*Uromyces*". However, this conclusion was not universally accepted (He et al., 2019; Berndt, 2020). In more recent studies, *Uredo myricae* sp. nov. was found on *Myrica* sp. (Myricaceae) in the South African Cape region (Berndt, 2020), and *Uredo longa* was described as new to science by Zhuang et al. (2021). Furthermore, Cummins and Hiratsuka (2003b) emphasized the general usage of the anamorph genus *Uredo*, strictly defining it as a morphological concept, rather than by its position as aecium or uredinium in its life cycle. We keep this processing status with using the name *Uredo* following recent studies due to the

lack of systematic research on a large number of *Uredo* species, which are located in several different families. Direct synonymization with *Uromyces* would cause even greater confusion.

Uredo is a group of rust fungi characterized by asexual morph that is biotrophic on various plants, with obovoid, ellipsoid, triangular-obovate, or amorphous urediniospores with obscure or distinct germ pores, and hyaline to golden to yellow brown spore wall (Cummins & Hiratsuka, 2003; Simpson et al., 2006; Salazar-Yepes & Buriticá Céspedes, 2008; Berndt, 2009; de Carvalho Jr & Hennen, 2010; Berndt & Wood, 2012; Aime et al., 2018). There are 19 *Uredo* species including two unidentified species associated with pteridophytes, belonging to 11 families of pteridophytes, and a worldwide distribution (Table 2.1). Further study is needed to determine the natural classification of these *Uredo* species (Aime et al., 2018; Aime & McTaggart, 2021)



Note Redrawn from the website https://luirig.altervista.org/pics/display.php?pos=77211

Figure 2.41 The development of teliospores of *Uredo betae*

2.5 Conclusion and Discussion

It covers two main components, offering a detailed checklist of fungi occurring on pteridophytes worldwide and their classification. These species are total 1,648 fungal species, including 348 undetermined species, belonging to 611 genera, 240 families, 100 orders, 34 classes, and 11 phyla. Additionally, it provides notes and re-drawn photo plates for selected fungal genera, showcasing host-specificity at the genus level and the highest occurrence frequencies of fungal genera. These two major fungal groups: (1) 36 genera with likely fern host-specificity (*Asterocalycella*, *Carrismyces*, *Completoria*, *Dangeardiella*, *Desmella*, *Equiseticola*, *Exoteliospora*, *Griggsia*, *Hyalopsora*, *Hysteropeltella*, *Lachnopsis*, *Massalongina*, *Melaniella*, *Milesina*, *Mixia*, *Nothodactylaria*, *Ophiodiaporthe*, *Paratrimmatostroma*, *Phacidina*, *Placothyrium*, *Platycarpa*, *Pleurothyrium*, *Poculopsis*, *Polycladium*, *Polycyclina*, *Polycyclus*, *Ptechetelium*, *Radiciseta*, *Repetobasidiellum*, *Rhagadolobiopsis*, *Rommelaarsia*, *Scolecoleotia*, *Uncol*, *Uredinopsis*, *Woldmaria* and *Zymochalara*), and (2) 10 genera with most species reported on ferns (*Cercospora*, *Hyalopsora*, *Lachnum*, *Milesina*, *Phaeosphaeria*, *Pseudocercospora*, *Ramularia*, *Taphrina*, *Uredinopsis* and *Uredo*) are discussed, providing generic notes and re-drawn photo plates.

The organization of fungal data related to pteridophytes has significant importance. Firstly, the checklist reveals the diversity of fungi on ferns and their allies, providing foundational data for future ecological and evolutionary studies. Secondly, these selected groups are prioritized for further research to enhance our understanding of their biology, ecology, and evolutionary relationships. Furthermore, these findings of dominant pathogens can led to applications in biological control and plant health (Hutchinson, 1976; Fisher & Petrini, 1992).

CHAPTER 3

MORPHO-MOLECULAR SYSTEMATICS OF SAPROBIC FUNGI ASSOCIATED WITH PTERIDOPHYTE IN SOUTHWESTERN CHINA

3.1 Introduction

Describing the world's mycota is a priority for mycologists in order to provide accurate estimates of fungal numbers (Guatimosim et al., 2014a; Hawksworth & Lucking, 2017; Hyde et al., 2024a, 2024b). A widely recognized strategy to enhance our understanding of the diversity of undiscovered fungal taxa involves studying their associations with specific plant taxa or groups that are not well-studied (Rocha et al., 2010; Hyde et al., 2020a, 2024a, 2024b). An example of a poorly studied niche is the fungi of pteridophytes (Guatimosim et al., 2014a). Although the fungi on pteridophytes have been known for over a century (Fries, 1823), they have received limited attention due to the long-standing perception of pteridophytes' limited economic importance (Guatimosim et al., 2014a, 2016a, 2016b). However, pteridophytes, as the only non-flowering primitive vascular plant group, are the oldest vascular plants, offering unique insights into plant evolution (Guatimosim et al., 2016a; Mehltreter et al., 2010; Pounraj, 2019). Their associated fungi are believed to have aided the transition of plants from aquatic to terrestrial environments, suggesting that the relationship between pteridophytes and fungi may represent the earliest symbiotic relationship between fungi and land plants (Remy et al., 1994; Taylor et al., 1995; Strullu-Derrien & Strullu, 2007).

Therefore, understanding the nature and biology of fungal associations in extant ferns may reveal the evolutionary history of plant-fungus symbiosis and mutual dependence during terrestrial adaptation (Bonfante & Genre, 2008; Pressel et al., 2016). This knowledge is crucial for a comprehensive understanding of fungi and fungal symbiosis evolution (Pressel et al., 2016; Guatimosim et al., 2016a).

Fungi associated with ferns have historically been overlooked and have received insufficient research attention, despite being an immensely promising and diverse group (Kirschner & Liu, 2014; Kirschner et al., 2019; Medel-Ortiz et al., 2020). Recent studies have provided evidence supporting this perspective, with many new species of fern-associated fungi being discovered (Guatimosim et al., 2016a; Guatimosim et al., 2016b; Li et al., 2023a; Wu & Diao, 2023; Zhang et al., 2023b). China has the highest fern species, with about 2,130 species, accounting for 19% of the total global fern and fern-allies species (Lin et al., 2013; Zhou et al., 2016). Notably, the Yunnan region houses approximately 1,500 fern species, while Guizhou has about 800, ranking them as the first and third most diverse regions for fern species in China (Li et al., 2015; Zhou et al., 2016). These regions boast abundant and diverse fern resources, offering great potential for the discovery of even more interesting fungi (Zhang et al., 2023b; Hyde et al., 2024a; Phookamsak et al., 2024). One obvious research gap is the large number of new fern-related fungal discoveries waiting to be documented.

In recent years, the application of molecular clock methods for estimating divergence time has been recommended to serve as an additional criterion for high-level classification, offering objective evidence for recognizing higher taxa and developing more natural groupings within ranks (Beimforde et al., 2014; Samarakoon et al., 2016a, 2016b; Hyde et al., 2017; Hongsanan et al., 2017). Evolutionary time estimation has been widely applied in studies of Pleosporales. For example, Liu et al. (2018a), Zhang et al. (2019) and Bhunjun et al. (2021) established new pleosporalean families —Lentimurisporaceae, Striatiguttulaceae and Anastomitrabeculiaceae, respectively —by integrating morphology, phylogeny and divergence time estimates.

Hongsanan et al. (2020a) employed molecular clock analyses to estimate that Pleosporales diverged at approximately 205 MYA (stem age), while Muyocopronales showed a crown age of 103 MYA and a stem age dating back to about 171 MYA during the Jurassic period (Mapook et al., 2016a; Hongsanan et al., 2020a;). Furthermore, there have been some outstanding research achievements for fungal taxonomy in Ascomycota using estimating divergence times that usually used as a guide to determine the higher ranks of fungi (Hyde et al., 2017; Liu et al., 2017). The recommendations for ranking families would correspond to stem age of 50–150 MYA (Hyde et al., 2017) and crown age of 20–100 MYA (Liu et al., 2017).

In this study, we investigated the diversity of fungi on pteridophytes in Southwestern China, including Guizhou and Yunnan Province, obtaining 111 fresh collections. Based on evidence from phylogeny, morphology and a molecular clock analysis, these 111 new collections representing 59 fungal species found on in Guizhou Province, China, have been identified, with introducing one new family, six new genera, 38 new species, five new combinations and 21 new records.

3.2 Materials and Methods

3.2.1 Collection, Examination, and Isolation of Fungi

The new collections in this study focused on pteridophytes (dead tissues of pteridophytes) in Guizhou and Yunnan Province, China, from 2019 to 2022. The collected specimens were packed into plastic bags for transportation to the laboratory, and associated metadata (i.e., date, locality, and host) were recorded (Rathnayaka et al., 2024). Macromorphological characters such as fruiting bodies were observed using a stereomicroscope (SMZ168-BL, Motic, China). Micro-morphological characteristics were examined with hand-sectioned structures and photographed using an ECLIPSE Ni-U compound microscope (Nikon, Japan) fitted with an EOS 90D digital camera (Canon, Japan). Tarosoft (R) Image Frame Work program was used for measuring, and

photographs were processed and combined with Adobe Photoshop CC 2019 (Adobe Systems, San Jose, USA) software.

Single spore isolations were carried out onto fresh water agar (WA; 16 g/L distilled water) or potato dextrose agar (PDA; 39 g/L distilled water, Difco potato dextrose) and germinated conidia were transferred onto PDA to get axenic cultures following the method in Chomnunti et al. (2014). Pure culture plates were incubated at 25°C for 3–8 weeks. The herbarium specimens (dry plant tissues with fungal material) were deposited at the herbarium of Kunming Institute of Botany, Academia Sinica (HKAS), Chinese Academy of Sciences, Kunming, China, and the herbarium of Guizhou Academy of Agricultural Sciences (GZAAS), Guiyang, China. Pure living cultures were deposited in the Kunming Institute of Botany Culture Collection (KUNCC), Kunming, China and the Guizhou Culture Collection, China (GZCC). New taxa were linked with Facesoffungi and Index Fungorum numbers, as guided by Jayasiri et al. (2015) and Index Fungorum (http://www.indexfungorum. org), respectively.

3.2.2 DNA extraction, PCR Amplification and Sequencing

Pure cultures were incubated on PDA media at 25°C for one month. Fresh fungal mycelia were scraped off using a sterilized toothpick and transferred to a 1.5 mL microcentrifuge tubes for genomic DNA extraction. Fungal genomic DNA was extracted from mycelia using the Biospin Fungus Genomic DNA Extraction Kit (BioFlux®, China) following the manufacturer's instructions. Polymerase chain reaction (PCR) was used to perform DNA amplification. The quality of the PCR products was checked on a 1% agarose gel electrophoresis stained with ethidium bromide. Purification and sequencing of PCR products were carried out with the primers mentioned above at Sangon Biotech (Shanghai, China).

3.2.3 Sequence Alignment and Phylogenetic Analyses

Forward and reverse sequence reads were assembled using SeqMan v. 7.0.0 (DNASTAR, Madison, WI). Consensus sequences were subjected to blastn search in NCBI GenBank (https://blast.ncbi.nlm.nih.gov/Blast.cgi) for selection of taxa for

subsequent phylogenetic analyses. Consequently, representative sequence data of each family from Pleosporales, Muyocopronales and several major related lineages, used for phylogenetic analyses in Dothideomycetes, were selected based on BLASTn searches, as well as recent publications (Zhang et al., 2019; Hongsanan et al., 2020, 2021). Sequences newly generated in this study were deposited in GenBank. Sequence alignments for different gene loci were performed using performed using the online multiple alignment programme MAFFT version 7.2 (https://mafft.cbrc.jp/alignment/server/; Katoh et al., 2019). Trimal v1.2 was used to remove ambiguously aligned regions and uninformative positions with "gt = 0.6" option (Capella-Gutiérrez et al., 2009). Sequences of each locus were combined to form a concatenated super matrix using SequenceMatrix 1.7.8 (Vaidya et al., 2011) and analysed with Maximum Likelihood (ML) and Bayesian Inference (BI) criteria.

Maximum Likelihood (ML) analysis was performed using IQ-TREE (Nguyen et al., 2015; Chernomor et al., 2016) under partitioned models. Substitution model was automatically tested. Ultrafast bootstrap (BS) analysis was implemented with 1,000 replicates. The BYPP analysis was performed using MrBayes v.3.2.7a via the CIPRES Science Gateway portal (Miller et al. 2010). The best-fit model of DNA evolution was determined by MrModeltest v. 2.3 (Nylander, 2004). Posterior probabilities (PPs) were determined by Bayesian Markov Chain Monte Carlo (BMCMC) sampling (Rannala & Yang, 1996; Huelsenbeck, 2001). Four simultaneous Markov Chains were run for 1 billion generations, and trees were sampled every 1,000 generation (resulting in 100,000 trees). The first 20,000 trees representing the burn-in phase of the analyses were discarded and the remaining 80,000 (post-burning) trees used for calculating posterior probabilities (PP) in the majority rule consensus tree (Larget & Simon, 1999).

Phylogenetic tree was visualized using FigTree v.1.4.4 (Rambaut et al., 2014), and the layouts were reorganized in website followed the methods described in Xie et al. (2023) and finalized with Adobe Illustrator CS6 (Adobe Systems, USA).

3.2.4 Fossil Calibrations and Divergence Times Estimates

This study used one secondary and three fossil calibration for the divergence time estimates. The crown age of the Dothideomycetes was calibrated using the secondary calibration, normal distribution with mean = 290, SD = 30, and 97.5% of CI = 349 MYA following (Phukhamsakda et al., 2016; Zhang et al., 2019; Hongsanan et al., 2020b). The fossil *Margaretbarromyces dictyosporus* was used to calibrate the minimum crown age of *Aigialus* as 34 Mya using a gamma distribution, with an offset of 35 MYA, a shape (Alpha) of 1.0, scale (Beta) of 25, providing 95% credibility interval of 110 MYA (Mindell et al., 2007; Phukhamsakda et al., 2016; Liu et al., 2018; Samarakoon et al., 2019). The fossils, *Muyocopron mucoris* and *M. neyveliensis* were used to calibrate the minimum age of *Muyocopron*, with an offset of 54 MYA in a LogNormal distribution (Reddy et al., 1982; Mapook et al., 2016; Samarakoon et al., 2019). Whereas the fossil taxa *Phragmothyrites* sp. & *Microthyriacites* sp. were used to calibrate the minimum age of Microthyriales, with an offset of 145 MYA in a LogNormal distribution (Martınez, 1968; Samarakoon et al., 2019).

Divergence time estimates were carried out in using BEAST 2.7.5 (Bouckaert et al., 2019) following the methodology as described in Phukhamsakda et al. (2016). LSU, *RPB2*, SSU and *tef1-α* aligned sequences data partitions were prepared separately. Each data partition was loaded into BEAUti 2.7.5 to prepare the XML file (Drummond et al., 2012). Clock models and the tree prior parameters were set to be linked, while the substitution model was set to be unlinked. The GTR+I+G nucleotide substitution model was selected for LSU, *RPB2* and *tef1-α* partitions, and TrN+I+G model for SSU partition based on the results from jModelTest 2.1.6 (Darriba et al., 2012) via the CIPRES Science Gateway 3.3 (https://www.phylo.org/portal2/home.action, Miller et al., 2010). An optimised relaxed clock model was used for the analyses (Douglas et al., 2021). The Yule speciation process, which assumes a constant rate of speciation divergence, was used as the tree prior. The analysis was run in BEAST 2.7.5 for 300 million generations, and sampling parameters every 1,000 generations. Tracer v1.6

(Rambaut et al., 2014) was utilized to check the effective sample sizes (ESS), ensuring that all values were greater than 200 (Rambaut et al., 2014). The maximum clade credibility was annotated by TreeAnnotator v 2.6.2. and then visualized in FigTree v.1.4.4 (Rambaut et al., 2014).

3.3 Results

These newly obtained taxa in this study are organized according to the outline of Ascomycota (Wijayawardene et al., 2022; Hyde et al., 2024c) and updated based on recent relevant literatures. A total of 111 new collections are identified, representing 59 species distributed across four classes, 11 order, 22 families, and 39 genera within Ascomycota. The decision as to whether a species is novel, or a record is based on the guidelines of Jayawardena et al. (2021) and Maharachchikumbura et al. (2021). The checklist of species isolated in this study in detail is provided in this study (Table 3.1). In result, we introduced one new family Xenoberkleasmiaceae, six new genera, 38 new species and five new combinations.

Table 3.1 Fifty-nine species isolated and identified in this study

Classes	Order	Family	genera	Species	Hosts	Notes
Dothideomycetes	Capnodiales	Capnodiaceae	*Leptoxyphium*	*L. madagascariens*e	*Alsophila gigantea* (Cyatheaceae), *Pteris vittata* (Pteridaceae), *Woodwardia japonica* (Blechnaceae), *W. prolifera*	H, G
	Pleosporales	Corynesporascaceae	*Corynespora*	*C. septata*	Fern	N
		Dictyosporiaceae	*Dendryphiella*	*D. eucalyptorum*	*Neolepisorus ovatus* (Polypodiaceae)	H
			Dictyocheirospora	*D. guizhouensis*	*Blechnopsis orientalis* (*Blechnaceae*), *Sphaeropteris brunoniana* (Cyatheaceae)	N
				D. multiappendiculata	*Pronephrium penangianum* (Thelypteridaceae), Unidentified ferns	H, T
				D. rotunda	Athyriaceae sp., *Woodwardia unigemmata* (Blechnaceae)	H, T
			Dictyosporium	*D. duliujiangense*	*Plenasium Vachellii* (Osmundaceae), *Dryopteris championii* (Dryopteridaceae), *D. aemula* (Dryopteridaceae)	H, T
			Neodendryphiella	*N. tarraconensis*	Fern	H
			Pseudodictyosporium	*P. elegans*	*Microlepia marginata* (Dennstaedtiaceae)	H
			Vikalpa	*V. dujuanhuensis*	*Athyrium filix-femina* (Athyriaceae), *Pronephrium penangianum* (Thelypteridaceae), *P. longipetiolatum*, *Woodwardia unigemmata* (Blechnaceae)	H, T
		Hermatomycetaceae	*Hermatomyces*	*H. nabanheensis*	*Cyathea spinulosa* (Cyatheaceae)	H
		Lentimurisporaceae	*Synnematouspora*	*S. pronephria*	*Pronephrium penangianum* (Thelypteridaceae)	N
		Lophiostomataceae	*Crassiclypeus*	*C. appendiculatus*	*Pteris vittata* (Pteridaceae)	N

Table 3.1 (continued)

Classes	Order	Family	genera	Species	Hosts	Notes
		Melanommataceae	*Camposporium*	*C. pteridicola*	*Odontosoria chinensis* (Lindsaeaceae), *Pteris vittata* (Pteridaceae), unidentified fern	N
				C. ramosum	*Plenasium Vachellii* (Osmundaceae), *Woodwardia* sp. (Blechnaceae)	H
			Phragmocephala	*P. atra*	*Pteris vittata* (Pteridaceae), *Woodwardia unigemmata* (Blechnaceae)	H
				P. cyatheae	*Gymnosphaera* sp. (Cyatheaceae)	N
		Periconiaceae	*Periconia*	*P. cookei*	Athyriaceae sp., *Equisetum* sp. (Equisetaceae), *Pteridium revolutum* (Dennstaedtiaceae)	H
				P. pseudobyssoides	*Alsophila metteniana* (Cyatheaceae)	H
		Phaeoseptaceae	*Pleopunctum*	*P. ellipsoideum*	*Woodwardia* sp. (Blechnaceae), *Hicriopteris yunnanensis* (Gleicheniaceae)	H
		Phaeosphaeriaceae	*Equiseticola*	*E. guizhouensis*	*Equisetum ramosissimum* subsp. *debile* (Equisetaceae)	N
		Torulaceae	*Dendryphion*	*D. europaeum*	*Pteridium revolutum* (Dennstaedtiaceae)	H, G
			Neopodoconis	*N. colorata*	Fern	N
			Torula	*T. guizhouensis*	*Dryopteris erythrosora* (Dryopteridaceae), *Woodwardia unigemmata* (Blechnaceae)	N
				T. woodwardiae	*Woodwardia unigemmata* (Blechnaceae), and unidentified fern	N
		Xenoberkleasmiaceae	*Xenoberkleasmium*	*X. mium pandani*	*Blechnopsis orientalis* (Blechnaceae), *Woodwardia japonica* (Blechnaceae)	H, T

Table 3.1 (continued)

Classes	Order	Family	genera	Species	Hosts	Notes
	Muyocopronales	Muyocopronaceae	*Cyatheomyces*	*C. synnematosa*	*Cyathea* spp. (Cyatheaceae)	N
			Pseudopalawanella	*P. woodwardiae*	*Woodwardia japonica* (Blechnaceae)	N
Pleosporales genera incertae sedis			*Microlepicola*	*M. guizhouensis*	*Microlepia marginata* (Dennstaedtiaceae)	N
			Xenopleopunctum	*X. guizhouensis*	Cyatheaceae sp.	N
				X. sporodochiale	*Woodwardia japonica* (Blechnaceae)	N
Eurotiomycetes	Chaetothyriales	Cyphellophoraceae	*Cyphellophora*	*C. alsophilae*	*Alsophila metteniana* (Cyatheaceae)	N
				C. guizhouensis	an unidentified fern, *Pronephrium penangianum* (Thelypteridaceae)	N
				C. multiseptata	*Blechnopsis* sp. (Blechnaceae)	N
		Herpotrichiellaceae	*Thysanorea*	*T. pronephrii*	*Pronephrium penangianum* (Thelypteridaceae)	N
				T. guttulata	*Microlepia marginata* (Dennstaedtiaceae)	N
				T. yunnanensis	Fern	H, T
Orbiliomycetes	Orbiliales	Orbiliaceae	*Arthrobotrys angiopteridis*	*A. angiopteridis*	*Angiopteris fokiensis* (Marattiaceae)	N
Sordariomycetes	Amphisphaeriales	Nothodactylariaceae	*Nothodactylaria*	*N. fusiformis*	*Blechnum orientale* (Blechnaceae)	N
				N. guizhouensis	*Pronephrium* sp. (Thelypteridaceae)	N
				N. polyblastis	*Alsophila podophylla* (Cyatheaceae)	N
				N. woodwardiae	*Blechnopsis orientalis* (Blechnaceae), *Woodwardia japonica* (Blechnaceae)	N
		Oxydothidaceae	*Oxydothis*	*O. woodwardiae*	*Woodwardia unigemmata* (Blechnaceae), *Woodwardia magnifica* (Blechnaceae)	N

Table 3.1 (continued)

Classes	Order	Family	genera	Species	Hosts	Notes
	Chaetosphaeriales	Chaetosphaeriaceae	*Codinaeella*	*C. lutea*	Fern	H
				C. plagiogyriae	*Plagiogyria euphlebia* (Plagiogyriaceae)	N
			Dictyochaeta	*D. diplopterygii*	*Diplopterygium chinense* (Gleicheniaceae)	N
			Tainosphaeria	*T. jonesii*	*Blechnopsis orientalis* (Blechnaceae)	H
	Glomerellales	Australiascaceae	*Monilochaetes*	*M. alsophilae*	*Alsophila spinulosa* (Cyatheaceae)	T
				M. guizhouensis	*Alsophila metteniana* (Cyatheaceae), *Alsophila spinulosa* (Cyatheaceae)	N
				M. pronephrii	*Pronephrium penangianum* (Thelypteridaceae)	N
				M. pteridophytophila	*Alsophila costularis* (*Cyatheaceae*)	N
	Hypocreales	Stachybotryaceae	*Achroiostachys*	*A. equiseti*	*Equisetum* sp. (Equisetaceae)	N
			Memnoniella	*M. discrete*	*Alsophila spinulosa* (Cyatheaceae) and *Pronephrium penangianum*（Thelypteridaceae)	N
				M. pteridophytorum	*Angiopteris fokiensis* (Marattiaceae), *Pronephrium penangianum* (Thelypteridaceae)	N
			Myxospora	*M. synnematosa*	Ferns	N
			Sirastachys	*S. longispora*	Ferns	H, G
	Myrmecridiales	Myrmecridiaceae	*Neomyrmecridium*	*N. pteridophytophilum*	Fern	N
	Sporidesmiales	Sporidesmiaceae	*Sporidesmium*	*S. diplazii*	*Diplazium dilatatum* (Athyriaceae)	N
				S. pronephrii	*Pronephrium penangianum* (Thelypteridaceae)	N

Note status: N denotes new species; H denotes new host record; T denotes new terrestrial habitat; G denotes new geographical record.

Ascomycota Caval.-Sm., Biol. Rev. 73: 247 (1998)

Dothideomycetes O.E. Erikss. & Winka, Myconet 1(1): 5 (1997)

Capnodiales Woron., Annls mycol. 23(1/2): 177 (1925)

Capnodiaceae Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 118: 1197 (1909)

Leptoxyphium Speg., Physis, Rev. Soc. Arg. Cienc. Nat. 4 (no. 17): 294 (1918)

Index Fungorum number: IF 8762; *Facesoffungi number*: FoF 06949; one species associated with pteridophytes newly described in this study; Figure 3.1

Notes: Spegazzini (1918) introduced the sooty mould genus *Leptoxyphium*, which falls within Capnodiaceae (Capnodiales, Dothideomycetes) (Chomnunti et al., 2011). *Leptoxyphium* is known by its asexual form, characterized by synnematous, brown conidiomata consisting of a compacted group of individual and fused hyphae, superficial and gregarious pycnidia with narrow bulbous bases and the cup-like apex, phialidic and acropleurogenous conidiogenesis, and ellipsoidal, slimy, hyaline conidia sometimes pigmented and guttulate when mature (Hughes, 1976; Cheewangkoon et al., 2009; Chomnunti et al., 2011; Yang et al., 2014; Li et al., 2020b). Currently, 20 species have been accepted within this genus, and they are distributed worldwide, including regions of Australia, China, India, Madagascar, Spain, and Thailand (Kajale et al., 2015; Abdollahzadeh et al., 2020; Li et al., 2020b). These species thrive as saprobes on sugary exudates produced by sap-feeding insects that grow on the surface of living leaves (Yang et al., 2014; Kajale et al., 2015; Li et al., 2020b). In this study, we isolated *L. madagascariense* from dead leaf axis of *Woodwardia japonica* (Blechnaceae) and the dead frond of *Pteris vittata* (Pteridaceae), marking the first evidence of *Leptoxyphium* species associated with pteridophytes.

Leptoxyphium madagascariense Cheew. & Crous, Persoonia 23: 67 (2009)

Index Fungorum number: IF513848; *Facesoffungi number*: FoF17022; Figure 3.2

Holotype: CBS H-20284

Saprobic on dead leaf axis of *Woodwardia japonica* (Blechnaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered, hairy, black, with a slimy mass at the apex of synnemata. *Mycelium* mostly immersed, composed of septate, unbranched, brown hyphae. *Pycnidiophores* 315–420 high ($\bar{x}$ = 366 μm, n = 10), 7.5–9(–11) μm ($\bar{x}$ =8.3 μm, n = 10) wide at the base, synnematous, superficial, erect, straight or slightly flexuous, arising from hyphal ropes, with slightly swollen stroma, consisting of numerous individual conidiophores, the apex expanding into a funnel shape, resembling a cupula, with flaring conidiogenous head, dark brown to brown towards apex. *Conidiophores* macronematous, erect, straight or slightly flexuous, arising from a compact basal, multiseptated, cylindrical thick-walled, consisting of several aggregated, synnematous hyphae that diverge close to the apex. *Conidiogenous cell* 1.8–2.5 μm ($\bar{x}$ = 2 μm, n = 10) wide, integrated, monophialidic, terminal, arising from the inner cell wall of the cupulate apex, subcylindrical to subulate, hyaline to light brown. *Conidia* (3.8–) 4–5.2 × 1.5–2.5 μm ($\bar{x}$ = 4.5 × 2 μm, n = 25), acrogenous, subcylindrical to ellipsoidal, straight, rounded at both ends, aseptate, hyaline.

Culture characteristics: Conidia germinating on WA within 13 h. Colonies growing on PDA under natural light, reaching 11 mm diameter in 28 days at 25℃, circular with entire margin, flat, dry, black from above and reverse, and not producing pigmentation in culture.

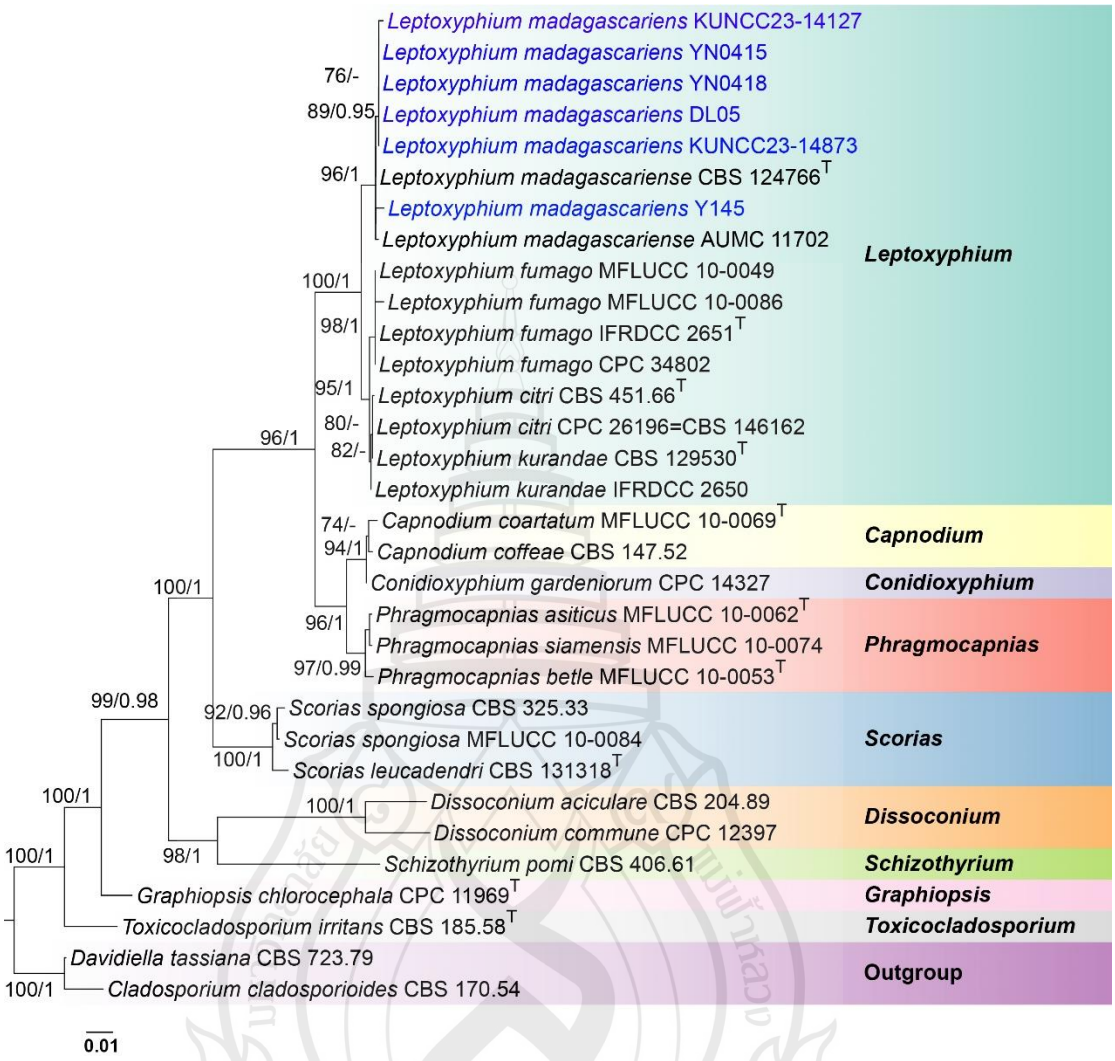
Material examined: CHINA, Guizhou Province, Tongren City, Jiangkou County, (27°46’38”N, 108°45’22”E), on dead leaf axis of *Woodwardia japonica* (Blechnaceae) in a forest near the roadside, 21 May 2022, J.Y. Zhang, F21 (HKAS 129704), living culture KUNCC 23–13873; *ibid*., Zunyi City, Chishui County, Hushi Town, on dead

frond of *Pteris vittata* (Pteridaceae), 13 April 2023, J.Y. Zhang, ZY57 (GZAAS 23–0821), living culture KUNCC 23–14127; CHINA, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, on dead rachis of *Woodwardia prolifera*, 16 November 2019, J.Y. Zhang, Y145; CHINA, Yunnan Province, Kunming City, on *Alsophila gigantea* (Cyatheaceae), 04 April 2022, R.J. Xu, YN0415; *ibid*., YN0418; CHINA, Yunnan Province, Dali City, on ferns, 12 April 2022, H.W. Shen, DL05.

Known hosts: *Eucalyptus camaldulensis* (Cheewangkoon et al., 2009); *Saccharum officinarum* (Abdel-Sater et al., 2018); *Alsophila gigantea*, *Woodwardia japonica*, *Woodwardia prolifera* and *Pteris vittata* (Pteridaceae) (This study).

Distribution: China (This study), Egypt (Abdel-Sater et al. 2018), Madagascar (Cheewangkoon et al., 2009).

Notes: Our new collections (HKAS 129704 and GZAAS 23–0821) are identified as *Leptoxyphium madagascariense* based on indistinguishable morphology and conspecific affiliation in phylogenetic analysis. *Leptoxyphium madagascariense* was described from *Eucalyptus camaldulensis* and *Saccharum officinarum* in Egypt and Madagascar (Cheewangkoon et al., 2009; Abdel-Sater et al., 2018). Therefore, our new collections are new geographical record of *L. madagascariense*, which are also new to their host of ferns.



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS and SSU sequence data. The tree was rooted to *Dissoconium aciculare* (CBS 204.89) and *D. commune* (CPC 12397). Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.1 Phylogenetic tree of *Leptoxyphium*

Note a Gregarious pycnidia on host surface. b Synema. c–f Brown stalked funnel cupulate apex. g, h Conidia. i Germinated conidium. j, k Colony on PDA from above and below. Scale bars: b = 50 µm, c–f = 20 µm, g–i = 5 µm

Figure 3.2 *Leptoxyphium madagascariense* (HKAS 12970)

Corynesporascaceae Sivan., Mycol. Res. 100(7): 786 (1996)

Corynespora Güssow, J. Royal Agric. Soc. England 65: 272 (1905)

Index Fungorum number: IF 7795; two species and one unidentified species associated with pteridophytes (including one newly described in this study).

Notes: *Corynespora* was established by Güssow (1905) with *C. mazei* Güssow as the type species. *Corynespora* was placed in Corynesporascaceae as the asexual morph associated with *Corynesporasca*, based on cultural studies (Sivanesan, 1996), although the latter is still accepted as a distinct genus in (Wijayawardene et al., 2022; Hyde et al., 2024b; Pem et al., 2024). Phylogenetic analyses demonstrated that *Corynespora* belongs to Corynesporascaceae, Pleosporales (Voglmayr & Jaklitsch, 2017; Hyde et al., 2024b; Thiyagaraja et al., 2024). The genus is characterized by a distinct conidiophores; integrated, terminal, monotretic, determinate, or percurrently extending conidiogenous cells; and acrogenous, solitary or catenate, distoseptate conidia (Sharma & Chaudhary, 2002; Pal et al., 2007; Voglmayr & Jaklitsch, 2017; Capital & Lao, 2020; Xu et al., 2020; Pem et al., 2024). Synopses of *Corynespora* species' characteristics have been provided by Siboe et al. (1999), Kumar et al. (2021) and Xu et al. (2020). Subsequently, Liu et al. (2023) provided the latest list of identified and accepted species of *Corynespora* with major morphological features, host information, and locality data. *Corynespora* species have a wide distribution and can be found as saprobes, pathogens, and endophytes on living leaves, or from decaying woody material of various plants, as well as on other fungi, nematodes, and human skin (Furukawa et al., 2008; Dixon et al., 2009; Kumar & Singh, 2016; Capital & Lao, 2020; Xu et al., 2020; Liu et al., 2022; Liu et al., 2023). Li et al. (2023) then introduced a new species, on branches of *Idesia polycarpa* from Sichuan Province, China. A total of 213 epithets were listed under *Corynespora* (http://www. indexfungorum.org, accessed 20, September 2024), with 129 species being accepted (Liu et al., 2023).

Corynespora septata J.Y. Zhang, Y.Z. Lu & K.D. Hyde, sp. nov.

Index Fungorum number: IF 902683; *Facesoffungi number*: FoF16619; Figure 3.3 and 3.4

Holotype: HKAS 129839

Etymology: Named after the presence of eu-septate conidia.

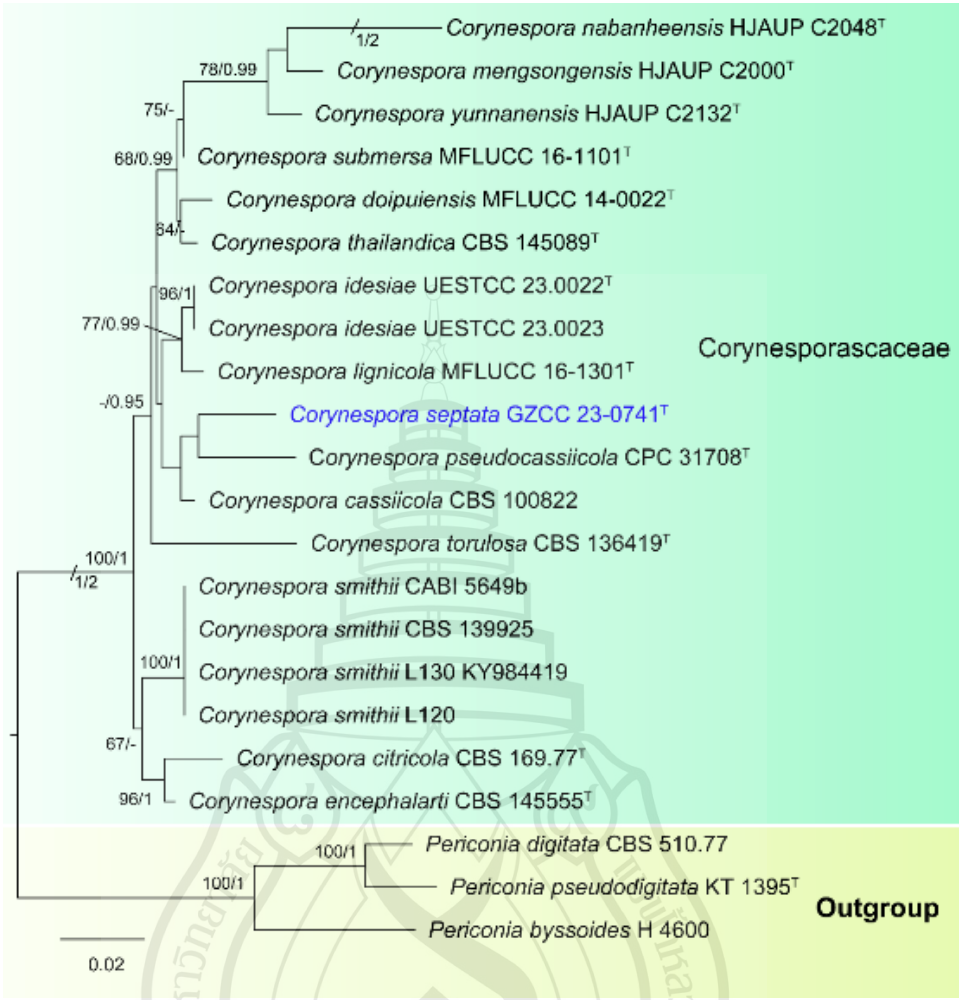
Saprobic on dead rachis of an unidentified fern in terrestrial habitat. ***Sexual morph*** undetermined. ***Asexual morph*** *Colonies* on natural substrate superficial, effuse, gregarious, hairy, brown to black. *Mycelium* partly superficial, partly immersed, composed of branched, septate, pale brown to brown, smooth-walled hyphae. *Conidiophores* 490–671 µm long, 3.5–6.5 µm wide at the base ($\bar{x}$ = 600 × 5 µm, n = 15), macronematous, mononematous, erect, straight or flexible, unbranched, or occasionally branched, septate, smooth, dark brown at the base, pale towards the apex. *Conidiogenous cells* 21–60 × 3–5.5 µm ($\bar{x}$ = 36.3 × 3.8 µm, n = 15), integrated, terminal, monotretic, cylindrical, smooth, pale brown to brown. *Conidia* 42–74 × 4.5–7.5 µm ($\bar{x}$ = 54 × 5.7 µm, n = 25), acrogenous, solitary, up to 7-distoseptate with one true septum, straight or slightly curved, subcylindrical to obclavate, rounded at the apex, base short obconically truncate, somewhat thickened and darkened, sometimes with percurrent proliferation which forms another conidium from the conidial apex, hyaline to pale brown.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from conidia. Colonies growing on PDA, reaching 55 mm diameter in 10 days at 26°C, circular, flat with entire margin, velvety, fluffy, white from above, reverse dark brown at center, paler to light yellow towards margin, and not producing pigmentation in culture.

Material examined: CHINA, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences (21°55’39”N, 101°15’15”E), on dead rachis of an unidentified fern, 16 November 2019, J.Y. Zhang, Y159 (HKAS 129839,

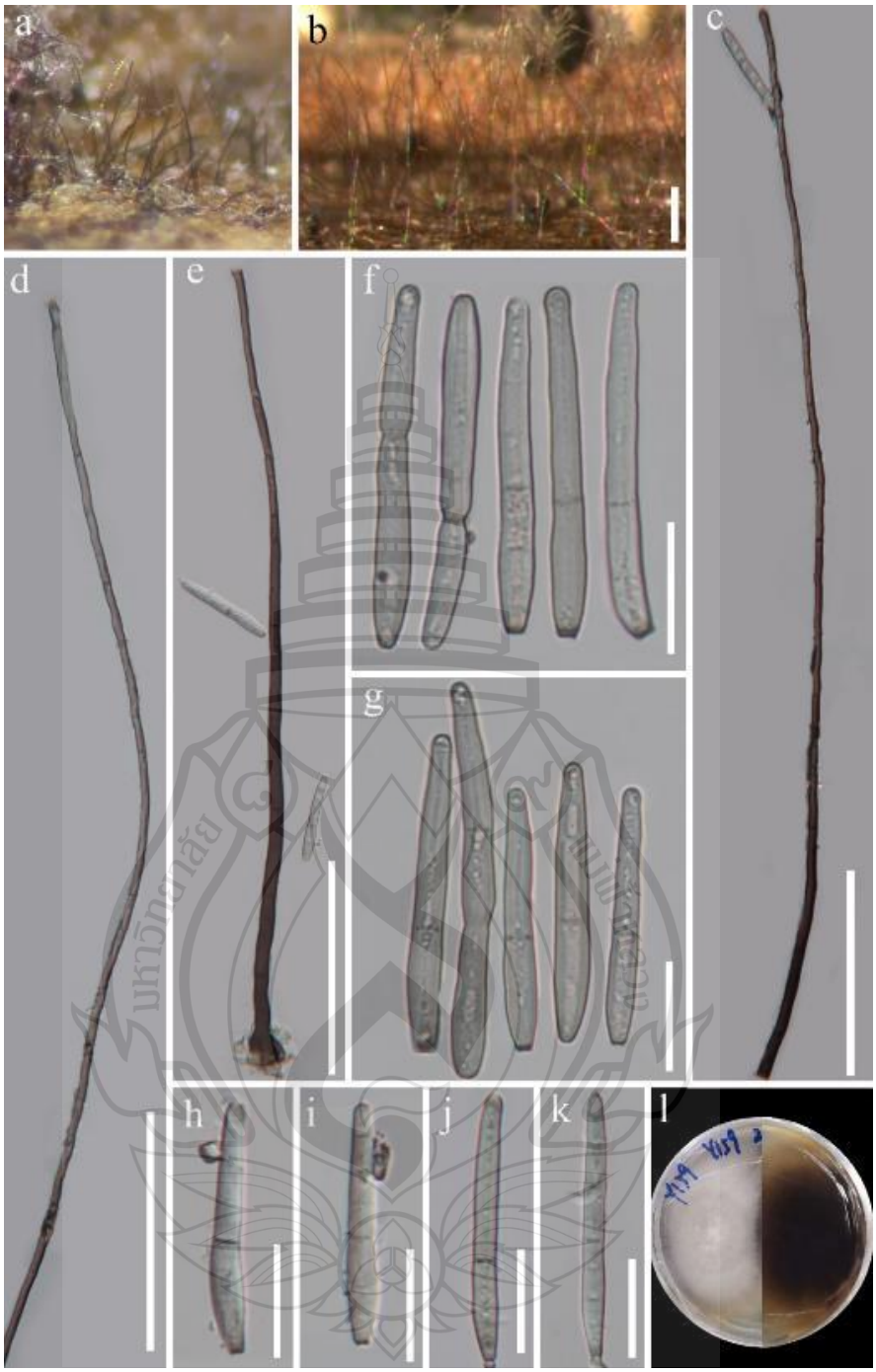
holotype; GZAAS 23–0769, isotype), ex-type living culture, GZCC 23–0741.

Notes: A BLASTn search in NCBI-GenBank revealed that the LSU and ITS sequences of our newly collected strain of *Corynespora septata* exhibited 99% similarity to *C. encephalarti* (NG_067878) and 95.62% similarity to *C. cassiicola* (MN648322), respectively. Phylogenetic analysis confirmed that *C. septata* formed a distinct clade within *Corynespora* and shared a sister relationship with *C. pseudocassiicola* Crous & M.J. Wingf. (Figure 3.2). There are 10 bp (10/841 bp without gap, 1%) and 38 bp (38/527 bp with 13 gaps, 7%) differences between the *C. pseudocassiicola* and *C. septata* in the LSU and ITS gene regions, respectively. Morphologically, *C. septata* has longer conidiophores (490–671 µm vs. 200–400 µm), and smaller conidia (42–74 × 4.5–7.5 µm vs. 95–160 × 9–10 µm) compared to *C. pseudocassiicola* (Crous et al. 2018). Similarly, *C. septata* is most similar to *C. lignicola* Z.L. Luo, H.Y. Su & K.D. Hyde in the shapes of conidiophores, conidiogenous cells, and conidia (Capital & Lao, 2020). However, *C. septata* differs from *C. lignicola* in having narrower conidiophores (3.5–6.5 µm vs. 9–13µm) and notably smaller conidia (42–74 × 4.5–7.5 µm vs. 110–156 × 7–9 µm).



Note Phylogram generated from maximum likelihood analysis based on combined LSU and ITS sequence data. Twenty-two taxa were included in the combined analyses, which comprised 1393 characters (LSU = 844 bp and ITS = 549 bp) after alignment. The best scoring RAxML tree with a final likelihood value of -4677.993509 is presented. Bootstrap support values for ML equal to or greater than 60% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP. The tree was rooted to *Periconia byssoides* (H 4600), *P. digitata* (CBS 510.77) and *P. pseudodigitata* (KT 1395). The strain numbers are noted after the species names with ex-type strains indicated by ^{T}. The newly generated sequences are indicated in blue.

Figure 3.3 Phylogenetic tree of *Corynespora*



Note a, b Colonies on the hostc–e Conidiophores with conidiogenous cells f–k Conidia l Pure culture from frontand reverse. Scale bar: b = 200 µm, c–e = 100 µm, f–k = 20 µm

Figure 3.4 *Corynespora septata* (HKAS 129839, holotype)

Dictyosporiaceae Boonmee & K.D. Hyde, Fungal Diversity: 80, 457–482 (2016); Figure 3.5

Dendryphiella Bubák & Ranoj., Annls mycol. 12(4): 417 (1914)

Index Fungorum number: IF7951; *Facesoffungi number*: FoF 08212; one species associated with pteridophytes newly described in this study.

Type species: *Dendryphiella interseminata* (Berk. & Ravenel) Bubák

≡ *Helminthosporium interseminatum* Berk. & Ravenel

Notes: Ranojevic (1914) introduced the genus *Dendryphiella* with *D. interseminata* as the type species. The genus was previously synonymized under *Dendryphion* and *Scolecobasidium* based on morphological characteristics (Hughes, 1953; Ellis, 1976). However, molecular data has confirmed that *Dendryphiella* represents a distinct genus within Dictyosporiaceae (Liu et al., 2017; Boonmee et al., 2016). *Dendryphiella* species areknown only from their asexual state, and are characterized by macronematous, pigmented conidiophores, polytretic, integrated conidiogenous cells with dark scarring on the nodose swellings, and acropleurogenous, solitary or catenate conidia (Rai & Kamal, 1986; Matsushima, 1971; Crous et al., 2014; Liu et al., 2017; Hyde et al., 2018a; Crous et al., 2019c). *Dendryphiella* process tretic conidiogenous cells, which distinguishes it from other asexual genera with blastic conidiogenous cells in Dictyosporiaceae. Currently, Index Fungorum lists 20 epithets under *Dendryphiella*, while only 16 species have been accepted (Liu et al., 2017; Hyde et al., 2018a; Iturrieta-González et al., 2018; Crous et al., 2019c; Ferreira & Barreto, 2019). Members of *Dendryphiella* are common saprobes found on various decaying herbaceous substrates from all over the world, with no records found on pteridophytes. In this study, we present a new host record of *Dendryphiella eucalyptorum*.

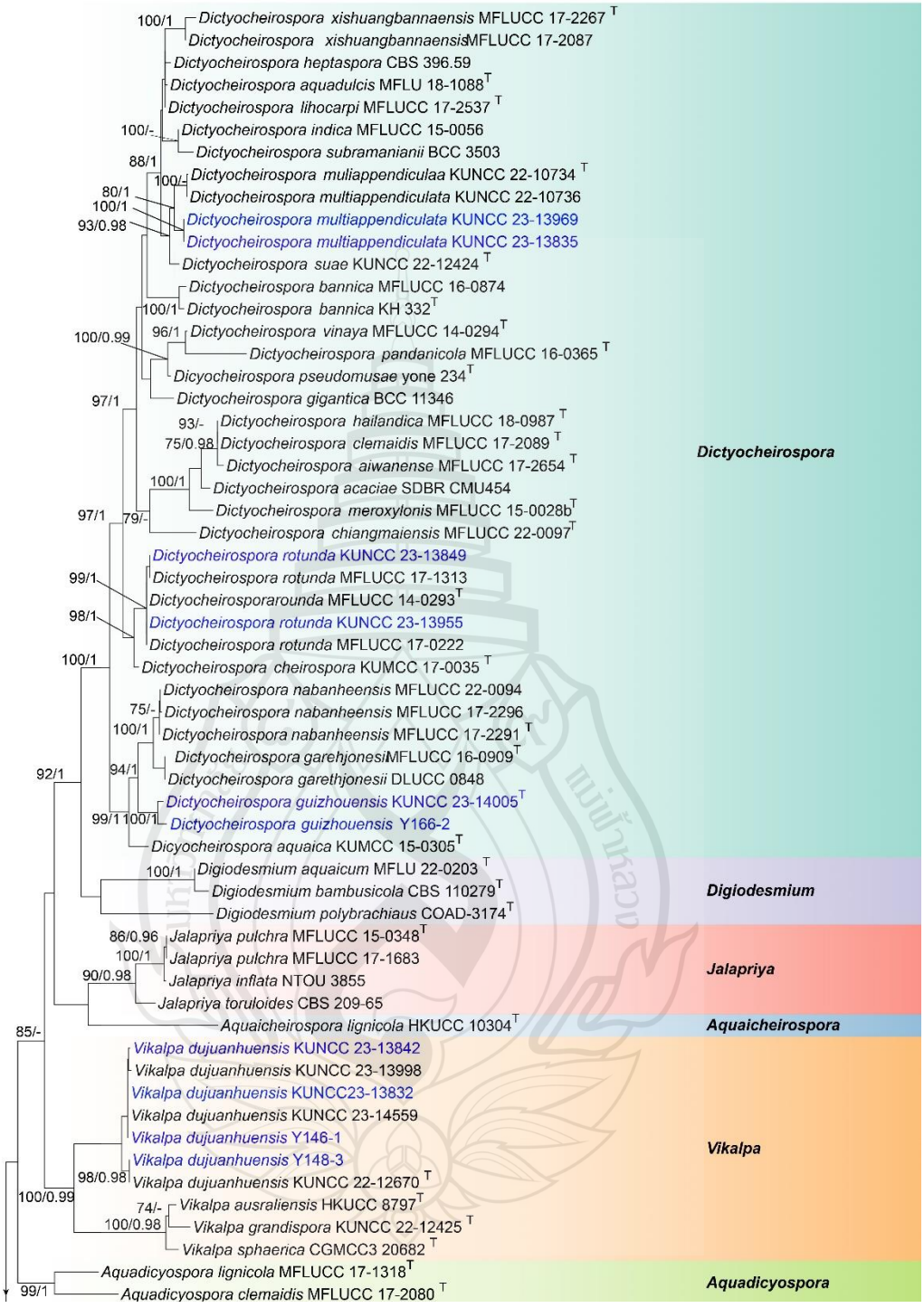
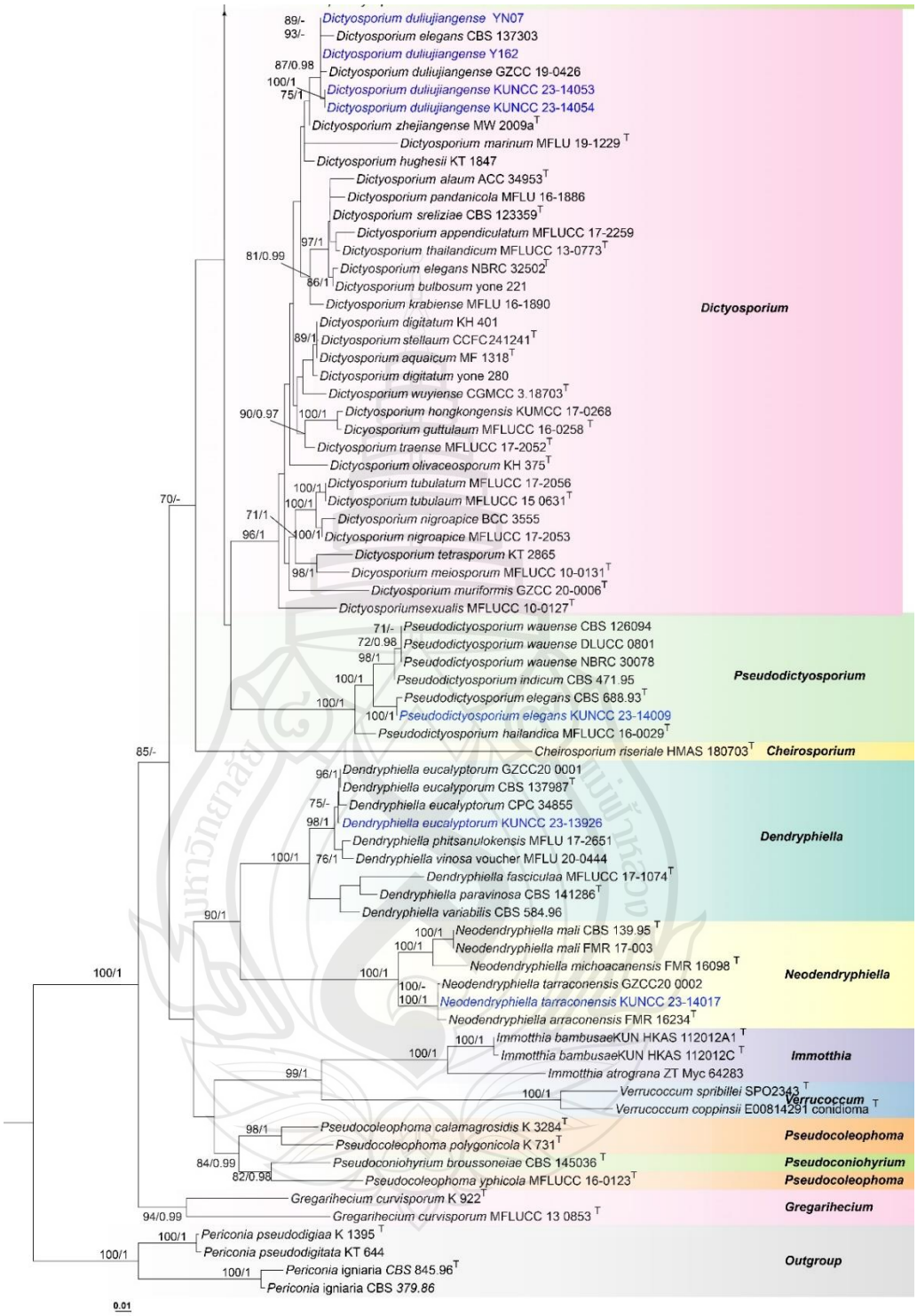


Figure 3.5 Phylogenetic tree of *Dictyosporiaceae*



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS and *tef1-α* sequence data. The tree was rooted to *Periconia pseudodigitata* (KT 644 and KT 1395).

Figure 3.5 (continued)

Note a Colonies on substrate. b–e Conidiophores with conidiogenous cells. f–h Conidiogenous loci. i–p Conidia. q Germinated conidium. r, s Colonies on PDA from above and below. Scale bars: b = 200 µm, c–e = 100 µm, f–q = 20 µm

Figure 3.6 *Dendryphiella eucalyptorum* (HKAS 129734)

Dendryphiella eucalyptorum Crous & E. Rubio, in Crous et al., Persoonia 32: 231 (2014)

Index Fungorum number: IF808918; *Facesoffungi number*: FoF 06712; Figure 3.6

Holotype: CBS H-21699

Saprobic on dead frond stalks of *Neolepisorus ovatus* (Polypodiaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, greyish-brown. *Mycelium* mostly immersed, composed of septate, hyaline hyphae. *Conidiophores* up to 615 µm long, 4–6.5 µm wide ($\bar{x}$ = 5.3 µm, n = 20) at the base, macronematous, mononematous, erect, single, straight or flexuous, unbranched or branched occasionally, 7–17-septate, brown or black at the base, paler towards the apex. *Conidiogenous cells* 24.5–52 × 3.7–6.5 µm ($\bar{x}$ = 33 × 5 µm, n = 20), polytretic, integrated, terminal and intercalary, proliferating asymmetrically, rough-wall, clavate, enlarged with conidiogenous loci at vertex, minutely verrucose, hyaline to pale brown. *Conidia* 24–32 × 5–7µm ($\bar{x}$ = 27.7 × 6 µm, n = 25), solitary to catenate, aseptate and pale brown when young, 1–3-septate and brown or dark brown when mature, sometimes slightly constricted at septa, fusiform to ellipsoidal, rounded at apex, occasionally guttulate when mature, rough-walled.

Culture characteristics: Conidia germinating on WA within 16 h and hyaline germ tube produced from both ends of conidia. Colonies growing on PDA at 25°C, reaching 26 mm in diameter in 14 days in natural light, circular, with entire margin, flat, fluffy, dense, velvety, gray-orange in the center, and pale yellow towards themargin from above; bright orange to white from center to edge in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Neolepisorus ovatus* (Polypodiaceae), 13 December 2021, J.Y. Zhang, J136 (HKAS 129734), living culture KUNCC 23–13926.

Known hosts: Decaying wood (Hyde et al., 2020c), *Eucalyptus globulus* (Myrtaceae) (Crous et al., 2014), *Neolepisorus ovatus* (Polypodiaceae) (this study), unidentified grass (Poaceae) (Crous et al., 2020b).

Distribution: China (Hyde et al., 2020c; this study), South Africa (Crous et al., 2020b), Spain (Crous et al., 2014).

Notes: *Dendryphiella eucalyptorum* was introduced by Crous et al. (2014), and has been found on various plant hosts in China, South Africa, and Spain (Crous et al., 2014, 2020b; Hyde et al., 2020c). Our collection closely resembles *Dendryphiella eucalyptorum* in the shape of conidiophores, conidiogenous cells and conidia, but differs from the holotype (CBS H-21699) in having longer conidiophores (up to 615 μm vs up to 500 μm) with more septa (7–17 vs 7–12), and large conidia [24–32 μm vs. (19–)20–23(–25) μm] (Crous et al., 2014). However, the ITS (Identities =547/549 bp without gap) and LSU (Identities = 820/821 bp without gap) regions exhibit no significant nucleotide differences. Therefore, we have identified this new collection as *D. eucalyptorum*. This represents a new host record of *D. eucalyptorum* found on *Neolepisorus ovatus* (Polypodiaceae) in a terrestrial habitat.

Dictyocheirospora M.J. D'souza, Boonmee & K.D. Hyde, Fungal Diversity 80: 465 (2016)

Index Fungorum number: IF551580; *Facesoffungi number*: FoF01261; 4 species associated with pteridophytes (including 3 species newly described in this study).

Type species: *Dictyocheirospora rotunda* M.J. D'souza, Bhat & K.D. Hyde

Notes: Based on phylogenetic analysis of ITS sequence data, *Dictyocheirospora* (Dictyosporiaceae, Pleosporales) was established to accommodate six species characterized by dark sporodochial colonies and aeroaquatic cheiroid, non-complanate or cylindrical conidia (Boonmee et al., 2016). An up-to-date synopsis of 24 known species of *Dictyocheirospora* was provided by Tennakoon et al. (2023). *Dictyocheirospora* members were collected from plant litter in terrestrial and aquatic habitats worldwide (Boonmee et al., 2016; Yang et al., 2018b; Dong et al., 2020; Shen

et al., 2022; Tennakoon et al., 2023). The only recorded hosts of *Dictyocheirospora* species related to pteridophytes was *Dictyocheirospora heptaspora,* which was found on *Angiopteris lygodiifolia* (Marattiaceae) in Taiwan Province, China (Matsushima 1980). In this study, one new species (*D. guizhouensis* sp. nov.) and two new host records of *Dictyocheirospora* species (*D. multiappendiculata* and *D. rotunda*) were isolated from ferns.

Dictyocheirospora guizhouensis J.Y. Zhang, K.D. Hyde & Y.Z. Lu, ***sp. nov.***

Index Fungorum number: IFxx; *Facesoffungi number*: FoF 17023; Figure 3.7

Etymology: The species epithet "*guizhouensis*" refers to the collecting site of this fungus.

Holotype: HKAS 129776

Saprobic on dead fronds of *Blechnopsis orientalis* (Blechnaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, sporodochial, punctiform, scattered, gregarious, dark brown. *Mycelium* mostly immersed, composed of septate, hyaline to pale brown hyphae. *Conidiophores* micronematous, mononematous, indistinct, hyaline, often reduced to conidiogenous cells. *Conidiogenous cells* (5.5–)6.5–11 × (3–)3.8–5.5 µm ($\bar{x}$ = 8.5 × 4 µm, n = 10), monoblastic, holoblastic, integrated, terminal, smooth, cylindrical, hyaline to pale brown. *Conidia* 29.5–40.5 × 14.5–20.5 (–27.5) µm ($\bar{x}$ = 36 × 17 µm, n = 22), acrogenous, solitary, cheiroid, not complanate, composed of 5–7 compact rows of arms of consisting of 7–10 cells, arising from a basal cell, euseptate, brown at the apex, paler towards base, medium brown, with subglobose or tubular, elongated appendages.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube attached with brown pigmentation produced from the base of conidia. Colonies growing on PDA, reaching 23 mm diameter in 10 days at 25°C, circular, flat, raised in the center, entire margin with thin mycelia, white in above; yellowish white with a yellowish to brown protuberance in the center in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of *Blechnopsis orientalis* (Blechnaceae) in a forest, 27 March 2022, J.Y. Zhang, J330 (HKAS 129776, holotype), ex-type living culture KUNCC 23–14005; CHINA, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, on dead rachis of *Sphaeropteris brunoniana*, 16 November 2019, J.Y. Zhang, Y166-2.

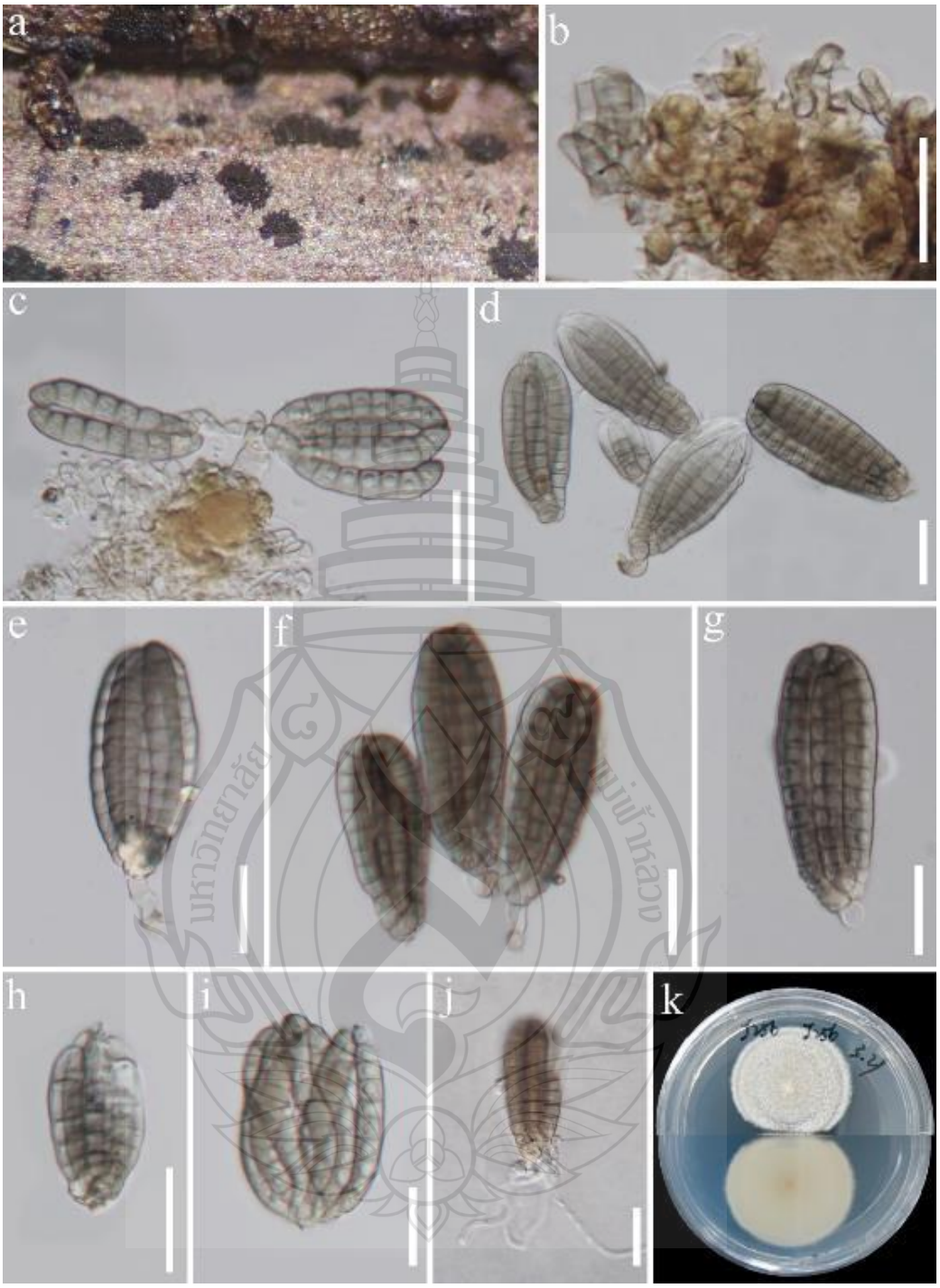
Notes: Phylogenetically, a new collection isolated from *Blechnopsis orientalis* (Blechnaceae) forms a distinct clade basal to *D. garethjonesii* and *D. nabanheensis* with 92% ML/0.98 PP support. Moreover, *Dictyocheirospora guizhouensis* (type material-KUNCC 23-14005) shows 14 bp (3%, including 1 gap) differences and 15 bp (3%, including 1 gaps) differences in ITS, 0 bp in LSU, and 25 bp (3%, without gap) differences and 29 bp (3%, without gap) differences in *tef1-α*, compared to the closest species *D. nabanheensis* (MFLUCC 17-2291) and *D. garethjonesii* (MFLUCC 16-0909), respectively. Morphologically, the new collection resembles *D. nabanheensis* in size, shape and color of conidia (Table 3.2). However, it differs from *D. nabanheensis* in having smaller conidiogenous cells [(5.5–)6.5–11 × (3–)3.8–5.5 μm vs. 9–20 × 5–7 μm], and different shape of appendages (subglobose or tubular, elongated appendages vs. rounded to cylindrical appendages) (Table 3.2). Thus, a new species, *Dictyocheirospora guizhouensis*, is introduced in this study.

Table 3.2 Comparison of morphological characteristics and habitats of *Dictyocheirospora nabanheensis, D. garethjonesii*, *D. aquatica* and *D. guizhouensis*

Species	Conidia Size (µm)	The cells numb. of each row	Appendages	Habitats	Conidial color	Conidial shapes	Reference
D. nabanheensis	35–40 × 18–21	6-10 cells	Rounded to cylindrica	Terrestrial, on *Pandanus* sp.	Pale brown to yellow brown	Cheiroid, compact to rows	Tibpromma et al. (2018)
D. garethjonesii	45.5–54.5 × 15.5–24.5	7-10 cells	No appendages	Freshwater, on submerged wood	Brown	Cheiroid, rows digitate	Wang et al. (2016)
D. aquatica	34–42 × 12.5–19.5	8–10 cells	No appendages	Freshwater, on submerged wood	Pale brown to brown	Cheiroid, rows palmately divergent	Wang et al. (2016)
D. guizhouensis.	29.5–40.5 × 14.5–20.5 (–27.5)	7–10 cells	Tubular to elongated appendages	Terrestrial, on ferns	Brown, paler towards base	Cheiroid, compact to rows	This study

Note a, b Colonies on the substrate. c–e Conidiogenous cells. f–k Conidia. l Germinated conidium. m Colonies on PDA. Scale bars: c–e = 20 μm, h–l = 10 μm

Figure 3.7 *Dictyocheirospora guizhouensis* (HKAS 129776, holotype)



Note a Colonies on substrate. b, c Conidiophores. d–g Conidiogenous cells and conidia. h, i Conidia. j Germinated conidium. k Colony on PDA from above and below. Scale bars: b–j = 20 μm

Figure 3.8 *Dictyocheirospora multiappendiculata* (HKAS 129759)

Dictyocheirospora multiappendiculata H.W. Shen & Z.L. Luo, Journal of Fungi 8 (11, no. 1200): 12 (2022)

Index Fungorum number: IF 846014; *Facesoffungi number*: FoF 17024; Figure 3.8

Holotype: KUN-HKAS 122866

Saprobic on dead fronds of ferns in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, sporodochial, punctiform, scattered, gregarious, dark brown to black. *Mycelium* mostly immersed, composed of septate, branched, hyaline to pale brown hyphae. *Conidiophores* micronematous, mononematous, septate, cylindrical, sometimes reduced to conidiogenous cell. *Conidiogenous cells* (6.5–)10–16 × 3.5–4.5 µm ($\bar{x}$ = 12.4 × 4.3 µm, n = 30), monoblastic, holoblastic, integrated, terminal, smooth, cylindrical, hyaline to pale brown. *Conidia* 47–59.5 × 17.5–25 µm ($\bar{x}$ = 54.5 × 20.5 µm, n = 30), acrogenous, solitary, guttulate, cheiroid, not complanate, composed of 5–7 rows of arms of consisting of 10–13 cells, sometimes with 1–2 semicircular, thin, hyaline appendages, euseptate, pale yellow to brown.

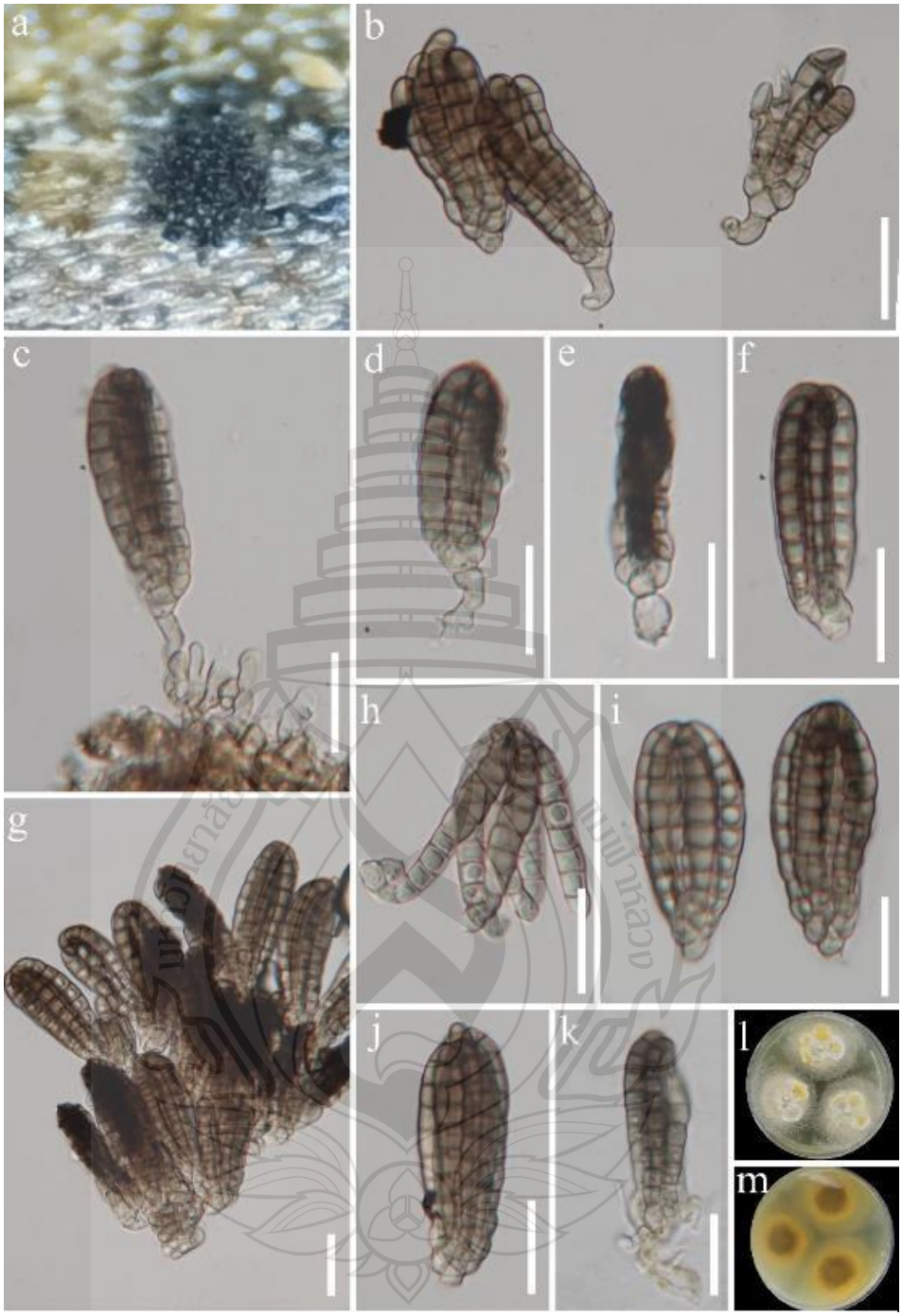
Culture characteristics: Conidia germinating on WA within 15 h and hyaline germ tube produced from the base of conidia. Colonies growing on PDA at 25°C, reaching 26 mm in diameter in 10 days, circular, entire, flat with a protuberance in the center, white, not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Baiyun District, Changpolin Forest Park, on dead frond stalks of an unidentified fern, 26 June 2022, J.Y. Zhang, A26-1 (HKAS 129680), living culture KUNCC 23–13835; CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Anlong County, Xianheping National Forest Park, on dead stems of *Pronephrium penangianum* (Thelypteridaceae), 16 March 2022, J.Y. Zhang, J256 (HAKS 129759), living culture KUNCC 23–13969.

Known hosts: *Pronephrium penangianum* (this study); submerged decaying wood (Shen et al., 2022); unidentified ferns (this study).

Distribution: China (Shen et al., 2022; this study).

Notes: *Dictyocheirospora multiappendiculata* was collected from freshwater in China (Shen et al., 2022). In this study, two new terrestrial collections (HAKS 129759 and HKAS 129680) isolated from *Pronephrium penangianum* (Thelypteridaceae) and an unidentified fern, clustered to *D. multiappendiculata* with few base pair differences (Figure 3.1). Morphologically, the new isolate is similar to *D. multiappendiculata*. Although, the new isolates differ with *D. multiappendiculata* in having fewer and semicircular appendages of conidia, whereas the holotype has multiple and globose to subglobose appendages of conidia (Shen et al., 2022). This variation may be due to the different habitats, as the appendages can help prevent conidia from escaping from strong currents (Bao et al., 2021). Therefore, the new isolates are identified as *D. multiappendiculata* based on both morphology and molecular data. Additionally, this study represents the first report of ferns being associated with *D. multiappendiculata*, expanding the known habitat of this species to terrestrial environments as well.



Note a Colonies on substrate. c Conidiophores with attached conidia. b, d, e Conidiogenous cells. f–j Conidia. k Germinated conidium. l, m Colonies on PDA from above and below. Scale bars: b–k = 20 µm

Figure 3.9 *Dictyocheirospora rotunda* (GZAAS 23–0659)

Dictyocheirospora rotunda D'Souza, Bhat & K.D. Hyde, Fungal Diversity 80: 465 (2016)

Index Fungorum number: IF551581; Facesoffungi number: FoF 01262; Figure 3.9

Holotype: MFLU 14–0253

Saprobic on dead fronds of ferns in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, sporodochial, punctiform, scattered, gregarious, dark brown. *Mycelium* mostly immersed, composed of septate, hyaline to pale brown hyphae. *Conidiophores* (13.5–)16–20 × 3.5–5.5 µm ($\bar{x}$ = 18 × 4.5 µm, n = 8), micronematous, mononematous, cylindrical, hyaline to pale brown. *Conidiogenous cells* 7–11.5 × 3.5–6.5 µm ($\bar{x}$ = 9.5 × 4.5 µm, n = 10), monoblastic, holoblastic, integrated, terminal, smooth, cylindrical, hyaline to pale brown. *Conidia* 47.5–57.5 × 16–24 (–27.5) µm ($\bar{x}$ = 51 × 19.5 µm, n = 15), acrogenous, solitary, cheiroid, not complanate, composed of 5–7 rows of arms of consisting of 8–11 cells, rows digitate, cylindrical, inwardly curved at the tip, pale brown to brown.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube attached with brown pigmentation produced from the base of conidia. Colonies growing on PDA, reaching 22 mm diameter in 14 days at 25℃, circular, flat, entire margin with thin mycelia, white with yellow block on the surface; claybank to pale yellow from center to edge in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Zunyi City, Chishui County, Hushi Town, on dead frond stalks of *Athyriaceae* sp., 27 July 2022, J.Y. Zhang, A75-1 (GZAAS 23–0659), living culture KUNCC 23–13849; CHINA, Guizhou Province, Guiyang City, Aha Lake National Wetland Park, on dead petiole of *Woodwardia unigemmata* (Blechnaceae), 9 January 2022, J.Y. Zhang, J221 (HKAS 129749), living culture KUNCC 23–13955.

Known hosts: On decaying wood (Boonmee et al., 2016; Wang et al., 2016; Dong et al., 2020).

Distribution: China and Thailand (Boonmee et al., 2016; Wang et al., 2016; Dong et al., 2020).

Notes: *Dictyocheirospora rotunda* was introduced by Boonmee et al. (2016) and was collected from decaying wood from freshwater habitats in Thailand (Boonmee et al., 2016). Subsequently, this species has been reported in the freshwater in China (Wang et al., 2016, Dong et al., 2020). In this study, two new collections (KUNCC 23–13849 and KUNCC 23–13955), isolated from Athyriaceae sp. and *Woodwardia unigemmata* (Blechnaceae), exhibit similar characters to *D. rotunda*. Additionally, the new collections differ from the holotype of *D. rotunda* in the size of conidiogenous cells (7–11.5 μm vs. 5–7 μm). Phylogenetically, the two new isolates clustered with three *D. rotunda* strains (MFLUCC 17–1313, MFLUCC 14–0293 and MFLUCC 17–0222) with strong statistical support (100% ML, Figure 3.44). Therefore, the two new collections are identified as *D. rotunda*. This represents the first report of Athyriaceae sp. and *Woodwardia unigemmata* as hosts of *D. rotunda* and indicates that this species can be found in a terrestrial habitat.

Dictyosporium Corda, Weitenweber's Beitr. Nat.: 87 (1836).

Index Fungorum number: IF8001; Facesoffungi number: FoF08210; 1 species associated with Pteridophytes.

Type species: *Dictyosporium elegans* Corda

Notes: Corda (1836) established *Dictyosporium* as the type of genus in Dictyosporiaceae, with *D. elegans* Corda as the type species. The holomorph genus is characterized by subglobose ascomata, bitunicate, cylindrical asci and hyaline, fusiform uniseptate ascospores with or without a sheath; sporodochial colonies, micronematous to macronematous, mononematous conidiophores and solitary, cheiroid, complanate conidia with multiple parallel rows of cells (Hyde & Goh 1998; Goh et al., 1999; Boonmee et al., 2016; Tibpromma et al., 2018; Yang et al., 2018b; Dubey, 2022).

Dictyosporium is a widely distributed genus (Hyde & Goh, 1998; Goh et al., 1999; Dubey, 2022), with 55 accepted species found on dead wood and plant litter in terrestrial and aquatic habitats (Goh et al., 1999; Dubey, 2022; Shen et al., 2022; Liu et al., 2023). In this study, we document new hosts (ferns) of *Dictyosporium* species from terrestrial habitats.

Note a The host substrate. b, c Colonies on the substrate. d–g Conidiophores with attached conidia. h–j Conidiogenous cells with conidia. k–n Conidia. o Germinated conidia. p, q Colonies on PDA from above and below. Scale bars: d–g = 50 µm, h–o = 20 µm

Figure 3.10 *Dictyosporium duliujiangense* (HKAS 129808)

Dictyosporium duliujiangense L.L. Liu & Z.Y. Liu, Phytotaxa 606: 259–272 (2023)

Index Fungorum number: IF 900403; *Facesoffungi number*: FoF 14119; Figure 3.10

Holotype: HKAS 129172

Saprobic on dead frond stalks of *Plenasium vachellii* (Osmundaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, sporodochial, punctiform, scattered, dark brown to black, glistening. *Mycelium* partly immersed, partly superficial, composed of septate, brown to atrovirens hyphae. *Conidiophores* micronematous, indistinct, cylindrical, often reduced to conidiogenous cells. *Conidiogenous cells* 10–15 × 3–4.5 µm ($\bar{x}$ = 12 × 4 µm, n = 10), monoblastic, holoblastic, integrated, terminal, determinate, smooth, cylindrical, hyaline to pale brown. *Conidia* 32–41.5 × 17–22 µm ($\bar{x}$ = 34.5 × 19.5 µm, n = 22), acrogenous, solitary, cheiroid, complanate, composed of 5 compact rows of arms consisting of 5–8 cells, arising from a basal cell, euseptate, brown at the apex, yellow green at the base, with hyaline, tubular, elongated, 29–57 × 4.5–6.5 µm ($\bar{x}$ = 40.5 × 5.5 µm, n = 20) appendages composed of 1-3 cells, slight constricted at the septat and mostly attached at the apical part of two outer arms.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube attached with brown pigmentation produced from the base of conidia. Colonies growing on PDA, reaching 21 mm diameter in 14 days at 25℃ in natural light, circular, with entire margin, flat, raised in the center, pale yellow to creamy white from center to margin in above; orange to pale yellow towards edge in reverse, not producing pigmentation in culture.

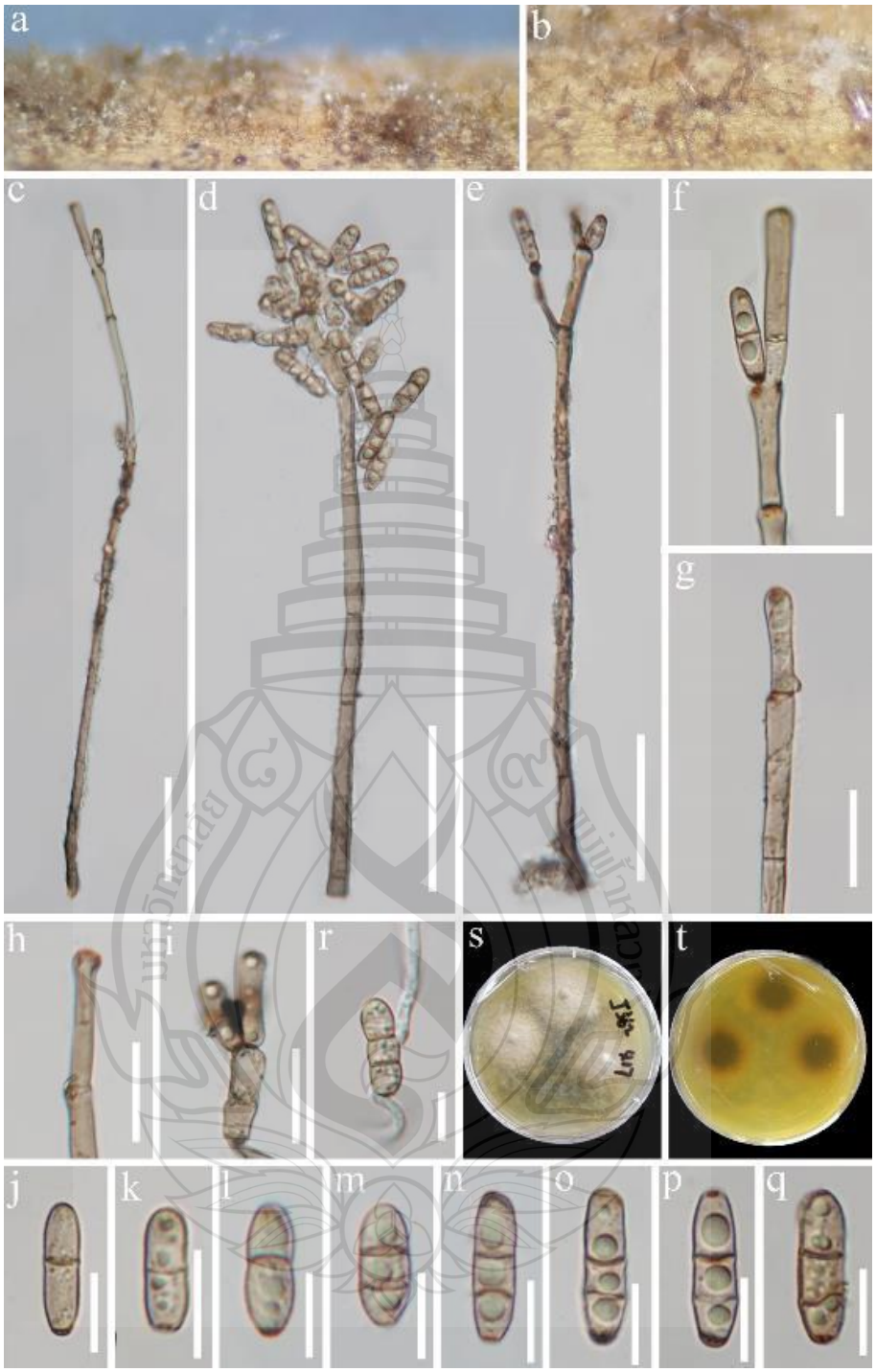
Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Plenasium vachellii* (Osmundaceae), 13 December 2021, J.Y. Zhang, J67-1 (HKAS 129808), living culture KUNCC 23–14054; *ibid*., J66 (HKAS 129807), living culture KUNCC 23–14053;

CHINA, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, on dead rachis of *Dryopteris aemula* (Dryopteridaceae), 16 November 2019, J.Y. Zhang, Y162; CHINA, Yunnan Province, Kunming City, on dead rachis of *Dryopteris championii* (Dryopteridaceae), 05 April 2022, R.J. Xu, YN07.

Known hosts: Unidentified plant substrates (Liu et al., 2023); *Dryopteris aemula*, *Dryopteris championii*, *Plenasium vachellii* (Osmundaceae) (this study).

Distribution: China (Liu et al., 2023, this study).

Notes: Based on the phylogenetic analysis of the combined LSU, ITS and *tef1-α* sequence data, our two new collections cluster with *Dictyosporium duliujiangense*. Morphologically, these two new collections are extremely similar to *D. duliujiangense*, except for the longer conidial appendages (29–57 μm vs. 16–38 μm) observed in our collections (Liu et al., 2023). This difference may be attributed to their different habitats. A comparison of nucleotide base pairs of ITS and *tef1-α* between our isolate (KUNCC23-14054) and *D. duliujiangense* (GZCC 19–0426) shows 7/482 bp (1%, including 1 gap) and 2/946 (no gap) differences. Hence, we identified these two new collections as *D. duliujiangense*, which was previously reported in freshwater habitats. Our isolates, on the other hand, are associated with *Plenasium vachellii* (Osmundaceae) in terrestrial habitats.



Note a, b Colonies on substrate. c–e Conidiophores with conidiogenous cells. f–i Conidiogenous cells. j–q Conidia. r Germinated conidium. s, t Colonies on PDA from above and below. Scale bars: c–e = 50 µm, f–i = 20 µm, j–r = 10 µm

Figure 3.11 *Neodendryphiella tarraconensis* (HKAS 129783)

Neodendryphiella Iturrieta-González, Dania García & Gené, MycoKeys 37: 19–38 (2018).

Index Fungorum number: IF 824664; *Facesoffungi number*: FoF 08214; 1 species associated with pteridophytes.

Type species: *Neodendryphiella mali* Iturrieta-González, Gené & Dania García, MycoKeys 37: 19–38 (2018).

Notes: *Neodendryphiella* was introduced by Iturrieta-González et al. (2018) for dendryphiella-like fungi, based on molecular data and morphological characteristics. *Neodendryphiella* species are characterized by semi-macronematous to macronematous, unbranched or branched towards the apical region, smooth to verrucose conidiophores, polytretic, integrated, terminal or intercalary conidiogenous cells and blastocatenate, aseptate or septate, ellipsoidal, doliiform, clavate or subcylindrical conidia (Iturrieta-González et al., 2018; Hongsanan et al., 2020a; Dong et al., 2023). Currently, *Neodendryphiella* comprises three species, *viz*., *N*. *mali* (as the type species), *N*. *michoacanensis*, and *N*. *tarraconensis*, isolated from soil and herbivore dung in Mexico and Spain (Iturrieta-González et al., 2018; Dong et al., 2023). This study adds a new host (fern) for *N*. *tarraconensis* reported as a saprobe in China.

Neodendryphiella tarraconensis Iturrieta-González, Gené & Dania García, MycoKeys 37: 30 (2018)

Index Fungorum number: IF824667; *Facesoffungi* number: FoF 06713; Figure 3.11

Holotype: CBS H-23479

Saprobic on dead frond stalks of an identified fern in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, light brown. *Mycelium* mostly immersed, composed of septate, hyaline to pale brown hyphae. *Conidiophores* (222–)343–509 × 4.5–5.2 µm ($\overline{x}$ = 421× 5 µm, n = 10), macronematous, mononematous, erect, straight or slightly flexuous, branch or unbranched, septate, cylindrical, yellowish-brown,

usually darker toward the base. *Conidiogenous cells* (14–)22.5–36 × 4.3–6.2 µm ($\overline{x}$ = 30 × 5.2 µm, n = 10), polytretic, integrated, terminal and intercalary, proliferating asymmetrically, enlarged at vertex, rough-wall, subcylindrical to clavate, pale brown, orange at sporulation point. *Conidia* 15.5–21.5 × 4–6.3 µm ($\overline{x}$ = 17.4× 5.1 µm, n = 20), catenate, (0–)1–2-septate, ellipsoidal or subcylindrical with more or less rounded ends, septate, guttulate, pale brown.

Culture characteristics: Conidia germinating on WA within 15 h and hyaline germ tube produced from conidia. Colonies growing on PDA at 25°C, reaching ca. 30 mm diameter in 14 days, circular, entire margin, flat with a protuberance in the center, white; brown to middle yellow form center to edge in reverse, not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead frond stalks of ferns near a river in a forest, 27 March 2022, J.Y. Zhang, J362 (HKAS 129783), living culture KUNCC 23–14015.

Known hosts: On garden soil (Iturrieta-González et al., 2018); on decaying wood (Hyde et al., 2020c); on an unidentified fern (this study).

Distribution: China (Hyde et al., 2020c, this study); Spain (Iturrieta-González et al., 2018).

Notes: A BLASTn search of the ITS sequence data indicated a close relationship between our new isolate and *Neodendryphiella tarraconensis* (FMR 16234) with 99% similarity (451/453 bp, without gap). The morphology of our isolate is similar to the holotype (FMR 16234), except that the longer conidiophores (343–509 µm vs. 19–185 µm) and guttulate conidia are observed in our collection. This difference may be due to the variation in growing substrates. *Neodendryphiella tarraconensis* was introduced by Iturrieta-González et al. (2018) based on the asexual morph produced in the culture, while our new collection formed fruitbodies in natural substrate. Furthermore, the presence of long conidiophores (up to 530 µm) was also noted in another specimen of

N. tarraconensis (GZAAS 20−0003) (Hyde et al., 2020c). Phylogenetic analysis confirmed that our isolate is conspecific and grouped with *N. tarraconensis*, thus reporting a new host record of *Neodendryphiella tarraconensis* on ferns.

Pseudodictyosporium Matsush., Bull. natn. Sci. Mus., Tokyo, N.S. 14: 473 (1971).

Index Fungorum number: IF 9568; *Facesoffungi number*: FoF01266; 1 species associated with pteridophytes.

Type species: *Pseudodictyosporium wauense* Matsush.

Notes: Kobayasi (1971) established the genus *Pseudodictyosporium* with *P. wauense* as the type species and the genus is placed in Dictyosporiaceae, Pleosporales. Dothideomycetes (Hyde et al., 2024c). The genus currently comprises four accepted species (*P. wauense*, *P.* elegans, *P. indicum*, and *P. thailandica*), characterized by macronematous, branched conidiophores, monoblastic, integrated, determinate conidiogenous cells and cheiroid, dictyosporous conidia composed of 2–3 rows of cell, were accepted in this genus (Tzean & Chen, 1990; Kirschner et al., 2013; Boonmee et al., 2016; Hyde et al., 2016; Li et al., 2017d; Hongsanan et al., 2020a). These fungi are saprobic and associated with plant substrates in China, India, Papua New Guinea, and Thailand (Rao & Subhedar, 1976; Tzean & Chen, 1990; Hyde et al., 2016; Wang et al., 2016; Li et al., 2017d). Notably, no *Pseudodictyosporium* species have been recorded as associated with pteridophytes. In this study, *Pseudodictyosporium elegans* is described based on morphology and phylogeny, representing the first record of *Pseudodictyosporium* species associated with ferns.

Pseudodictyosporium elegans (Tzean & J.L. Chen) R. Kirschner, Mycological Progress 12 (1): 32 (2013)

Index Fungorum number: IF563994; *Facesoffungi number*: FoF17025; Figure 3.12

Holotype: PPH7

Saprobic on dead frond stalks of ferns in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. Colonies on natural substrate superficial, sporodochial, punctiform, scattered, gregarious, dark-slate-blue. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophore* 29–92 µm long, 3–8.5 µm wide, macronematous, mononematous, scattered or caespitose, irregularly branched, composed of cylindrical or ellipse cells, septate, constricted at septa, guttules, hyaline. *Conidiogenous cells* mono-polyblastic, integrated, terminal or subapically giving rise to branches, with an apical conidiogenous locus, smooth, cylindrical to oval, hyaline. *Conidia* 18–24× 10.5–25 µm ($\overline{x}$ = 20.9 × 13 µm, n = 35), acrogenous, cheiroid, solitary, complanate, composed of basal a trapezoid cell (–2)3 compact arms consisting of 2–5 cells each arm, subhyaline to pale brown.

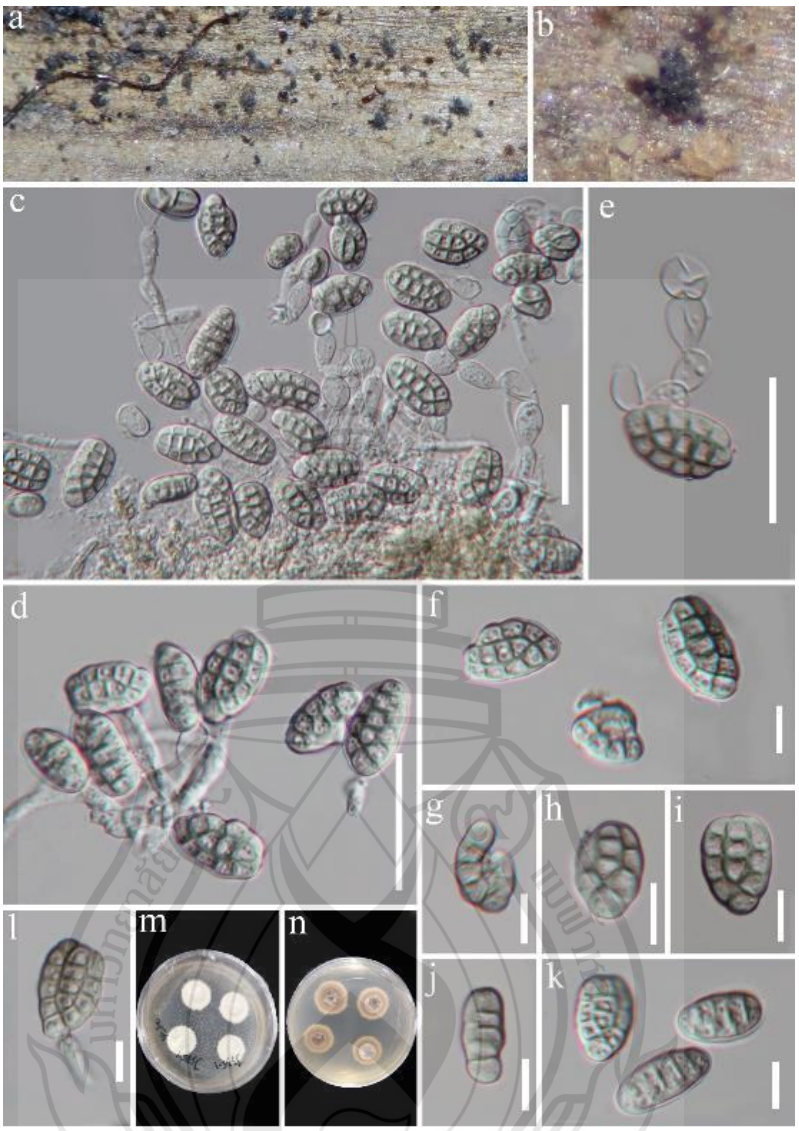
Culture characteristics: Conidia germinating on WA within 12 h and hyaline germ tube produced from the base of conidia. Colonies growing on PDA at 25°C, reaching ca. 13 mm in diameter in 14 days, circular, entire with slightly undulate margin, flat with fluffy, dense, velvety, white mycelium on the surface, offwhite to brown-yellowish from center to edge in reverse, not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of *Microlepia marginata* (Dennstaedtiaceae) near a river in a forest, 27 March 2022, J.Y. Zhang, J335-1 (HKAS 129779), living culture KUNCC 23–14009.

Known hosts: On dead twig of unidentified plant (Tzean & Chen, 1990; Kirschner et al., 2013); on *Microlepia marginata* (Dennstaedtiaceae) (This study).

Distribution: China (Tzean & Chen, 1990; Kirschner et al., 2013; this study).

Notes: *Cheiromoniliophora elegans* was introduced by Tzean and Chen (1990) and was subsequently transferred to the *Pseudodictyosporium* (*P. elegans*) based on morphological examination (Kirschner et al., 2013). Our new collection aligns well morphologically with the original diagnosis of holotype (PPH7) in the characteristic of conidiophores, conidiogenous cells and conidia (Tzean & Chen, 1990; Kirschner et al., 2013). Furthermore, multigene phylogenetic analysis indicated that our new collection (KUNCC 23–14009) clustered together with the type strain of *P. elegans* (CBS 688.93), confirming their conspecific status. This finding represents a new host record of *Pseudodictyosporium elegans* associated with the host plant *Microlepia marginata* (Dennstaedtiaceae).



Note a, b Colonies on the substrate. c, d Conidiophores with attached conidia. e–k Conidia. l Germinated conidium. m, n Colonies on PDA from above and below. Scale bars: c–e = 30 µm, f–l = 10 µm

Figure 3.12 *Pseudodictyosporium elegans* (HKAS 129779)

Vikalpa M.J. D'souza, Boonmee, Bhat & K.D. Hyde, Fungal Diversity: (2016)

Index Fungorum number: IF551585; Facesoffungi number: FoF 01361; 1 species associated with pteridophytes.

Type species: *Vikalpa australiensis* (B. Sutton) D'souza, Boonmee & K.D. Hyde

Notes: The genus *Vikalpa* was introduced by Boonmee et al. (2016) to

accommodate four species (*V. australiensis*, *V. lignicola*, *V. freycinetiae* and *V. lignicola*) and is placed in Dictyosporiaceae, Pleosporales. Dothideomycetes. The genus is characterized by sporodochial conidiomata, euseptate, non-complanate conidia consisting of three rows of cells (Sutton, 1985; Boonmee et al., 2016; Shen et al., 2022). Subsequently, three new species, namely *V. dujuanhuensis*, *V. grandispora* and *V. sphaerica*, were introduced (Shen et al., 2022; Liu et al., 2024). *Vikalpa* species have been reported as saprobes found on decaying wood and leaves in both freshwater and terrestrial habitats across Australia, China, New Zealand, and Federated States of Micronesia (Sutton, 1985; McKenzie, 2008b; Boonmee et al., 2016; Shen et al., 2022). Our study presents a new host record of *V. dujuanhuensis* on ferns from a terrestrial habitat, highlighting the first instance of an association between *Vikalpa* species and ferns.

Vikalpa dujuanhuensis H.W. Shen & Z.L. Luo, Mycology, 3 (2024)

Index Fungorum number: IF571593; *Facesoffungi number*: FoF15707; Figure 3.13

Holotype: KUN-HKAS 125817

Saprobic on dead frond stalks of ferns in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, sporodochial, punctiform, scattered, white to grayish, glistening. *Mycelium* partly immersed, partly superficial, composed of branched, septate, hyaline to light brown hyphae. *Conidiophores* 10–21 × 1.5–3.5 µm ($\bar{x}$ = 16 × 2.5 µm, n = 15), micronematous, mononematous, cylindrical, straight or flexuous, smooth-walled, hyaline or colourless. *Conidiogenous cells* 4–6.5(–10.5) × (2–)2.5–4 µm ($\bar{x}$ = 5.5 × 3.5 µm, n = 15), holoblastic, integrated, terminal, smooth, cylindrical, hyaline to pale brown. *Conidia* 26–32.5 ×10.5–14 µm ($\bar{x}$ = 29 × 11 µm, n = 20), acrogenous, solitary, chiroid, not complanate, composed of 4 rows of arms consisting of 9–11 cells, with subglobose hyaline appendages at the apex of each arm, colorful crystalloid mounted at the upper part surrounded with four arms, distoseptate, guttulate, subhyaline.

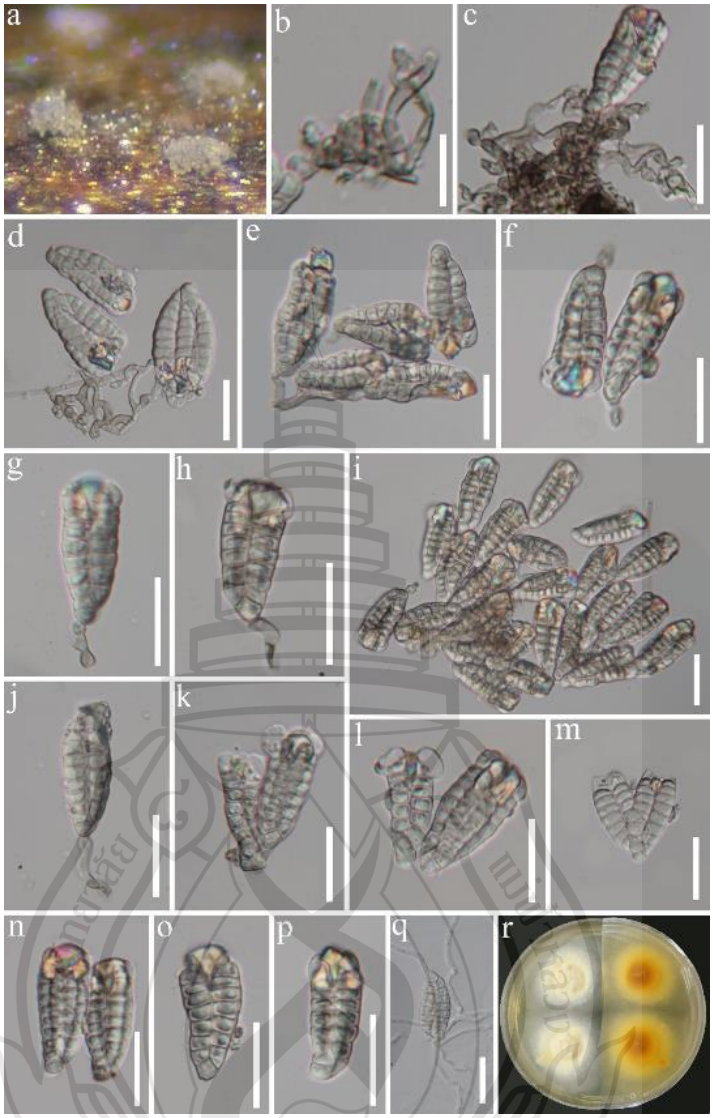
Culture characteristics: Conidia germinating on WA within 12 h, and hyaline germ tubes produced from conidia. Colonies growing on PDA at 25°C, reaching 26 mm in diameter in 14 days, circular, flat with entire margin composed of thin mycelia, white to pale yellow, orange to pale yellow in reserve from center to margin, not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Changpo Forest Forest Park, on dead fronds of *Pronephrium penangianum* (Thelypteridaceae), 26 June 2022, J.Y. Zhang, A16 (HAKS 129677); living culture KUNCC 23–13832; *ibid*., Guiyang city, on dead fronds of *Woodwardia unigemmata* (Blechnaceae), 21 July 2022, J.Y. Zhang, A59-2 (HKAS 129685), living culture KUNCC 23–13842; CHINA, Yunnan Province, Xishuangbanna Dai Autonomous Prefecture, Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, on dead rachis of *Pronephrium longipetiolatum* (Thelypteridaceae), 16 November 2019, J.Y. Zhang, Y146-1; *ibid*., on *Athyrium filix-femina* (Athyriaceae), Y148-3.

Known hosts: Decaying wood (Liu et al., 2024; Wang et al., 2024); *Athyrium filix-femina*, *Pronephrium penangianu*, *P. longipetiolatum* (This study); *Woodwardia unigemmata* (Blechnaceae) and unidentified ferns (this study).

Distribution: China (Liu et al., 2024, this study, Wang et al., 2023).

Notes: *Vikalpa dujuanhuensis* was described from submerged decaying wood in freshwater habitats (Liu et al., 2024; Wang et al., 2024). In the LSU-ITS-*tef1*-*α* phylogenetic tree, our three isolates grouped together with *V. dujuanhuensis* strains (KUNCC 22–12670 and KUNCC 23-13398). Morphologically, our three collections and the newly recorded specimen of *V. dujuanhuensis* (KUNCC 23–13398) are indistinguishable. They are characterized by micronematous, mononematous conidiophores, holoblastic, integrate conidiogenous cells and subhyaline, cheiroid conidia with subglobose hyaline appendages at the apex and colorful crystalloid (Liu et al., 2024; Wang et al., 2024). We therefore identified our new isolates as *V. dujuanhuensis*. This report represents the first instance for ferns being identified as hosts of *V. dujuanhuensis* in terrestrial habitats.



Note a Colonies on the host. b–e Conidiophores with attached conidia. f–j Conidiogenous cells and conidia. k–p Conidia. q Germinated conidia. r Colonies on PDA from above and below. Scale bars: b = 10 μm, c–q = 20 μm

Figure 3.13 *Vikalpa dujuanhuensis* (HAKS 129677)

Hermatomycetaceae Locq. ex A. Hashim. & Kaz. Tanaka, in Hashimoto, Matsumura, Hirayama & Tanaka, Persoonia 39: 56 (2017)

Hermatomyces Speg., Anal. Mus. nac. B. Aires, Ser. 3 13: 445 (1910)

Index Fungorum number: IF 202440; Facesoffungi number: FoF 08252; one species associated with pteridophytes.

Type species: *Hermatomyces tucumanensis* Speg., Anal. Mus. nac. B. Aires, Ser. 3 13: 446 (1910)

Note: *Hermatomyces* (Hermatomycetaceae, Pleosporales) was established as a monotypic genus by Spegazzini (1910) based on asexual morph, with *H. tucumanensis* as the type species. *Hermatomyces* was treated as 'incertae sedis' within Ascomycota (Wijayawardene et al., 2012). Latter, Doilom et al. (2017) and Tibpromma et al. (2016) presented Hermatomyces should be placed in Lophiotremataceae based on phylogenetic analysis of SSU, LSU, TEF1α and RPB2 sequence data. However, Hashimoto et al. (2017) argued that it belongs to Hermatomycetaceae. Hermatomyces is now recognized as a well-resolved genus in Hermatomycetaceae (Tibpromma et al., 2018; Hyde et al., 2019; Nuankaew et al., 2019; Delgado et al., 2020; Hongsanan et al., 2020). *Hermatomyces* can be isolated from various plants in temperate and tropical countries (Doilom et al., 2017; Koukol et al., 2018; Tibpromma et al., 2018; Delgado et al., 2020; Hongsanan et al., 2020). Index Fungorum (2020) has listed 28 epithets under Hermatomyces. In this study, a new host record of *Hermatomyces nabanheensis* from *Cyathea spinulosa* in China was described and illustrated.

Hermatomyces nabanheensis Tibpromma, Bhat & K.D. Hyde, Fungal Diversity 87: 39 (2017)

Index Fungorum number: IF552901; *Facesoffungi number*: FoF 03135, Figure 3.14 and 3.15

Saprobic on dead rachis of *Cyathea spinulosa*. **Sexual morph**: Undetermined. **Asexual morph**: Hyphomycetes. *Colonies* on natural substrate dry, blackish brown, superficial, circular or oval, bird nest-like, doughnut-shaped, scattered, blackish brown,

glistening, conidia readily liberated when disturbed. *Mycelium* 1.7–3.3 μm wide, superficial, composed of a network of branched, septate, hyaline to pale brown. *Conidiophores* are reduced to Conidiogenous cells, micronematous, short, hyaline to pale brown, arising from prostrate hyphae at the centre of circular colony. *Conidiogenous cells* 4–5.5 (–8.5) × 2.4–3.7, holoblastic, monoblastic, integrated, terminal, cylindrical, hyaline to subhyaline. *Conidia* two types, dimorphic, lenticular and cylindrical, thick-walled. Lenticular conidia 30–39 × 20–28 μm ($\overline{x}$ = 34 × 23.5 μm, n = 20), numerous, thick-walled, central cells dark brown, hyaline to pale brown peripheral cells with septa, forming a distinct ring on the outside. Cylindrical conidia 32–39 × 19.5–27 μm ($\overline{x}$ = 36 × 24 μm, n = 15) μm in broadest part of lower cells, with 2 forked columns of 2–4 cells, cylindrical, swollen, constricted at septa, subhyaline, upper part of terminal cells dark brown, granulate, rough.

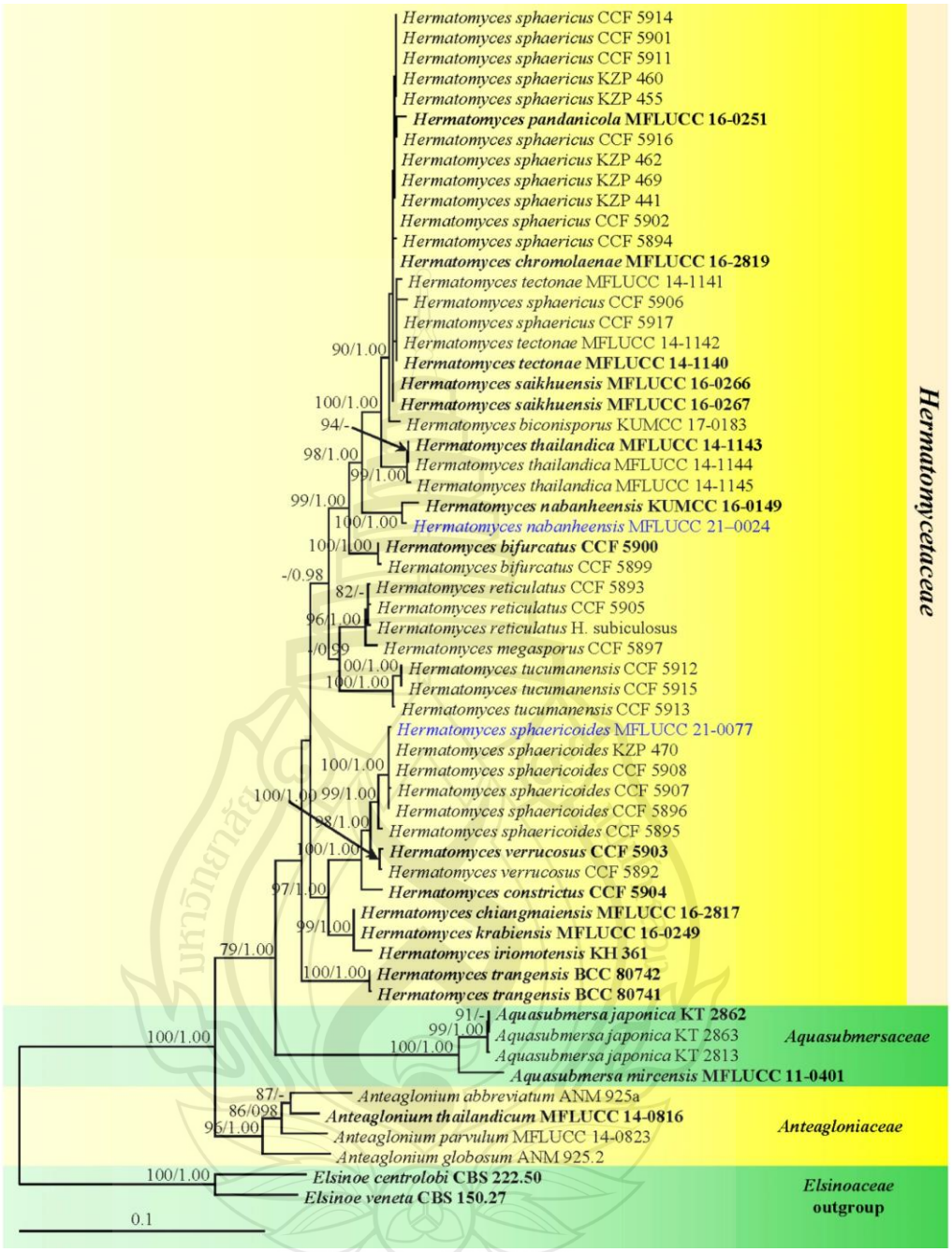
Culture characteristics: Conidia germinated on PDA within 15h at incubator (25ºC). Germ tubes produced around conidia and were transferred to fresh PDA media. Pure cultures were incubated at 25ºC and reaching 2.2 cm diam. in 10 days, circular, smooth surface, velvety and raised, gray to brown to gray from center to margin from the forward of culture, yellow-brown in the centre while white at the edge from the reverse of culture.

Material examined: CHINA, Guizhou province, Zunyi city, Chishui county, Hushi town, Chishui Alsophila Natural Reserve (28°29’43”N, 106°0’24”E), on dead rachis of *Cyathea spinulosa*, 22 September 2019, Jing-Yi Zhang, C30 (MFLU 21-0025), living culture MFLUCC 21-0024.

Known distribution (based on molecular data): China (Hyde et al., 2017), this study.

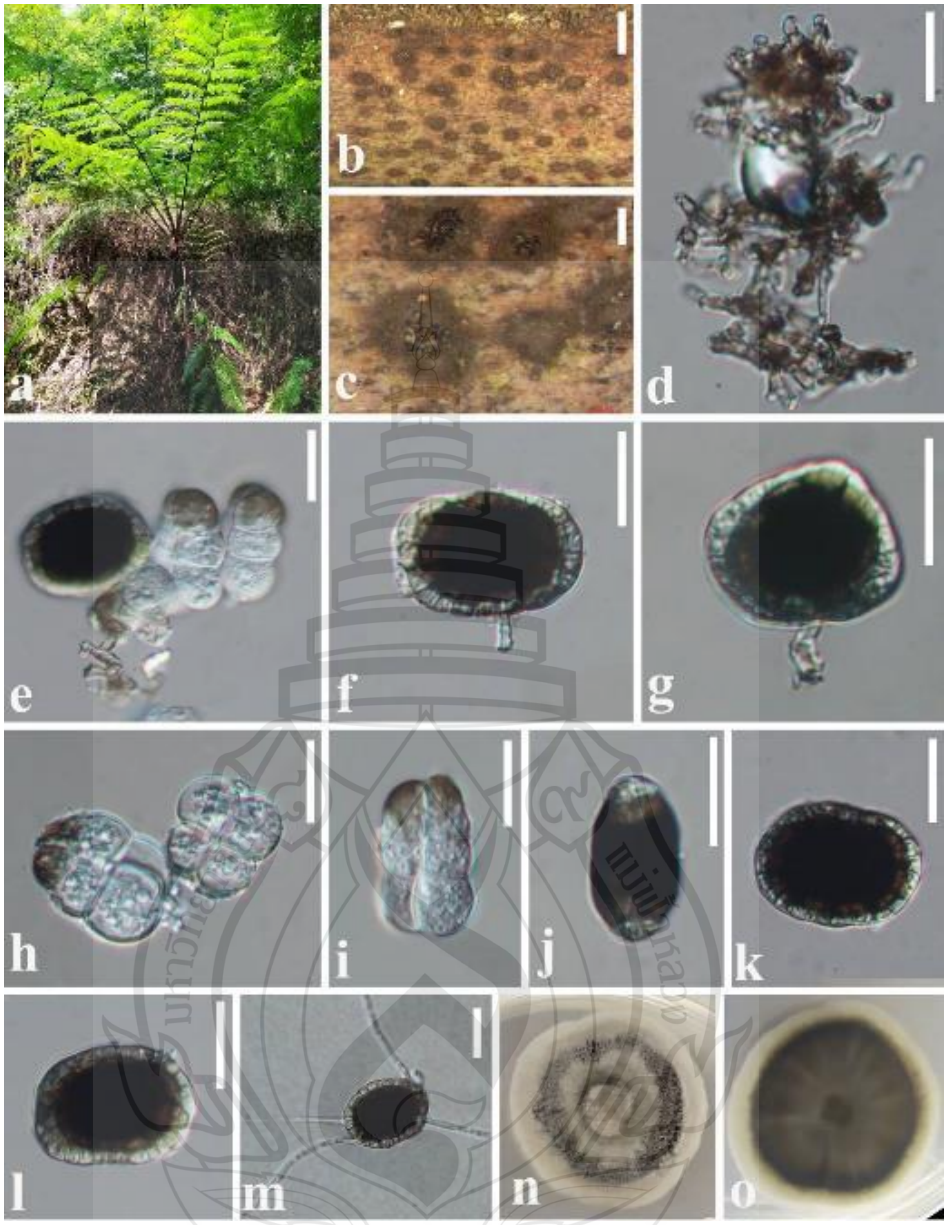
Known hosts: on dead leaves of *Pandanus* sp. (Hyde et al., 2017), on dead rachis of *Cyathea spinulosa* (this study).

Notes: The phylogenetic analysis based on multi-gene phylogenetic analyses of a combined ITS, LSU and *tef* sequence data indicates that the new isolate clustered together with *Hermatomyces nabanheensis* with strong support (100% MLBP/1.00 BYP). A comparison of base sequence between *H. nabanheensis* (HKAS96214) and the new collection of this study showed that they are 3 bases differ in LSU and 5 bases differ in ITS. Morphologically, the newly obtained isolate is similar to *H. nabanheensis* in shape of colony, conidiophores, conidiogenous cells and conidia. However, the new isolate differs from *H. nabanheensis* (HKAS96214) in having larger conidia (Lenticular conidia 30–39 × 20–28 μm vs 20.2–25 ×16.6–20.7, Cylindrical conidia 30–37 × 19.5–25 μm Vs. 15–26.8 ×12.1–18.2). The difference of spore size may be due to the influence of host, climate, substrate, measurement error etc. Based on the evidence of phylogeny and morphological characteristics, we consider the new isolates conspecific to *H. nabanheensis* and this is the first record of *H. nabanheensis* isolated from fern (*Cyathea spinulosa*).



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU and TEF1-α sequence data of Hermatomyces taxa (Hermatomycetaceae) and closely related families Aquasubmersaceae and Anteagloniaceae. Elsinoe centrolobi CBS 222.50 and E. veneta CBS 150.27 are selected as the outgroup taxa.

Figure 3.14 Phylogenetic tree of *Hermatomyces*



Note a Host b–c Colonies on substrate. d Mycelium. e–g Conidia with conidiogenous cells. h–i Cylindrical conidia j–l Lenticular conidia. m Germinated conidium. n–o Colony on PDAfrom above and below. Scale bars: b = 1000 µm, c = 200 µm, d–m = 20 µm

Figure 3.15 *Hermatomyces nabanheensis* (MFLU 21-0025)

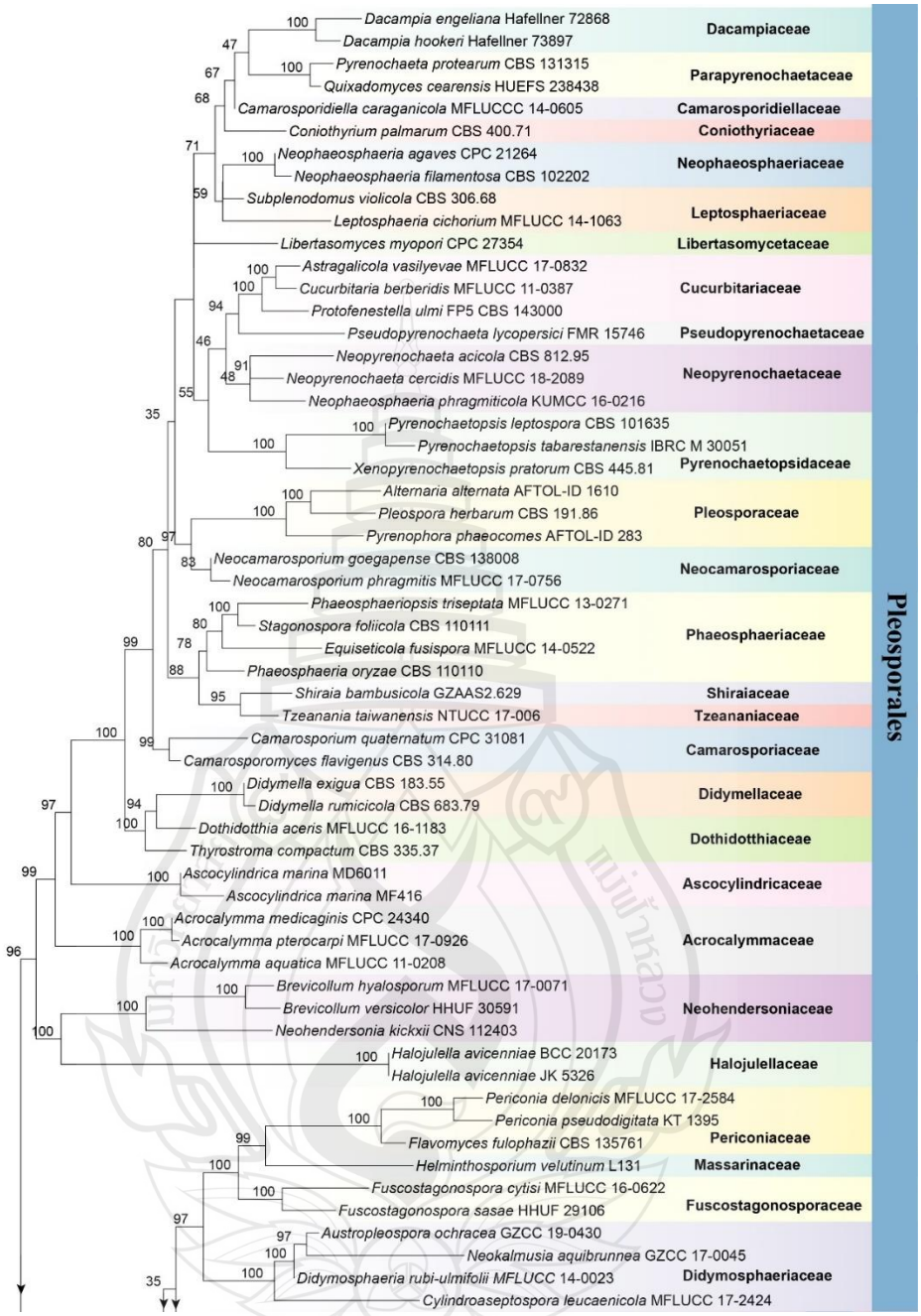


Figure 3.16 Phylogenetic tree of Pleosporales

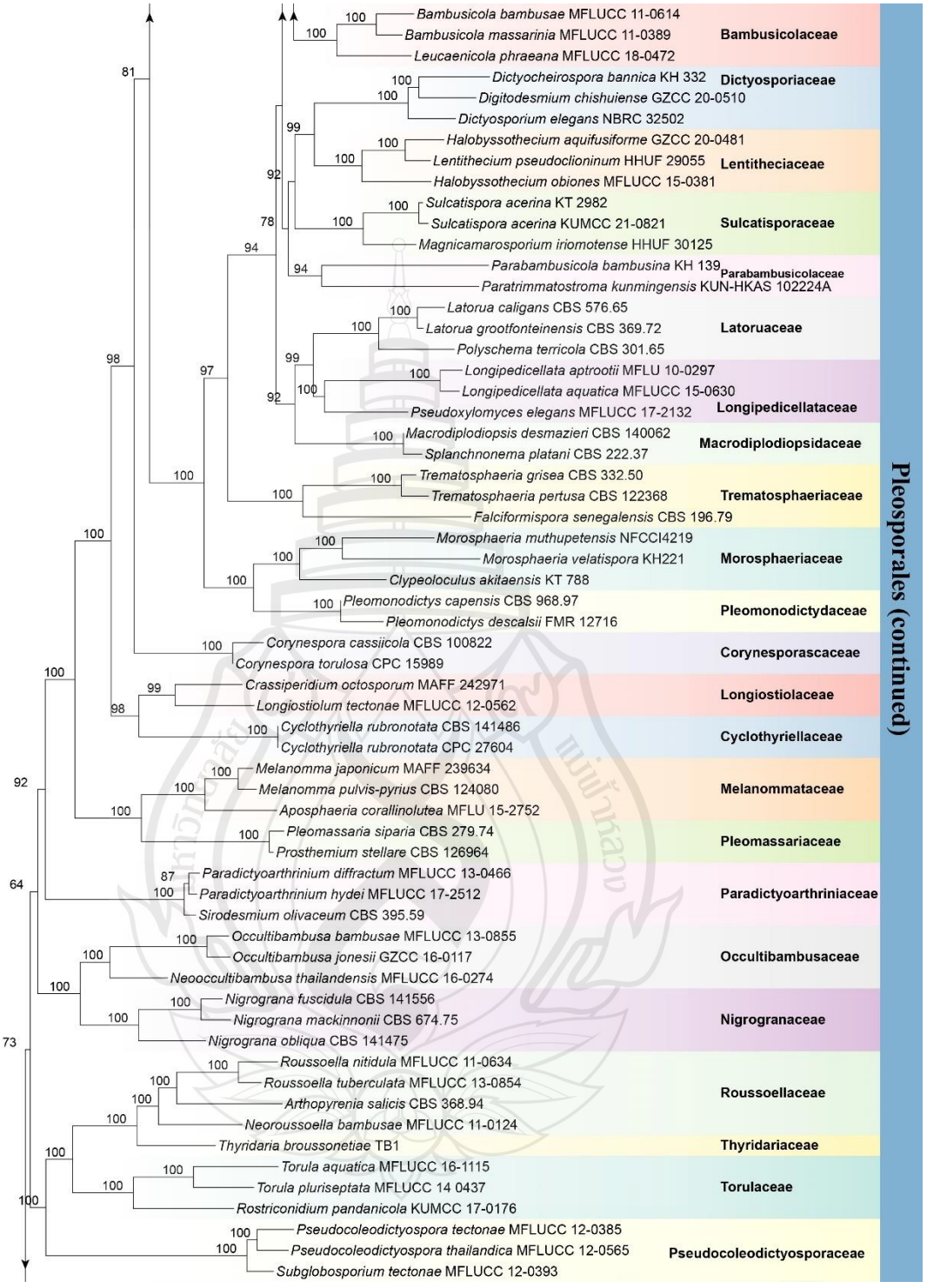


Figure 3.16 (continued)

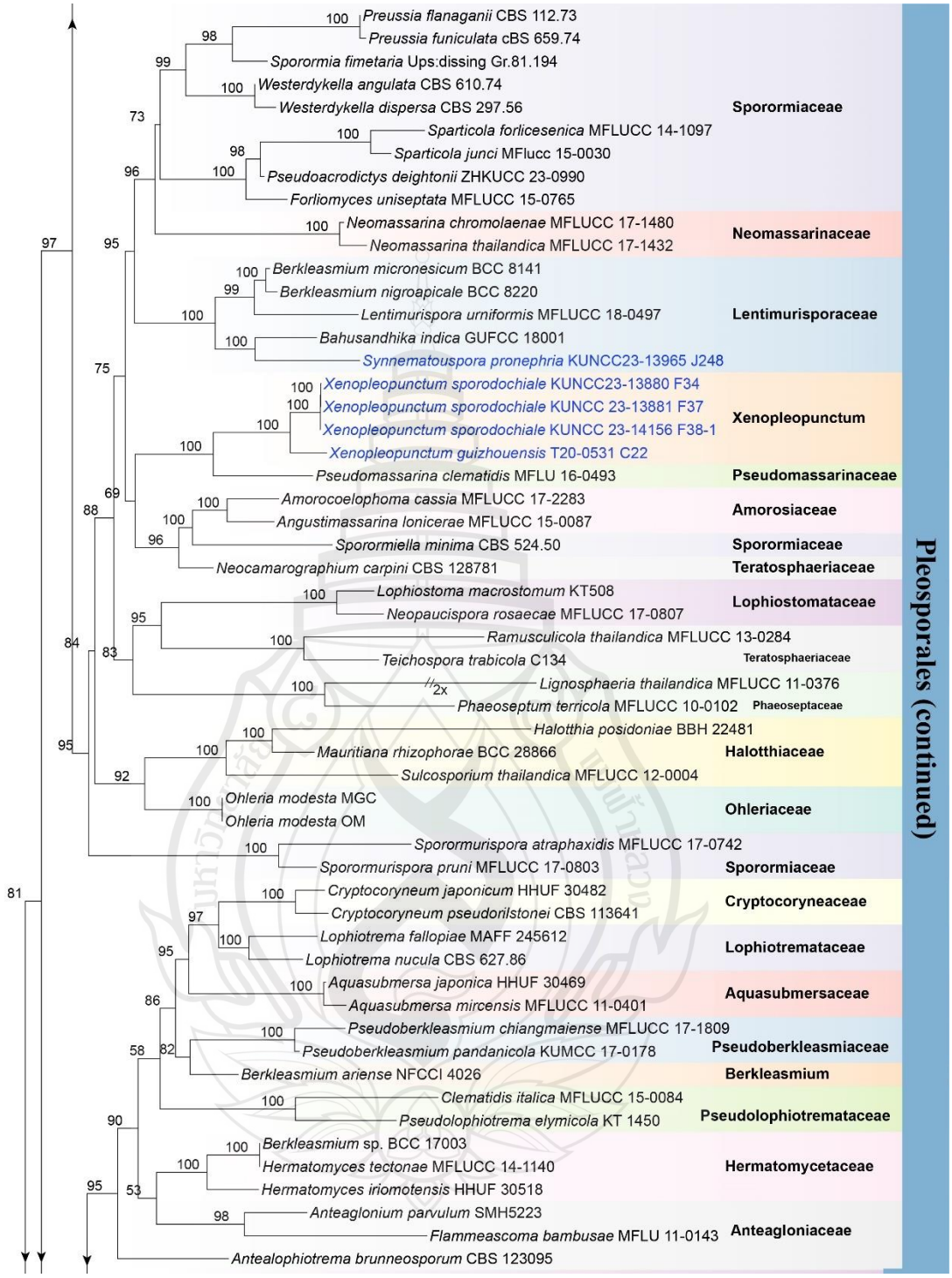


Figure 3.16 (continued)

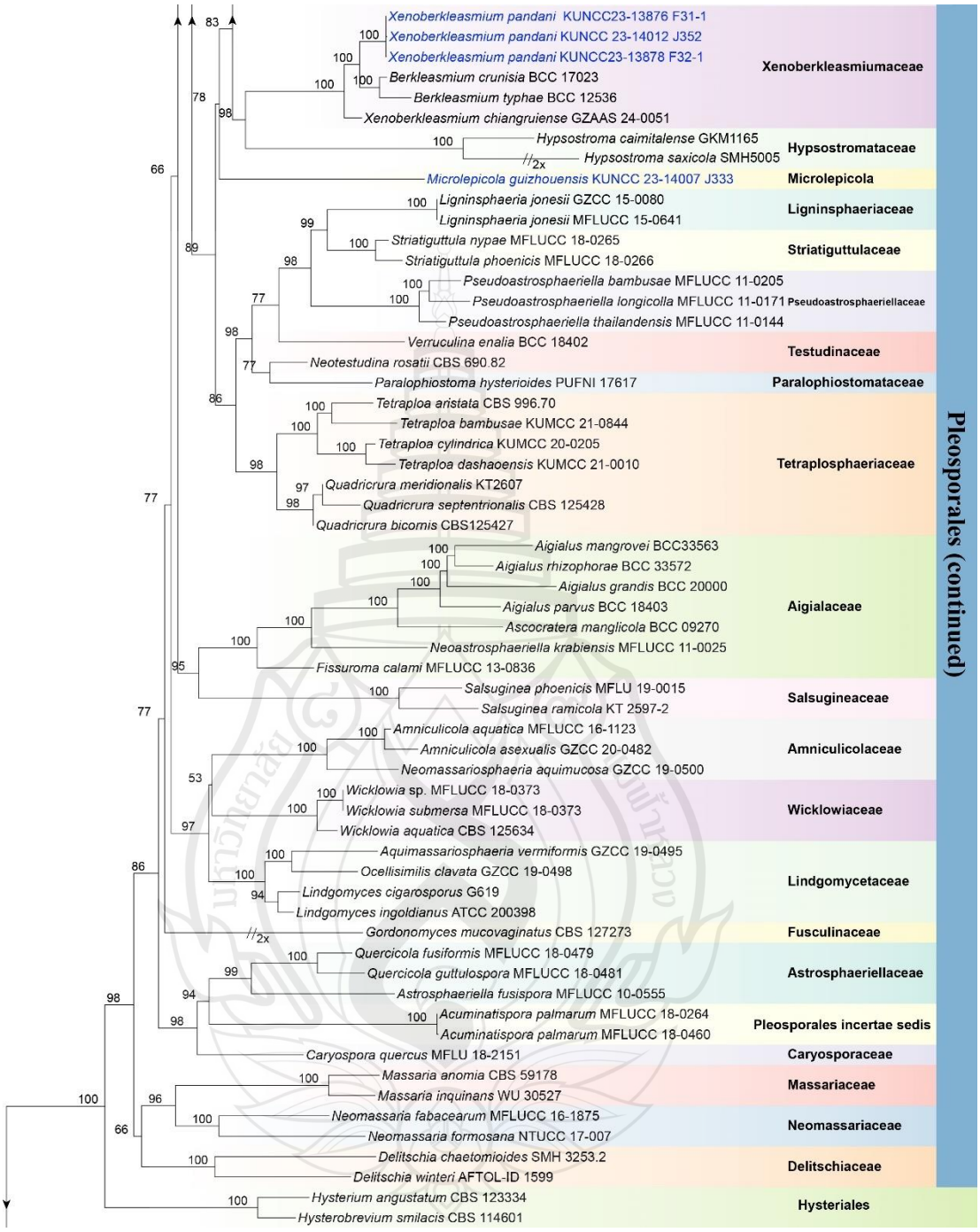
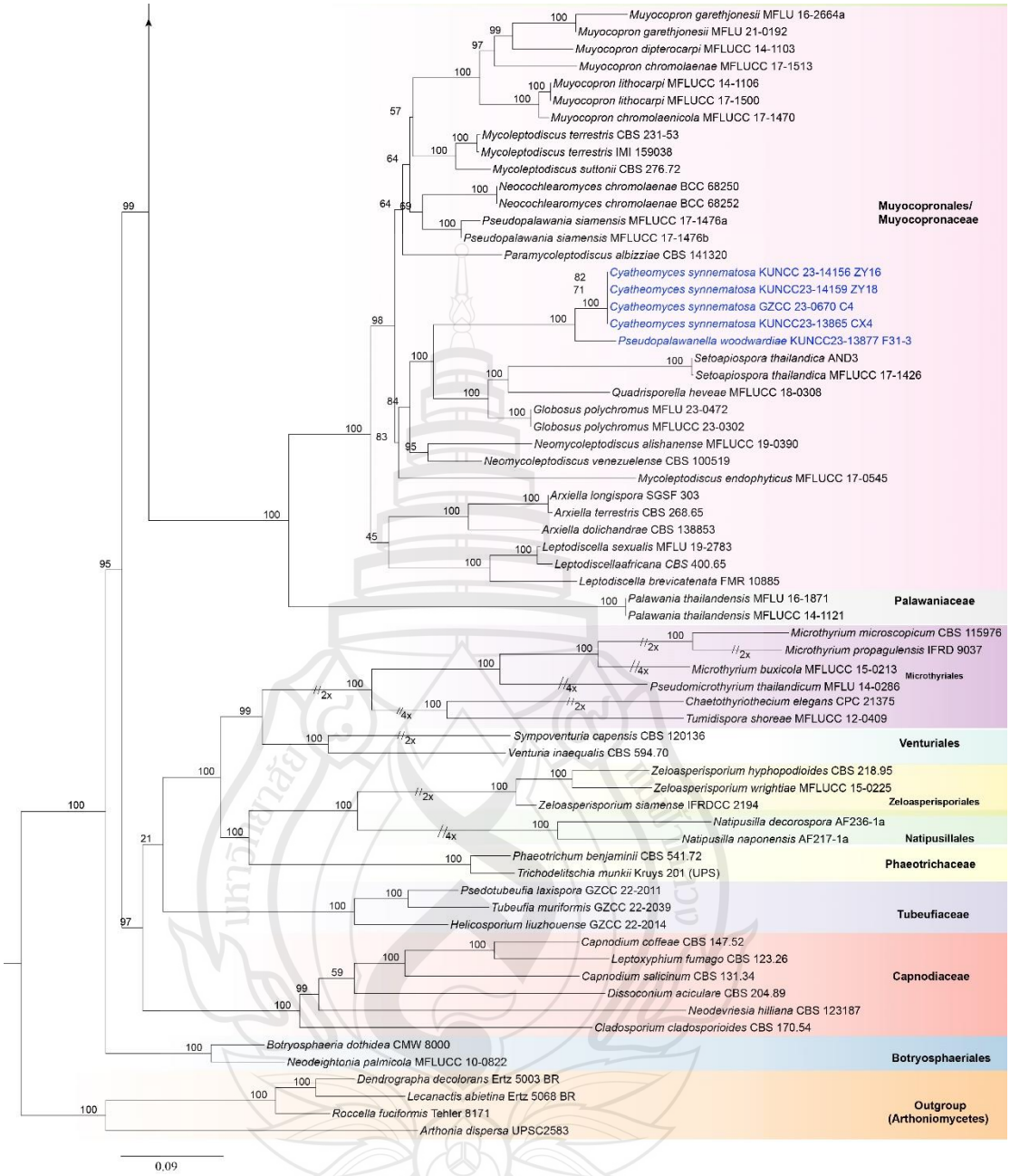


Figure 3.16 (continued)



Note Phylogram generated from maximum likelihood analysis based on combined LSU, RPB2, SSU and Tef sequence data. The tree was rooted to *Arthonia dispersa* (UPSC2583), *Dendrographa decolorans* (Ertz 5003), *Lecanactis abietin*a (Ertz 5068) and *Roccella fuciformis* (Tehler 8171).

Figure 3.16 (continued)

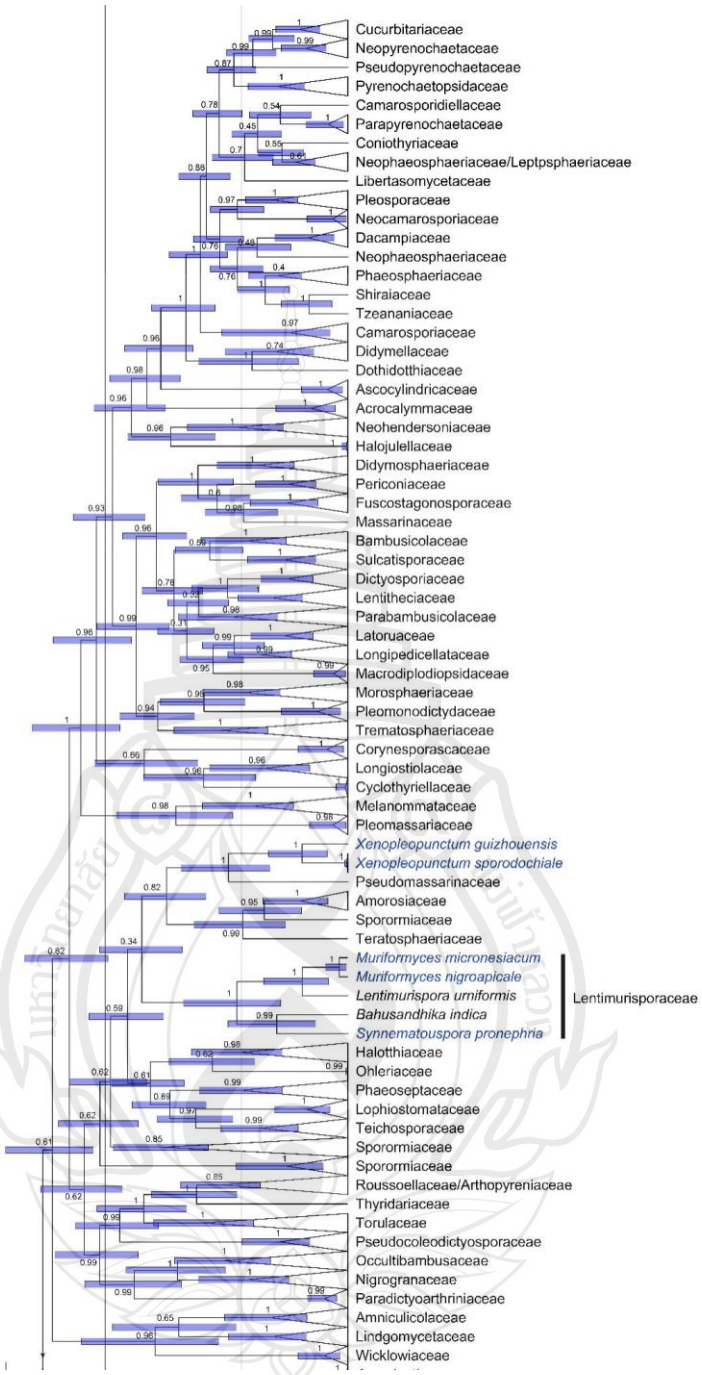
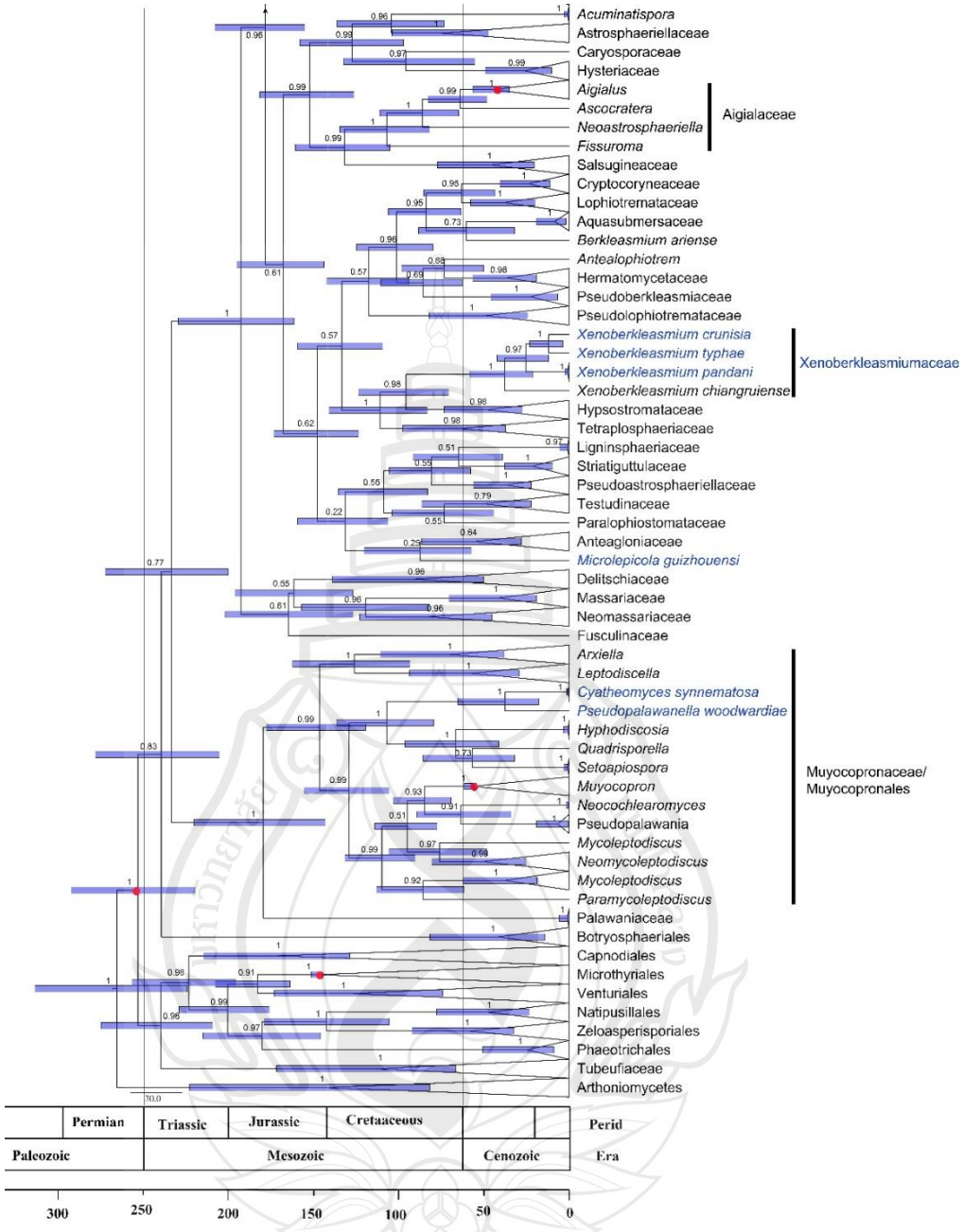


Figure 3.17 Maximum clade credibility (MCC) tree



Note Maximum clade credibility (MCC) tree with divergence times estimates of families in Dothideomycetes. Bars correspond to the 95% highest posterior density (HPD) intervals. The scale axis shows divergence times as millions of years ago (MYA). The new taxa are indicated in blue. Geological periods are indicated at the base together with scale in million years ago (MYA) (Cohen et al., 2013)

Figure 3.17 (continued)

Lentimurisporaceae N.G. Liu, Jian K. Liu & K.D. Hyde, Cryptog. Mycol. 39(2): 270 (2018); Figure 3.16 and Figure 3.17

Synnematouspora J.Y. Zhang, Y.Z. Lu & K.D. Hyde, gen. nov.

Etymology: Referring to the synnematous conidiophores

Type species: *Synnematouspora pronephria* J.Y. Zhang, Y.Z. Lu & K.D. Hyde

Saprobic on dead frond stalks of ferns in the terrestrial habitat. Sexual morph: undetermined. Asexual morph: hyphomycetous. *Colonies* on natural substrate superficial, effuse, dark brown. *Mycelium* mostly immersed, composed of septate, smooth, hyaline to brown hyphae. Synnemata superficial, scattered, brown to dark brown, composed of compactly adpressed conidiophores. *Conidiophores* macronematous, fasciculate, cylindrical, smooth-walled, septate, brown. *Conidiogenous cells* phialidic, discrete, spherical, flask-shaped, with cup-shaped collarette, light brown. *Conidia* phragmosporous, catenate, cylindrical to oblon, straight or slightly cure, septate, constricted at septa, guttulate, smooth-walled, brown.

Synnematouspora pronephria J.Y. Zhang, Y.Z. Lu & K.D. Hyde, sp. nov., Figure 3.18

Etymology: Referring to the fungal host "*Pronephrium penangianum*"

Saprobic on dead frond stalks of *Pronephrium penangianum* in the terrestrial habitat. **Sexual morph**: undetermined. **Asexual morph**: hyphomycetous. *Colonies* on natural substrate superficial, effuse, dark brown, with pale brown masses of conidia at the apex of conidiophores. *Mycelium* mostly immersed, composed of septate, smooth, hyaline to brown hyphae. *Synnemata* 328–564 µm long and up to 35 µm wide at the base, superficial, scattered, brown to dark brown, with brown conidial masses at the upper part, composed of compact, parallel, adpressed conidiophores. *Conidiophores* 1.8–2.7 µm wide, macronematous, fasciculate, cylindrical, smooth-walled, septate, unbranched, pale brown to brown, tightly compact forming synnemata. *Conidiogenous cells* 2.5–5.3 × 2.8–4.2 µm ($\overline{x}$ = 4 × 3.4 µm, n = 20), monophialidic, discrete, ampulliform, flask-shaped, cup-shaped collarette, light brown with darked at the

collarette. *Conidia* 9–15 × 3.7–5 μm ($\overline{x}$ = 12.5 × 4.4 μm, n = 25), phragmosporous, catenate, cylindrical to oblong with rounded or truncated ends, straight, (1-)3-septate when mature, always with one guttules in each cell, constricted at septa, smooth-walled, brown.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from the ends of conidia. Colonies growing on PDA, reaching ca. 36 mm diameter in 20 days at 26℃, circular, with entire margin, flat, with raise in the central part, dry, gray in the central part, brownness to pale brown towards the margin in front; dark brown in the center, paler to light brown towards the edge in reverse, and not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Anlong County, Xianheping National Forest Park, on dead stems of *Pronephrium penangianum* (Thelypteridaceae), 16 March 2022, J.Y. Zhang, J248 (holotype), ex-type living culture KUNCC23-13965.

Notes: In the phylogenetic analysis, *Synnematouspora pronephria* formed a distinct and strongly supported lineage, which is sister to *Bahusandhika indica* (GUFCC 18001) within Lentimurisporaceae. Members of *Bahusandhika* are characterized by conidiophores that are present or absent, borne terminally or laterally on the hyphae when present, and conidia are fusiform, cylindrical or rhomboidal, often verrucose (Crane & Miller, 2016; Pratibha et al., 2014; Pem et al., 2024a). However, *Synnematouspora pronephria* feathers macronematous, synnematous conidiophores, and smooth-walled, cylindrical to oblong conidia with guttules, which also can be differentiated from other genera in Lentimurisporaceae with sporodochial conidiomata, micronematous, mononematous conidiophores (Liu et al., 2018). Hence, we establish a new genus to accommodate *Synnematouspora pronephria* based on the morpho-phylogenetic evidence.

Note a–c Colonies on the host substrate. d-h Conidiophores. i–l Conidiogenous cells. m–p Conidia. q Geminated conidium. r, s Pure culture from above and below. Scale bar: d–f = 100 µm, h = 50 µm, i–k= 5 µm, g, l = 20 µm, m–q = 10 µm

Figure 3.18 *Synnematouspora pronephria* (J248, holotype)

Muriformyces J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *gen*. *nov*.

Etymology: Name refers to its muriform conidia.

Type species: *Muriformyces nigroapicale* (Bussaban, Lumyong, P. Lumyong, McKenzie & K.D. Hyde) J.Y. Zhang, K.D. Hyde & Y.Z. Lu

Saprobic on dead ferns in the terrestrial habitats. Sexual morph: undetermined. Asexual morph: hyphomycetous. Colonies on natural substrate superficial, effuse, sporodochial, pulvinata, in small groups, black, punctiform. Mycelium partly immersed, partly superficial, composed of subhyaline to brown, branched, septate hyphae. Conidiophores macronematous, septata, brown. Conidiogenous cells blastic, integrated, terminal, hyaline. Conidia acrogenous, solitary, muriform, constricted at septa, cylindrical to broadly clavate, smooth-walled, brown.

Notes: *Berkleasmium* has been considered polyphyletic and phylogenetically unresolved due to its long-term broad delimitation accommodating sporodochial species (Moore, 1958). Until Lu et al. (2018) emended that *Berkleasmium* species has associated with helicosporous fungi, with only accepting seven species resides in Tubeufiaceae, Tubeufiales be a monophyletic clade, which includes type species, *B. concinnum* (Berk.) S. Hughes. In our phylogenetic analysis, two *Berkleasmium* species forms a distinct lineage in Lentimurisporaceae, Pleosporales, which is sister to the type genus *Lentimurispora*. Therefore, we establish a new genus, *Muriformyces*, in Lentimurisporaceae, to accommodate *Berkleasmium micronesiacum* and *Berkleasmium nigroapicale*, the latter as the generic type. Morphologically, *Muriformyces* fit well with the concept of Lentimurisporaceae, and resemble the type genus *Lentimurispora* in having sporodochial, brown to black conidiomata, monoblastic conidiogenous cells and muriform, dematiaceous conidia. However, *Muriformyces* is distinguished from *Lentimurispora* by its cylindrical to broadly clavate conidia often with darked at the upper part, while *Lentimurispora* produced conidia that are lenticular with dark brown central cells and pale coloured peripheral cells. Furthermore, a comparison of nucleotide base pairs of LSU between type strains of *Berkleasmium nigroapicale* (BCC

8220) and *Lentimurispora urniformis* (MFLUCC 18-0497) showed sufficient nucleotide differences of 28/877 bp (3.2%, with 3 gaps).

Muriformyces micronesiacum (Matsush.) J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *comb. nov*.

≡ *Berkleasmium micronesiacum* Matsush., Mycol. Mem. 2: 2 (1981)

Holotype: USA, Guam, Mangilao, on the dead petiole of *Cocoris nuciferae*, 19 September 1980, Dried culture CMA, MFC-10321.

Description: see Matsushima (1981).

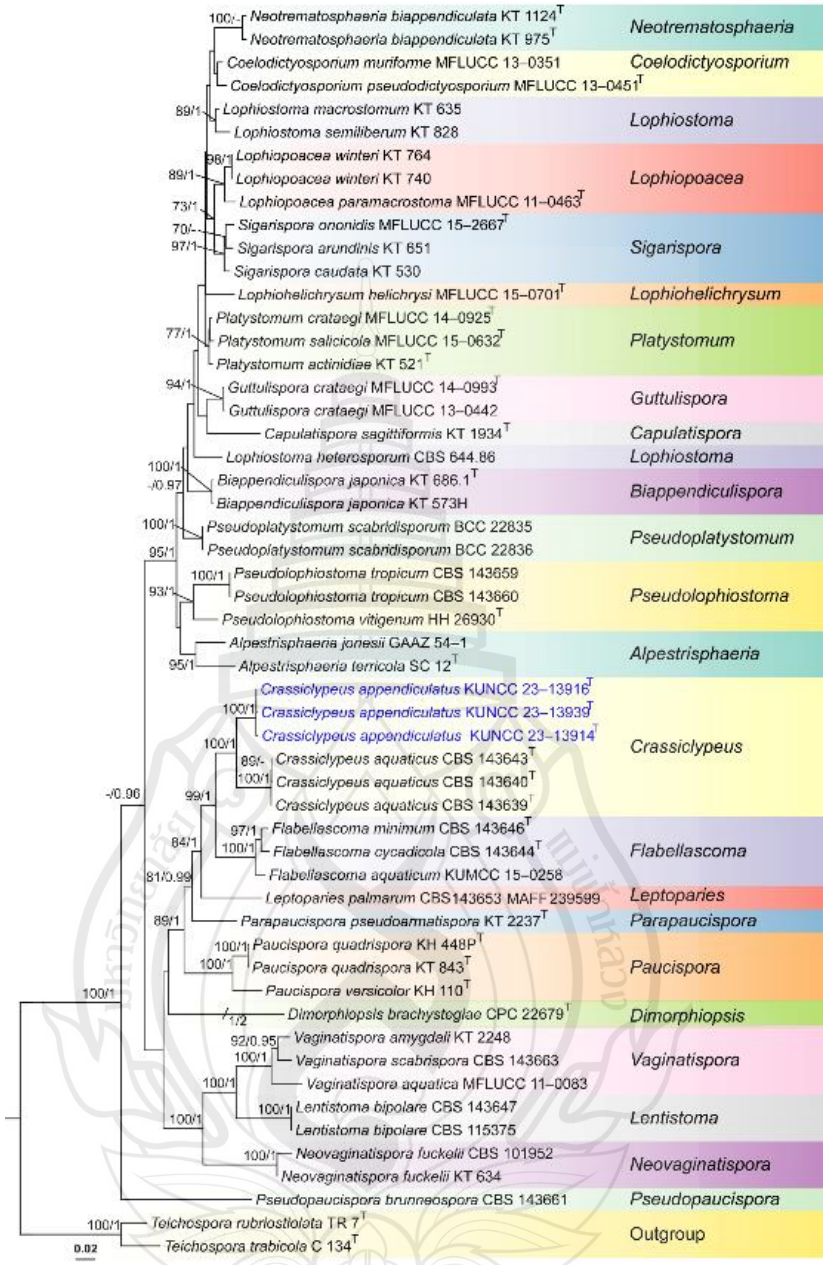
Notes: *Berkleasmium micronesiacum* was introduced by Matsushima (1981) based on morphological characteristic alone. However, phylogenetic analyses showed that *B. micronesiacum* and *B. nigroapicale* apart from the monophyletic *Berkleasmium* lineage included the type species *B. concinnum* and other six accepted *Berkleasmium* species (Pinnoi et al., 2007; Liu et al., 2018; Lu et al., 2018). Therefore, we synonymize *Berkleasmium micronesiacum* and *B. nigroapicale* to *M. micronesiacum* and *M. nigroapicale*, respectively.

Muriformyces nigroapicale (Bussaban, Lumyong, P. Lumyong, McKenzie & K.D. Hyde) J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *comb. nov*.

≡ *Berkleasmium nigroapicale* Bussaban, Lumyong, P. Lumyong, McKenzie & K.D. Hyde, Fungal Diversity 8: 80 (2001)

Holotype: THAILAND, Chiang Mai, Doi Suthep-Pui National Park, on dead pseudostems of *Amomum siamense* (Zingiberaceae), 15 October 2000, B. Bussaban CMUZS2 (POD 74415, holotype; ex-types living culture, BCC 8220 and HKUCC 7909)

Notes: *Berkleasmium nigroapicale* was introduced by from Thailand, based on morphology alone. In our phylogenetic analysis, *B. nigroapicale* clustered within *Muriformyces* and is sister to *B. micronesiacum*. Therefore, we transfer *B. nigroapicale* to *Muriformyces* as *M. nigroapicale* comb. nov. *Muriformyces nigroapicale* differs from *B. micronesiacum* by its conidia that are broadly clavate, with pale coloured basal cells and dark coloured apical cells, whereas *B. micronesiacum has* cylindrical, middle brown conidia (Matsushima, 1981; Bussaban et al., 2001).



Note Phylogram generated from maximum likelihood analysis based on combined SSU, ITS, LSU, *tef1-α* and *rpb2* sequence data. Bootstrap support values for ML equal to or greater than 70% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP.

Figure 3.19 Phylogenetic tree of *Crassiclypeu*

Lophiostomataceae Luerss., Handbuch der systematischen Botanik mit besonderer Berücksichtigung der Arzneipflanzen 1: 154 (1879)

Crassiclypeus A. Hashim., K. Hiray. & Kaz. Tanaka, Stud. Mycol. 90: 167 (2018)

Index Fungorum number: IF823131; *Facesoffungi number*: FoF 08273; 1 species associated with pteridophytes in this study.

Type species: *Crassiclypeus aquaticus* A. Hashim.

Notes: *Crassiclypeus* (Lophiostomataceae, Dothideomycetes, Ascomycota) was proposed by Hashimoto et al. (2018) for the type species *C. aquaticus*, which has both sexual and asexual morph. The sexual morph of *Crassiclypeus* is characterized by clypeate, crest-like, elongate, and laterally compressed ostiolar necks, with a well-developed peridium surrounded by brown hyphae, bitunicate asci with a long stipe, and fusiform, hyaline ascospores with a narrow bipolar sheath. The asexual morph is coelomycetous, characterized by pycnidial conidiomata, ampliform, phialidic conidiogenous cells, and aseptate, subglobose conidia (Hashimoto et al., 2018). The red pigment was produced in water agar medium of *C. aquaticus* strains. A single species *C. aquaticus* was reported as a saprobic fungus from submerged dead twigs of woody plants in aquatic habitats from Japan (Hashimoto et al., 2018). In this study, we introduce the second *Crassiclypeus* species, *C. appendiculatus* collected from ferns in terrestrial habitats.

Crassiclypeus appendiculatus J.Y. Zhang, Y.Z. Lu & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IFxx, Facesoffungi number: FoF17026; Figure 3.19 and Figure 3.20

Etymology: The species epithet "*appendiculatus*" refers to ascospores with sheath drawn out to form polar appendages

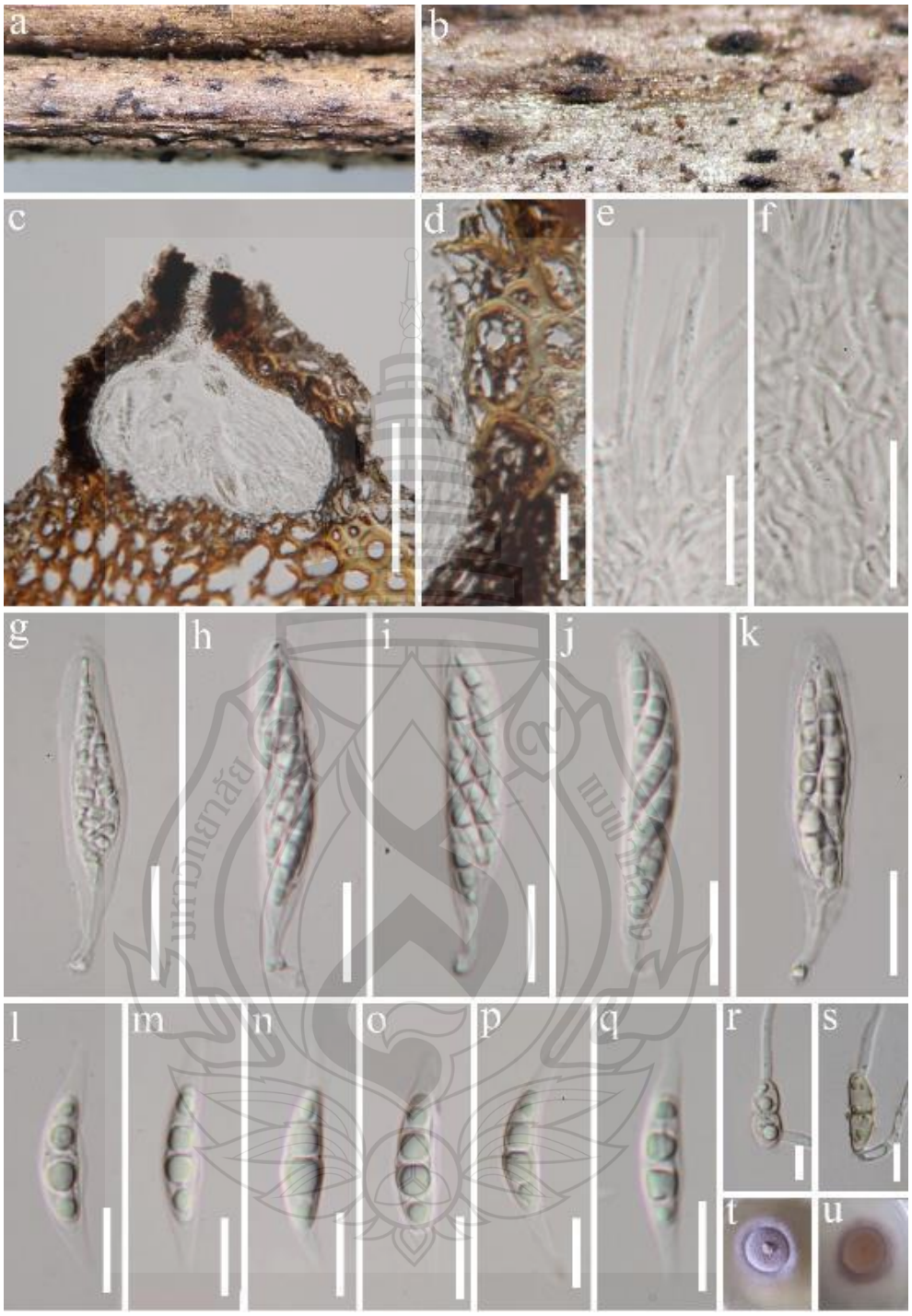
Saprobic on dead frond stalks of *Pteris vittata* (Pteridaceae) in terrestrial habitats. **Sexual morph:** *Ascomata* 182–226 µm diam. × 146–179 µm high ($\bar{x}$ = 204 × 164 µm, n = 12), perithecium, solitary, scattered to clustered, immersed to erumpent

in the host tissues, visible as black, uni-loculate, glabrous, elliptical to ampulliform, brown to dark brown. *Ostiolate* papillate, protruding from host tissues, without periphysis. *Peridium* 14.5–29.5 μm thick, intermixed with host tissue, composed of 2–6 layers, dark brown cells of *textura angularis* to *textura prismatica*. *Hamathecium* composed of 1–2.3 μm broad ($\bar{x}$ = 1.7 μm, n = 20), dense, hyaline, anastomosing, branched, smooth-walled, pseudoparaphyses. *Asci* 57.5–73 × 10–13 μm ($\bar{x}$ = 65 × 11.7 μm, n = 20), 8-spored, bitunicate, fissitunicate, clavate to cylindric-clavate, straight or slightly curved, apically rounded with ocular chamber, short pedicellate with slightly furcate pedicel, hyaline. *Ascospores* 16–22 × 3.7–5.6 μm ($\bar{x}$ = 19 × 4.7 μm, n = 30), 1–2-seriate, with a septum nearly median, constricted at the septum, fusiform with obtuse ends, straight to slightly curved, smooth-walled, guttulate, hyaline; sheath drawn out 5–7 μm long to form polar appendages, narrow, straight or slightly curved. **Asexual morph:** Undetermined.

Culture characteristics: Ascospores germinating on WA within 15 h at room temperature. The hyaline germ tube germinates from both ends of ascospores, often with yellow pigmentation at ascospores. colonies growing on PDA, slowly growth, reaching 18 mm diameter in 20 days at 26°C, circular, flat with a protuberance in the center and a circle sag in the surface, fuzzy, creamy-white in above, in reverse brownish red in the center, taupe to white from the middle ring to margin, and not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Pteris vittata* (Pteridaceae), 23 December 2021, J.Y. Zhang, J116 (HKAS 129726, **holotype**; GZAAS 23–0681, **isotype**), ex-type living culture KUNCC 23–13914; *ibid*., J119 (HKAS 129728), living culture KUNCC 23–13916; *ibid*., Aha Lake National Wetland Park, on dead petiole of *Pteris vittata* (Pteridaceae), 9 January 2022, J.Y. Zhang, J160 (HKAS 129743 = GZAAS 23–0691), living culture KUNCC 23–13939.

Notes: *Crassiclypeus appendiculatus* resembles *C. aquaticus* in having a crest-like, ostiolar neck, a dark brown peridium, anastomosed pseudoparaphyses, bitunicate clavate asci with pedicellate, and fusiform, hyaline ascospores with a narrow bipolar sheath (Hashimoto et al., 2018). However, there are noticeable different in the sizes of their microstructures. *Crassiclypeus appendiculatus* is distinguishable from *C. aquaticus* by its smaller ascomata (146–179 μm high × 182–226 μm diam. vs. 400–780 μm high × 600–1, 000 μm diam.), thinner peridium (45–70 μm vs. 14.5–29.5 μm), smaller asci (85–125 × 11–17.5 μm vs. 57.5–73 × 10–13 μm) and ascospores (16–22 × 3.7–5.6 μm vs. 20–32.5 × 5–8 μm). Phylogenetically, three strains (KUNCC 23–13914, KUNCC 23–13916 and KUNCC 23-13939) representing *C. appendiculatus* sp. nov. formed a distinct clade sister to *C. aquaticus*, reinforcing the notion that they are separate species.



Note a, b Ascomata on substrate. c Ascoma. d Peridium. e, f Paraphyses. g–k Asci. l–q Ascospores. r, s Germinated ascospores. t, u Colony on PDA from above and below. Scale bars: c = 100 µm, d–k = 20 µm, l–s = 10 µm

Figure 3.20 *Crassiclypeus appendiculatus* (HKAS 129726, holotype)

Melanommataceae G. Winter, Rabenhorst's Kryptogamen-Flora, Pilze—Ascomyceten, Edn 2 1(2): 220 (1885)

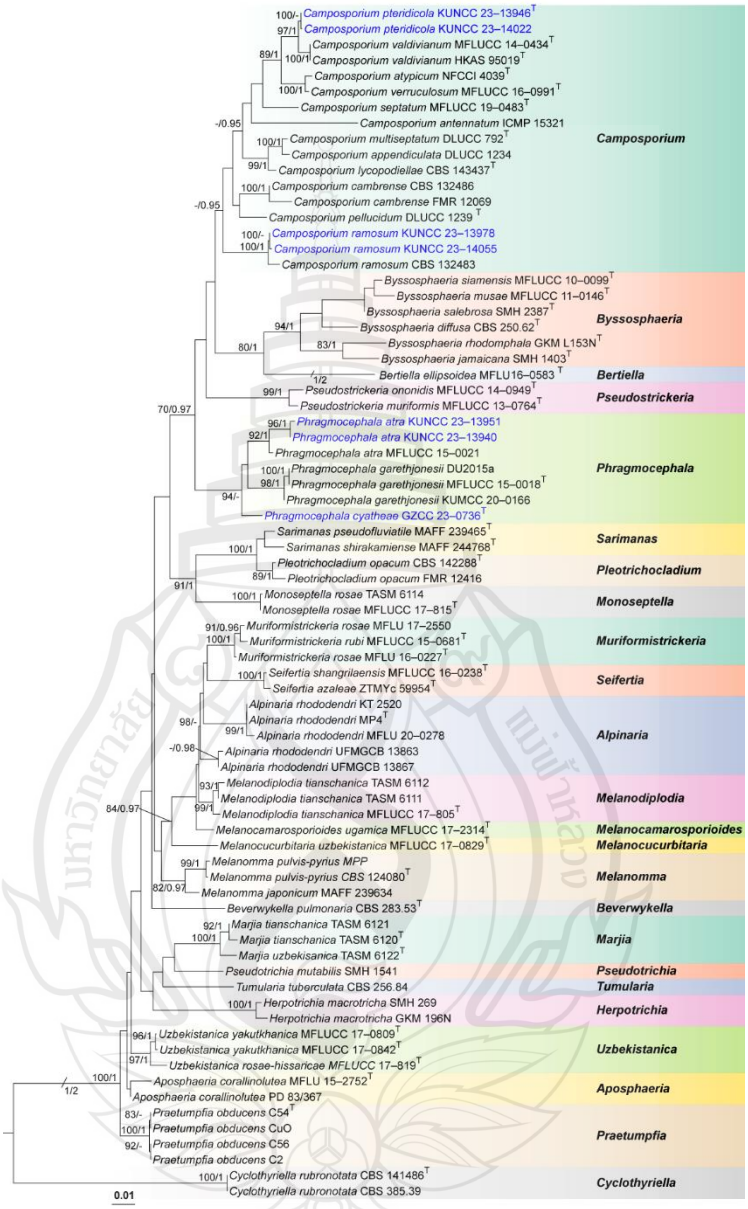
Camposporium Harkn., Bull. Calif. Acad. Sci. 1(no. 1): 37 (1884)

Index Fungorum number: IF 7479; *Facesoffungi number*: FoF08296; 4 species associated with pteridophytes.

Type species: *Camposporium antennatum* Harkn.

Notes: *Camposporium* was introduced by Harkness (1899) to accommodate the single species *C. antennatum*. The placement of this genus was unclear, and phylogenetic analyses revealed that *Camposporium* is related to the Pleosporales (Hernandez-Restrepo et al., 2017; Crous et al., 2018b), until Hyde et al. (2020c) placed *Camposporium* in Melanommataceae, Pleosporales, Dothideomycetes, Ascomycota based on phylogeny with adding more sequence data of *Camposporium* species. The genus is typically characterized by dematiaceous, simple conidiophores, terminal, integrated, polyblastic, denticulate conidiogenous cells with sympodial proliferation, and cylindrical to elongate, multiseptate conidia with one or more cylindrical appendage at the apex and often a persistent portion of attached denticle at the base (Hughes, 1951; Ellis, 1971; Whitton et al., 2002b; Hyde et al., 2020c; Xu et al., 2021; Pem et al., 2024). Later, Koukol and Delgado (2021) clarified that *Fusiconidium* is a synonym of *Camposporium* based on morphological and phylogenetic evidence explained, broadening the genetic concept with being well-development conidiophores, enteroblastic, terminal to intercalary conidiogenous cell and euseptate, fusiform conidia (Li et al., 2017b; Pratibha et al., 2017; Xu et al., 2021). Key to species of *Camposporium* were provided (Whitton et al., 2002b; Calabon et al., 2021; Xu et al., 2021), as well as morphological synopsis of *Camposporium* species (Whitton et al., 2002b; Adamčík et al., 2015). Currently, 25 species are accepted in this genus (Xu et al., 2021), and they are found worldwide on dead plant substrates in freshwater and terrestrial habitats (Guozhu et al., 2002; Pratibha et al., 2017; Hyde et al., 2020c). In this study, we followed the taxonomic treatment of *Camposporium* and updated the phylogenetic tree

of combined LSU, ITS, SSU and *tef1-α* sequence data. We introduce one new species and one new record in *Camposporium* isolated from ferns for the first time.



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, SSU and *tef1-α* sequence data. Bootstrap support values for ML equal to or greater than 70% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP.

Figure 3.21 Phylogenetic tree of Melanommataceae

Camposporium pteridicola J.Y. Zhang, Y.Z. Lu & K.D. Hyde, ***sp. nov.***

Index Forum number: IFxx; *Facesoffungi number*: FoF 17027; Figure 3.21 and Figure 3.22

Etymology: The species epithet "*pteridicola*" refers to the fungal host genus *Pteris*.

Saprobic on dead frond stalks of *Pteris vittata* (Pteridaceae) in a terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. Colonies on natural substrate superficial, effuse, hairy, brown to black, glistening. *Mycelium* partly immersed, partly superficial, composed of septate, smooth, unbranched, pale brown hyphae. *Conidiophores* 164–494 µm × 5.5–8.5 µm ($\bar{x}$ = 7.3 µm, n = 10), macronematous, mononematous, solitary or groups, straight to flexuous, cylindrical, unbranched, up to 46-septate, thick-walled, brown to reddish orange to subhyaline towards apex. *Conidiogenous cells* 7.5–18(–28) × 4.5–8.3 µm ($\bar{x}$ = 11.5 × 6 µm, n = 20), polyblastic, integrated, terminal to intercalary, sympodial, cylindrical, brown to reddish orange to subhyaline. *Conidia* 40–57.5 × 8–10 µm ($\bar{x}$ = 48 × 8.9 µm, n = 20), acropleurogenous, solitary, simple, fusiform, usually with rounded at apex and truncate base, straight, 8–11-septate when mature, no constricted or slightly constricted at septa, guttulate, light brown to brown, with light-colored at both sides.

Culture characteristics: Conidia germinating on WA within 16 h and germ tube produced from ends of conidium. Colonies growing on PDA under natural light, reaching ca. 29 mm diameter in 10 days at 25°C, circular with entire margin, flat with a protuberance in the center, taupe brown with a ring of white mycelium at the edge, not producing pigmentation in culture.

Material examined: CHINA, Guiyang City, Nanming District, Guiyang Aha Lake National Wetland Park, on dead frond stalks of *Odontosoria chinensis* (Lindsaeaceae), 9 January 2022, J.Y. Zhang, J206 (HKAS 129747, **holotype**), ex-type living culture KUNCC 23–13946; *ibid*., Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, on dead frond stalks of unidentified fern,

4 April 2022, J.Y. Zhang, J371 (GZAAS 23–0812), living culture KUNCC 23–14022.

Notes: *Camposporium pteridicola* is similar to *C. atypicum* (syn. *Fusiconidium indicum*) in having well-developed, unbranched conidiophores, polyblastic, terminal to intercalary, sympodial conidiogenous cells with acropleurogenous, brown conidia (Pratibha et al., 2017). However, they are notably distinct in conidiogenous cell sizes and conidial shapes (Pratibha et al., 2017). *Camposporium pteridicola* has 7.5–18(–28) µm long conidiogenous cells and fusiform, 8–11-septate, larger conidia with a rounded at apex and a truncate base, whereas *C. atypicum* has 40–60 µm long conidiogenous cells and obovoid, slightly curved, 5–7-septate conidia (Pratibha et al., 2017). Phylogenetically, *C. pteridicola* is not closely related to *C. atypicum*, rather it formed a distinct lineage and is sister to *C. valdivianum* (Syn. *Fusiconidium mackenziei*) with strong statistical support. This may be due to the unavailability of ITS sequence for *C. valdivianum*. Moreover, *C. pteridicola* has larger conidiophores (164–494 µm × 5.5–8.5 µm vs. 91–114 µm × 8.5–11 µm) with more septate conidiophores (up to 46-septate vs. 7–9-septate), polyblastic, terminal to intercalary conidiogenous cells with sympodial proliferations, and acropleurogenous, longer conidia [40–57.5 µm vs. 38–40 µm], while *C. valdivianum* has enteroblastic, monoblastic, terminal, conidiogenous cells with percurrently proliferating, and acrogenous conidia (Li et al., 2017b). Thus, we introduce a new species, *Camposporium pteridicola*.

Note a The host substrate. b Colonies on substrate. c–e Conidiophores with conidiogenous cells. f Conidiogenous cells with conidia. g–j Conidia. k Colony on PDA from above and below. Scale bars: c = 100 µm, d–f = 50 µm, g–j = 20 µm

Figure 3.22 *Camposporium pteridicola* (HKAS129747, holotype)

Note a Colonies on substrate. b–e Conidiophores with conidiogenous cells. f–k Conidia. l Germinated conidium. m, n Colonies on PDA from above and below. Scale bars: b–l = 20 μm

Figure 3.23 *Camposporium ramosum* (GZAAS 23–0813)

Camposporium ramosum Whitton, McKenzie & K.D. Hyde, Fungal Diversity 11: 183 (2002)

Index Forum number: IF489895; *Facesoffungi number*: FoF 16039; Figure 3.23

Holotype: HKU(M)12924

Saprobic on dead frond stalks of *Woodwardia* sp. (Blechnaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, pale brown. *Mycelium* mostly immersed, composed of branched, septate, smooth, hyaline hyphae. *Conidiophores* 45–85 × 4.4–6.7 µm ($\bar{x}$ = 69.5 × 5.5 µm, n = 20), macronematous, mononematous, often procumbent on substrate, solitary, erect, cylindrical, straight or flexuous, often irregularly bent, unbranched, thick-walled, brown, paler towards the apex. *Conidiogenous cells* 9.5–28.8 × 5–7 µm ($\bar{x}$ = 18.5 × 6 µm, n = 20), holoblastic, polyblastic, integrated, terminal, denticulate, cylindrical, subhyaline to pale brown. *Conidia* 44.5–62 × 5.5–8.5 µm ($\bar{x}$ = 55 × 7.5 µm, n = 30), acrogenous, solitary, cylindrical, rounded at apex, truncate at basal cell, often with a persistent portion of the denticle attached, 7–10-septate, no constricted slightly constricted, with a filiform, hyaline, often bearing 1–3 divergent, non-septate setulae at the apical cell, smooth-wall, pale brown, with the end cells being colourless or subhyaline.

Culture characteristics: Conidia germinating on WA within 13 h and germ tube produced from conidia. Colonies growing on PDA under natural light, reaching ca. 22 mm diameter in 14 days at 26°C, circular with entire margin, flat, cottony, fluffy, veined, white from above; black to brownish green to light cream yellow from center to edge in reverse, not producing pigmentation in culture.

Material examined: CHINA, Qianxinan Buyi and Miao Autonomous Prefecture, Zhenfeng County, Huanlian Township, Fengyouwan Village, (25°19'41‘’N,105°40'20‘‘E), on dead frond stalks of *Woodwardia* sp. (Blechnaceae), 17 March 2022, J.Y. Zhang, J275-1 (GZAAS 23–0813), living culture KUNCC 23–13978; China, Guizhou

Medicinal Botanical Garden, on dead stems of *Plenasium vachellii* (Osmundaceae), 13 December 2021, J.Y. Zhang, J68 (GZAAS 23–0814), living culture KUNCC 23–14055.

Known hosts: An unidentified broadleaf tree (Li et al., 2017a); *Freycinetia scandens* and *F. arborea* (Whitton et al. 2002b); *Plenasium vachellii* (Osmundaceae) and *Woodwardia* sp. (Blechnaceae) (this study).

Distribution: Australia; China; USA (Whitton et al., 2002b; Li et al., 2017a; this study).

Notes: Our new collection matches well with the original diagnosis of the type specimen of *Camposporium ramosum* (HKU(M)12924), except that the type specimen has larger conidia with more septa (80–112 × 6.4–9.6 µm vs. 44.5–62 × 5.5–8.5 µm; 8–15-septate vs. 7–10-septate) (Whitton et al., 2002b). However, both the morphology of our new collection and the new geographical record of *C. ramosum* (HSAUP H7919) are indistinguishable (Li et al., 2017a). The phylogenetic tree (Figure 3.55) confirms that our new isolates are conspecific with *C. ramosum*.

Note a Colonies on substrate. b–d Conidiophores wih attached conidia. e Conidiogenous cells with conidia. f–i Conidia. j Germinated conidium. k Colony on PDA from above and below. Scale bars: b–e = 50 µm, f–j = 20 µm

Figure 3.24 *Phragmocephala atra* (HKAS 129744)

Phragmocephala atra (Berk. & Broome) E.W. Mason & S. Hughes, Naturalist: 97 (1951)

Index Fungrorm number: IF303243, *Facesoffungi number*: FOF00573; Figure 3.24

Saprobic on dead petiole of *Pteris vittata* (Pteridaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* superficial, scattered, glistening, dark brown to black. *Mycelium* mostly immersed, composed of septate, smooth, hyaline to brown hyphae. *Conidiophores* 120–222 × 4.7–6.9 µm ($\bar{x}$ = 185 × 5.7, n = 12), synnematous 16–29.5 µm wide ($\bar{x}$ = 22 µm, n = 25 µm), flared at the 1/3 upper part of conidiophores, macronematous, septate, unbranched, erect, dark brown at the base, pale brown to subhyaline at apex, septate, black at the base, pale to subhyaline towards apex. *Conidiogenous cells* 8.5–27 × 5.8–9.5 µm ($\bar{x}$ = 16.5 × 8, n = 20), monoblastic, terminal, integrated, often separating from the conidium through a break or frill below the base of conidium, cylindrical, hyaline to light brown. *Conidia* 25–32 × 16–20 µm ($\bar{x}$ = 28.7 × 17.5 µm, n = 25), acrogenous, solitary, ellipsoidal, rounded at apex, rounded to truncate at base, 4-septate, no constricted at the septa, smooth-walled, thick-walled, dark brown to black at central cells, with a thick dark band on the central septum, sub-hyaline to pale brown at apical and basal cells; conidial secession schizolytic.

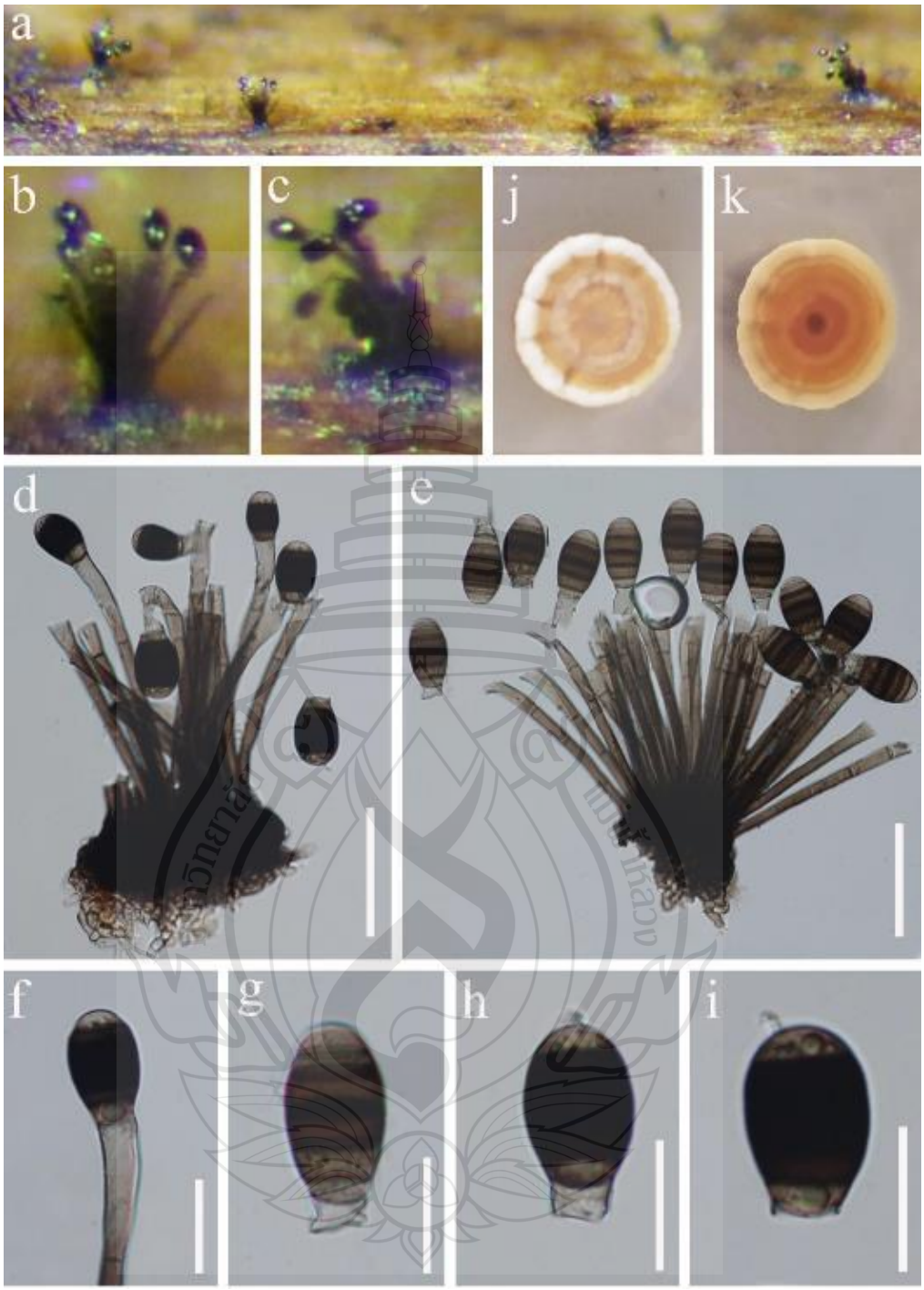
Culture characteristics: Conidia germinating on WA within 15 h. Colonies growing on PDA under natural light, reaching ca. 23 diam. in 22 days at room temperature, circular with entire margin, flat, with a fluffy, aurantiacus protuberance in the center, velvety, aurantiacus to yellow to light yellow from center to edge, not producing pigmentation in culture.

Know hosts: Decaying wood (Su et al. 2015); Urtica dioica (Ellis, 1959); *Pteris vittata* (Pteridaceae) and *Woodwardia unigemmata* (Blechnaceae) (this study).

Distribution: China (Su et al., 2015, this study); Great Britain and Italy (Ellis, 1959).

Material examined: CHINA, Guizhou Province, Guiyang City, Aha Lake National Wetland Park, on dead petiole of *Pteris vittata* (Pteridaceae), 9 January 2022, J.Y. Zhang, J161 (HKAS 129744), living culture KUNCC 23–13940; CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Woodwardia unigemmata* (Blechnaceae), 23 December 2021, J.Y. Zhang, J217 (GZAAS 23–0694,), living culture KUNCC 23–13951.

Notes: The morphological description of our new collections are similar to *Phragmocephala atra* (Su et al., 2015), but they have minor differences in sizes of conidiophores (120–222 × 4.7–6.9 μm vs. 128–157 × 6.5–8.5 μm) and conidia (25–32 × 16–20 μm vs. 30–35 ×16–19 μm). Furthermore, sequence similarity of the LSU, ITS, and SSU gene regions between our new isolates (KUNCC 23–13940) and *P*. atra (MFLUCC 15–0021) is 99.76% (848/850 bp), 98.22% (498/507 bp, including 3 gaps) and 99.9% (1020/1021, including 1 gap) similarities, respectively. Therefore, we identified our new collections as *P*. *atra* based on morphological and phylogenetic evidence, and it is new to ferns. Additionally, *tef1-α* sequence is provided for the species *P*. *atra* for the first time.



Note a–c Colonies on host substrate. d, e Conidiophores, conidiogenous cells and conidia. f Conidiogenous cell with conidia. g–i Conidia. j, k Colony on PDA from above and below. Scale bars: d, e = 50 μm, f–i = 20 μm

Figure 3.25 *Phragmocephala cyatheae* (GZAAS 23–0815, holotype)

Phragmocephala cyatheae J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

Facesoffungi number: FoF 17028; Figure 3.25

Etymology: The species epithet "*cyatheae*" refers to the host family Cyatheaceae.

Holotype: GZAAS 23–0815

Saprobic on dead fronds of Cyatheaceae in a terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered, glistening, dark brown to black. *Mycelium* partly immersed, partly superficial, composed of smooth, septate, hyaline to pale brown, 1.5–3.4 µm wide ($\bar{x}$ = 2.7 µm) hyphae. *Conidiophores* 79–112 × 3–4.7 µm ($\bar{x}$ = 91 × 3.8 µm, n = 25 µm), macronematous, mononematous, in groups from the mycelial knots, septate, unbranched, erect, black or dark brown at the base, subhyaline to pale brown at apex, 3–5-septate. *Conidiogenous cells* 15–33 × 5.2–7.4 (–9.2) µm ($\bar{x}$ = 24.7 × 6.3, n = 18), monoblastic, terminal, integrated, elongated, slightly wider at the apex, subhyaline to pale brown. *Conidia* 20–33 × 13–18.5 µm ($\bar{x}$ = 27 × 15.6 µm, n = 25), acrogenous, solitary, ellipsoidal, rounded at apex, rounded to truncate at base, usually 5-septate, not constricted at septa, smooth-walled, dark brown to black at central cells, with a thick dark band on the central septum, sub-hyaline to pale brown at apical and basal cells; conidial secession schizolytic.

Culture characteristics: Conidium germinating on PDA within 15 h. Colonies growing on PDA under natural light, reaching ca.12 mm diameter in 20 days at 25℃, circular, with entire margin, flat, with a protuberance in the center and indentations radiating from the center, causing the surface to be fan shape, aurantiacus in the center, followed by light yellow to aurantiacus to white in concentric circles towards the edge, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Zunyi city, Chishui county, Hushi Town, Chishui Alsophila Natural Reserve (28°29'43" N, 106°0'24" E), on dead fronds of Cyatheaceae sp. by the side of a stream, 22 September 2019, Jing-Yi Zhang, C14 (GZAAS 23–0815, holotype), ex-type living culture GZCC 23–0736.

Notes: *Phragmocephala cyatheae* fits well with the generic concept and is most similar to *P. garethjonesii* in having mononematous, unbranched conidiophores which are in groups, monoblastic elongated conidiogenous cells and ellipsoidal to subglobose conidia with secession schizolytic (Su et al., 2015). However, *Phragmocephala cyatheae* has notably shorter conidiophores (79–112 μm vs. 163.5–199.5 μm). In addition, BLAST results of ITS and *tef1-α* sequence data indicate that *P. garethjonesii* is the closest species to our new species *P. cyatheae*, with similarities of 96.62% (NR_147636, 486/503 bp, including 3 gaps) and 96.78% (MZ394067, 903/933 bp, no gap). Moreover, our phylogenetic analysis indicated that *P. cyatheae* sp. nov. constitutes an independent lineage that is sister to the clade including *P. atra* and *P. garethjonesii*.

Periconiaceae Nann., Repert. mic. uomo: 482 (1934)

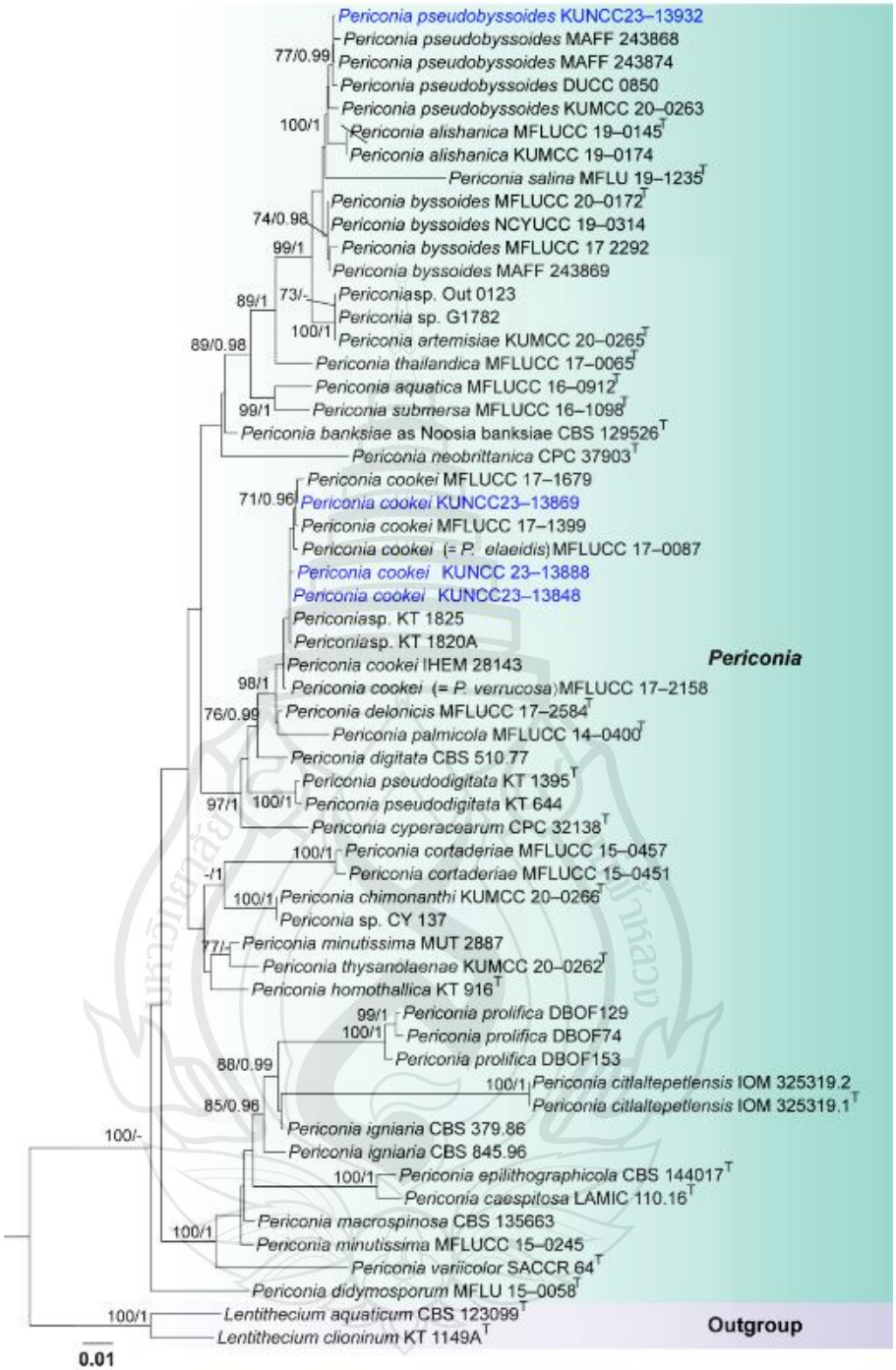
Periconia Tode, Fung. mecklenb. sel. (Lüneburg) 2: 2 (1791)

Index Fungorum number: IF 9263; *Facesoffungi number*: FoF 06658; 5 species associated with pteridophytes (including 3 species newly described in this study).

Type species: *Periconia lichenoides* Tode

Notes: The polyphyletic genus *Periconia* (Periconiaceae, Dothideomycetes, Ascomycota) was introduced by Tode (1791) and typified by *P. lichenoides*. *Periconia* species are mainly known from their asexual morphs and are characterized by macronematous, mononematous conidiophores; monoblastic to polyblastic conidiogenous cells that are discrete on the terminal or intercalary of the stipe; ellipsoidal to oblong, catenate or solitary, smooth or verruculose conidia (Ellis, 1971; Markovskaja & Kačergius, 2014; Hyde et al., 2018a; Calvillo-Medina et al., 2020; Su et al., 2023; Pem et al., 2023). Five specie, namely *P. didymosporum*, *P. homothallica*, *P. igniaria*, *P. prolifica*, and *P. pseudodigitata*, are represented by sexual morphs, characterized by globose ascomata with a central ostiole, fissitunicate asci with a short stalk and broadly fusiform, 1-septate, hyaline ascospores with an entire sheath (Tanaka et al., 2015; Yang et al., 2022b). Index Fungorum (August 2024) has listed 228 epithets

under *Periconia*, while 139 morphological species have been listed in Species Fungorum). However, only 44 species are supported by sequence data (Thambugala et al., 2017; Hongsanan et al., 2020a; Yang et al., 2022b; Su et al., 2023; Zhang et al., 2024). Members of *Periconia* are widely distributed and occur as endophytes, saprobes and pathogens on various hosts, especially graminaceous plants (Leukel, 1948; Ellis, 1971, 1976; Romero et al., 2001; Carmarán & Novas, 2003; Markovskaja & Kačergius, 2014; Yang et al., 2022b; Su et al., 2023). The earliest association of *Periconia* species related to pteridophytes is *P. shyamala* found on dead fronds of *Pteridium aquilinum* (Dennstaedtiaceae) in England, United Kingdom (Hawksworth & Punithalingam, 1975). The second species, *P. byssoides*, related to pteridophytes was also found on decomposing petioles of *Pteridiurn aquilinum* in the United Kingdom (Frankland, 1976). Phookamsak et al. (2024) introduced *P. kunmingensis* on dead, standing rachis of a fern from China. In this study, we describe *P. cookei* and *P. pseudobyssoides* isolated from ferns based on evidence of morphology and phylogeny. Additionally, *Periconia elaeidis* and *P. verrucosa* are synonymized under *P. cookei* based on conspecific phylogenetic relationship and morphological comparison (Figure 3.26).



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, SSU and *tef1-α* sequence data. The tree was rooted to *Lentithecium aquaticum* CBS 123099 and *L. clioninum* KT 1149A.

Figure 3.26 Phylogenetic tree of *Periconia*

Periconia cookei E.W. Mason & M.B. Ellis, Mycol. Pap. 56: 72 (1953)

= *Periconia elaeidis* T. Sunpapao & K.D. Hyde, in Hyde et al., Mycosphere 9(2): 323 (2018)

= *Periconia verrucosa* Phukhams., Ertz, Gerstmans, and K.D. Hyde, in Phukhamsakda et al. Fungal Diversity, 102(1): 71 (2020)

Index Forum *number*: IF 302477; *Facesoffungi number*: FoF 03856; Figure 3.27

Holotype: IMI 16174

Saprobic on dead petiole of *Equisetum* sp. (*Equisetaceae*) in terrestrial habitats (HKAS 129701). Sexual morph: Undetermined. Asexual morph: Hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered, hairy, dark brown to black. *Mycelium* partly immersed, partly superficial, composed of septate, branched, brown hyphae. *Conidiophores* 485–816 × 8–12.5 µm, macronematous, mononematous, solitary, cylindrical, straight or slightly flexuous, with a knot-like at the base, branched at the apex, thick-wall, black to dark brown towards the apex. *Conidiogenous cells* 6–9 × 3.8–4.7 µm ($\bar{x}$ = 7.3 × 4.3 µm, n = 20), polyblastic, discrete, terminal, cylindrical to ellipsoidal, pale brown to brown. *Conidia* 10.5–13 µm diam. ($\bar{x}$ = 12 µm, n = 25), acrogenous, solitary or catenate in chains, oval to globose, aseptate, smooth to echinulate or minutely verruculose, pale yellow to brown.

Culture characteristics: Conidia germinating on WA within 15 h. Colonies growing on PDA, reaching 30 mm diameter in 10 days at 25°C in natural light, circular, with entire margin, flat with a protuberance in the center, white from above; cream yellow with orange spot in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Tongren City, Jiangkou County, Taiping Town, Banaogou Group, on dead petiole of *Equisetum* sp. (Equisetaceae) in a distributed forest, 21 May 2022, J.Y. Zhang, F10-1 (HKAS 129701), living culture KUNCC 23–13869; CHINA, Guizhou Province, Bijie City, Weining County, (26°44‘19.66”N, 104°32’3.9‘’E), on dead frond stalks of *Pteridium revolutum* (Dennstaedtiaceae) in a distributed forest, 19 June 2022, J.Y. Zhang, F60 (HKAS

129711), living culture KUNCC 23–13888; CHINA, Guizhou Province, Zunyi City, Chishui County, Hushi Town, on dead frond stalks of Athyriaceae sp., 27 July 2022, J.Y. Zhang, A75 (HKAS 129689), living culture KUNCC 23–13848.

Known hosts: on *Arctium lappa*, *Conium maculatum*, *Eupatorium cannabinum*, *Heracleum sphondylium*, *Ranunculus acris* and *Urtica dioica* (Mason & Ellis, 1953); On *Artemisia* sp., *Sasa kurilensis*, *Clematis viticella* (Phukhamsakda et al., 2020); on Athyriaceae sp., *Equisetum* sp., *Pteridium revolutu* (this study); On *Digitaria sanguinalis*, *Neyraudia reynaudiana*, *Pennisetum polystachion*, *Phyllostachys nigra*, *Stipa tenuissima* (Su et al., 2023); on decaying wood and oil palm leaves (Hyde et al., 2018a);

Distribution: China (Hyde et al., 2018a; Su et al., 2023 this study); Belgium, Japan (Phukhamsakda et al., 2020); England, Germany and Sarnia Island (Mason & Ellis, 1953); Thailand (Hyde et al., 2018a).

Notes: *Periconia cookei*, *P. elaeidis*, *P. verrucosa* and our new collections clustered together without distinct branches in the phylogenetic tree. They exhibit similar morphology but have some differences in the sizes of conidiophores and conidia. (Table 3.3). *Periconia cookei* was introduced by Mason and Ellis (1953) and was designated a reference specimen by Hyde et al. (2018a) based on the shape and diameter of conidia. Hyde et al. (2018a) introduced *P. elaeidis* based on minor branches in phylogenetic tree and notably sizes of conidiophores (8–10 µm wide vs 15.5–19.5 µm wide) and conidia (4–5-6.5 µm vs 12–15 µm). However, conidiophore and conidial sizes in *Periconia* species show significant variability, which complicates species differentiation. For example, conidiophores of *P. cookei* are 360–800 µm long in the holotype, but 240–372 µm and 310–515 µm long in the reference specimen and additional collection, respectively (Mason & Ellis, 1953; Hyde et al., 2018; Su et al., 2023); Similarly, conidiophores in *P. verrucosa* are 170–29 µm long in the holotype, but 353–545 µm long in the other collections (Phukhamsakda et al., 2020; Su et al., 2023); conidia of *P. cookei* are 16 diam. in the holotype and reference specimen, but

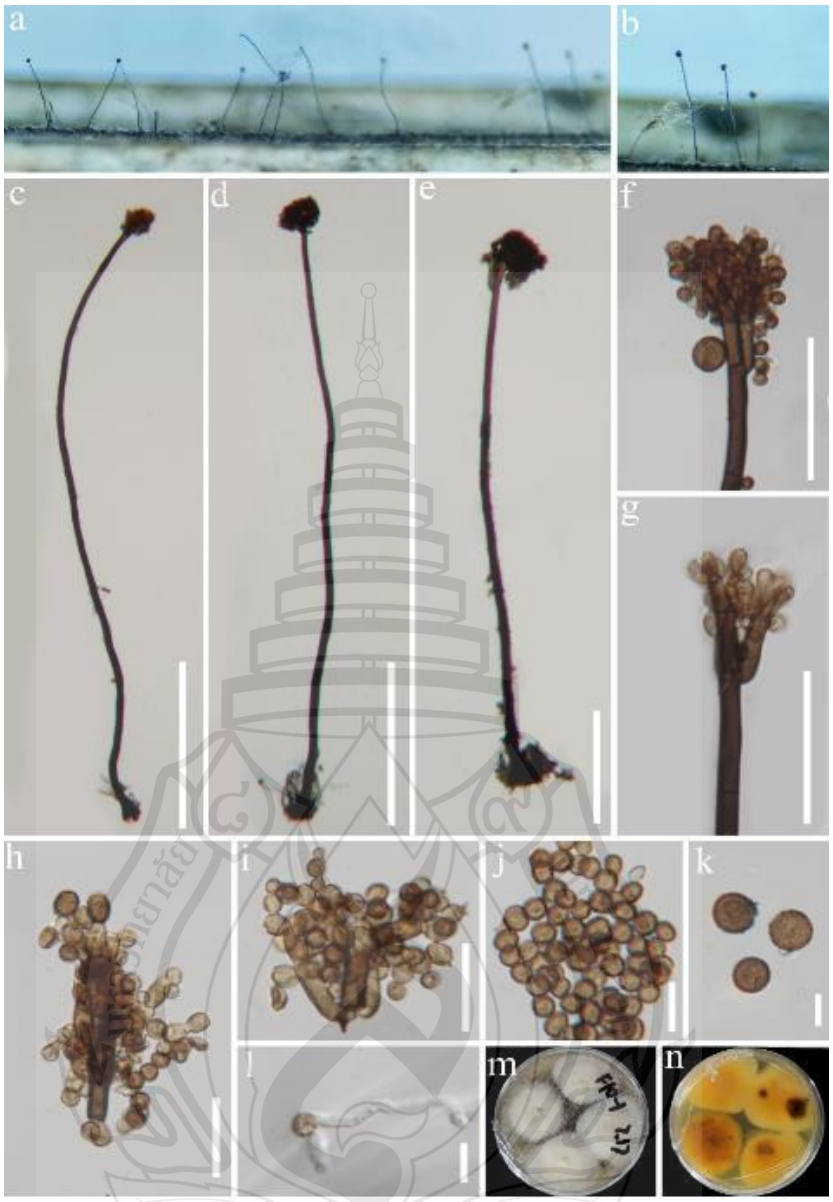
5–8 × 5–7 µm in the specimen HUEST 22.0135. This variability suggests that conidial size is less reliable as a taxonomic marker for distinguishing certain *Periconia* species. Our collections further support this [conidiophores: 485–816 × 8–12.5 µm (HKAS 129701) vs. 230–463.5 × 9.5–16 µm (HKAS 129711); conidia: 10.5–13 µm diam. (HKAS 129701) vs. 6–7.5 µm diam. (HKAS 129711)]. Both morphological and nucleotides comparisons of ITS, LSU and TEF sequence data between *Periconia cookei* and phylogenetically related species are provided in Table 3.3 and Table 3.4. This revealed no significant differences in morphological characters and base pair between them (Table 3.4). Therefore, we identify our isolates as *P. cookei* and synonymize *P. elaeidis* and *P. verrucosa* under *P. cookei* based on the nomenclatural priority.

Table 3.3 Morphological comparison of *Periconia cookei*, *P. elaeidis*, *P. verrucosa* and new collections

Species	Conidiophores (µm)	Conidiogenous cells (µm)	Conidia (µm)	Reference
P. cookei (IMI 16174)	360–800 long	7–11 diam.	13–16 diam.	Mason and Ellis (1953)
P. elaeidis (MFLU 18–0626)	200–400 × 8–10	-	4.5–6.5 diam.	Hyde et al. (2018a)
P. verrucosa (MFLU 17–151)	170–296×10–12	11–26 × 6–14	7–15 diam.	Phukhamsakda et al. (2020)
New collection (HKAS 129701)	485–816 × 8–12.5	6–9 × 3.8–4.7	10.5–13 diam.	This study
New collection (HKAS 129711)	230–463.5 × 9.5–16	(4.5–)6.5–8.5 × 3.5–5.3	6–7.5 diam.	This study

Table 3.4 Comparison of nucleotide differences between *Periconia cookei* (MFLUCC 17–1399) and *P. elaeidis*, *P. verrucosa* and new isolate (KUNCC 23–13888)

Species	ITS	LSU	TEF
P. elaeidis (MFLUCC 17–0087)	1/497 (no gap)	7/813 (including 2gap)	No available
P. verrucosa (MFLUCC 17–2158)	5/487 (including 3 gaps)	3/778 (including 1gap)	3/736(no gap)
New isolates (KUNCC 23–13888)	1/497(no gap)	3/824(including 1 gap)	3/736 (no gap)



Note a, b Colonies on the host. c–e Conidiophores. f–i Conidiogenous cells and conidia. j, k Conidia. l Germinated conidium. m, n Colonies on PDA from above and below. Scale bars: c, d = 200 µm, e = 100 µm, f, g = 50 µm, h, i = 20 µm, j–l = 10 µm

Figure 3.27 *Periconia cookei* (HKAS 129701)

Note a The host substrate. b Colonies on substrate. c, d Conidiophores with attached conidia. e, f Conidiogenous cells. g, h Conidia. i Germinated conidium. j, k Colonies on PDA from above and below. Scale bars: c, d = 200 µm, e, f = 30 µm, g–i = 10 µm

Figure 3.28 *Periconia pseudobyssoides* (HKAS 129735)

Periconia pseudobyssoides Markovsk. & A. Kačergius, Mycological Progress 13 (2): 293 (2014)

Index Fungorum number: IF804763; *Facesoffungi number*: FoF03857; Figure 3.28

Holotype: BILAS 50334

Saprobic on dead frond stalks of *Alsophila metteniana* (Cyatheaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, hairy, dark brown to black. *Mycelium* partly immersed, partly superficial, composed of septate, brown hyphae. *Conidiophores* 813–1093 × 15–20 µm ($\bar{x}$ = 909 × 17 µm, n = 15), macronematous, mononematous, solitary, rarely 1−2 together arising from inconspicuous stromatic base, cylindrical, straight or slightly flexuous, swollen at the apex, unbranched, septate, black to brown from base towards the apex. *Conidiogenous cells* 7.9–12.5 × 7.7–11 µm ($\bar{x}$ = 10 × 9 µm, n = 20), polyblastic, integrated, terminal, ellipsoidal to subglobose, pale brown to brown. *Conidia* 9–14.5 µm diam. ($\bar{x}$ = 11 µm, n = 30), acrogenous, solitary or catenate in chains, spherical or globose, aseptate, smooth to echinulate or minutely verruculose, pale to dark brown.

Culture *characteristics*: Conidia germinating on WA within 15 h. Colonies growing on PDA, reaching 33 mm diameter in 10 days at 25℃ in natural light, circular with entire margin, flat, cottony to fluffy, white; the reverse of the colony is dark brown-yellow in the center with a white margin, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Alsophila metteniana* (Cyatheaceae), 23 December 2021, J.Y. Zhang, J146 (HKAS 129735), living culture KUNCC 23–13932.

Known hosts: on *Alsophila metteniana* (Cyatheaceae) (this study); on *Heracleum sosnowskyi* (Markovskaja & Kačergius, 2014); On *Euphorbia ingens* (Euphorbiaceae) (Crous et al., 2022); on *Digitaria sanguinalis* (Poaceae) (Su et al.,

2023); on *Cananga odorata*; on decaying wood (Hyde et al., 2018a); from the surface of the outdoor stone sculptures (Boniek et al. 2017); on *Berchemia racemose* (Rhamnaceae) and *Rodgersia podophylla* (Saxifragaceae) (Yang et al., 2022b); on *Magnolia* sp. (Magnoliaceae) (de Silva et al., 2022); on *Scrophularia ningpoensis* (Scrophulariaceae) (Yang et al., 2022b).

Distribution: Brazil (Boniek et al., 2017); China (Hyde et al., 2018a; de Silva et al., 2022; Yang et al., 2022b; Su et al., 2023; this study); Lithuania (Markovskaja & Kačergius, 2014); Japan (Yang et al., 2022b); South Africa (Crous et al., 2022); Thailand.

Notes: Based on the phylogenetic analysis of LSU, ITS and TEF sequence, our collection KUNCC 23–13932 clustered with *Periconia pseudobyssoides* strains. Moreover, our collection matches well with the description of *P. pseudobyssoides*. We therefore identified our collections as *P. pseudobyssoides*. *Periconia pseudobyssoides* is a species with a worldwide distribution, found on various substrates from both freshwater (Hyde et al., 2018a) and terrestrial habitats (Markovskaja & Kačergius, 2014; Tanaka et al., 2015; Crous et al., 2022; de Silva et al., 2022; Yang et al., 2022b; Su et al., 2023), as well as being present as an environmental fungus (Boniek et al., 2017). Our isolate KUNCC 23–13932 was obtained from the dead frond stalks of *Alsophila metteniana* (Cyatheaceae), representing the first reported occurrence of *Periconia pseudobyssoides* on fern.

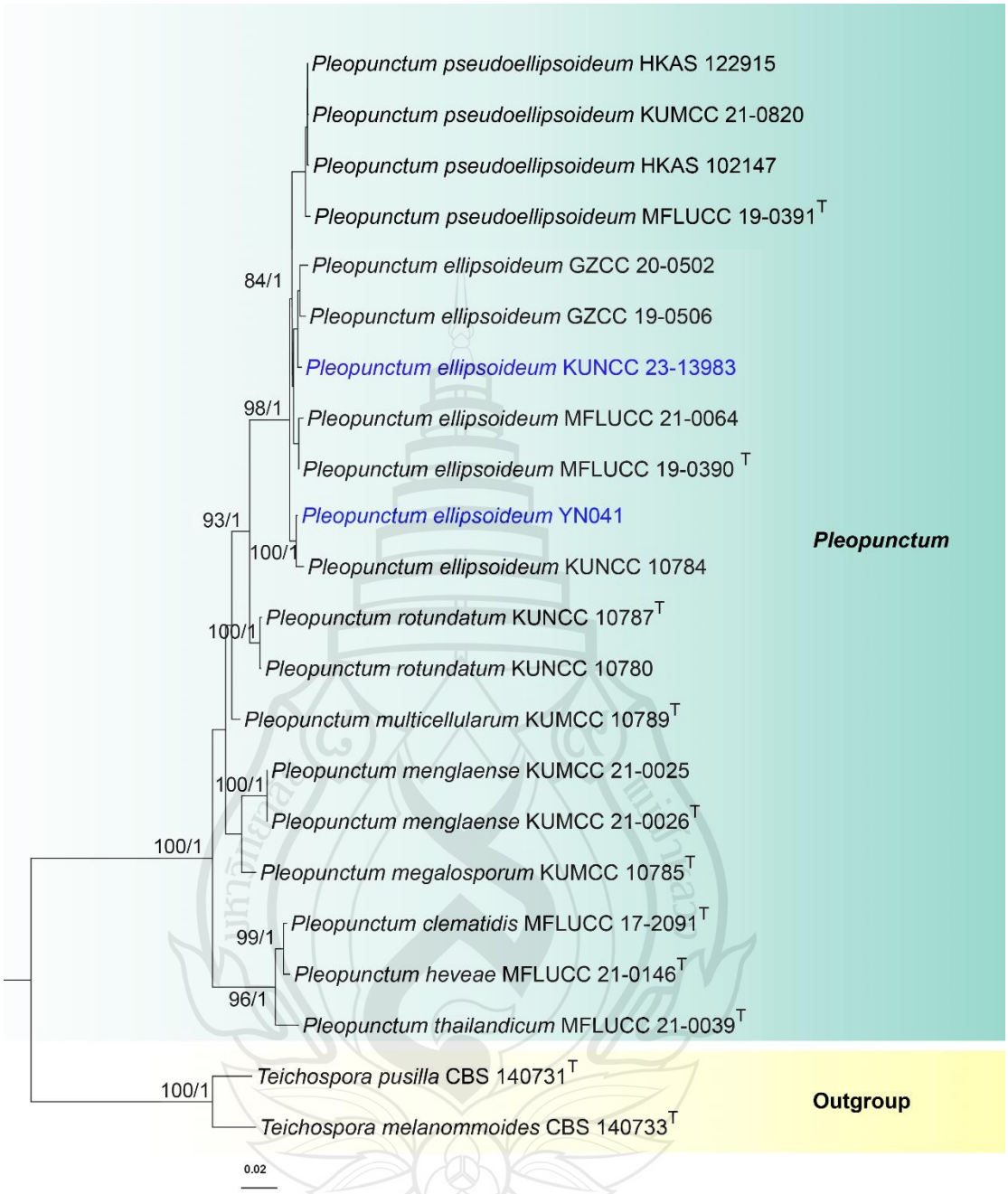
Phaeoseptaceae Boonmee, Thambugala & K.D. Hyde, Mycosphere 9(2): 323 (2018)

Pleopunctum N.G. Liu, K.D. Hyde & J.K. Liu Mycosphere 10(1), 757–775 (2019).

Index Fungorum number: IF556522; *Facesoffungi number*: FoF06113; 1 species associated with pteridophytes in this study.

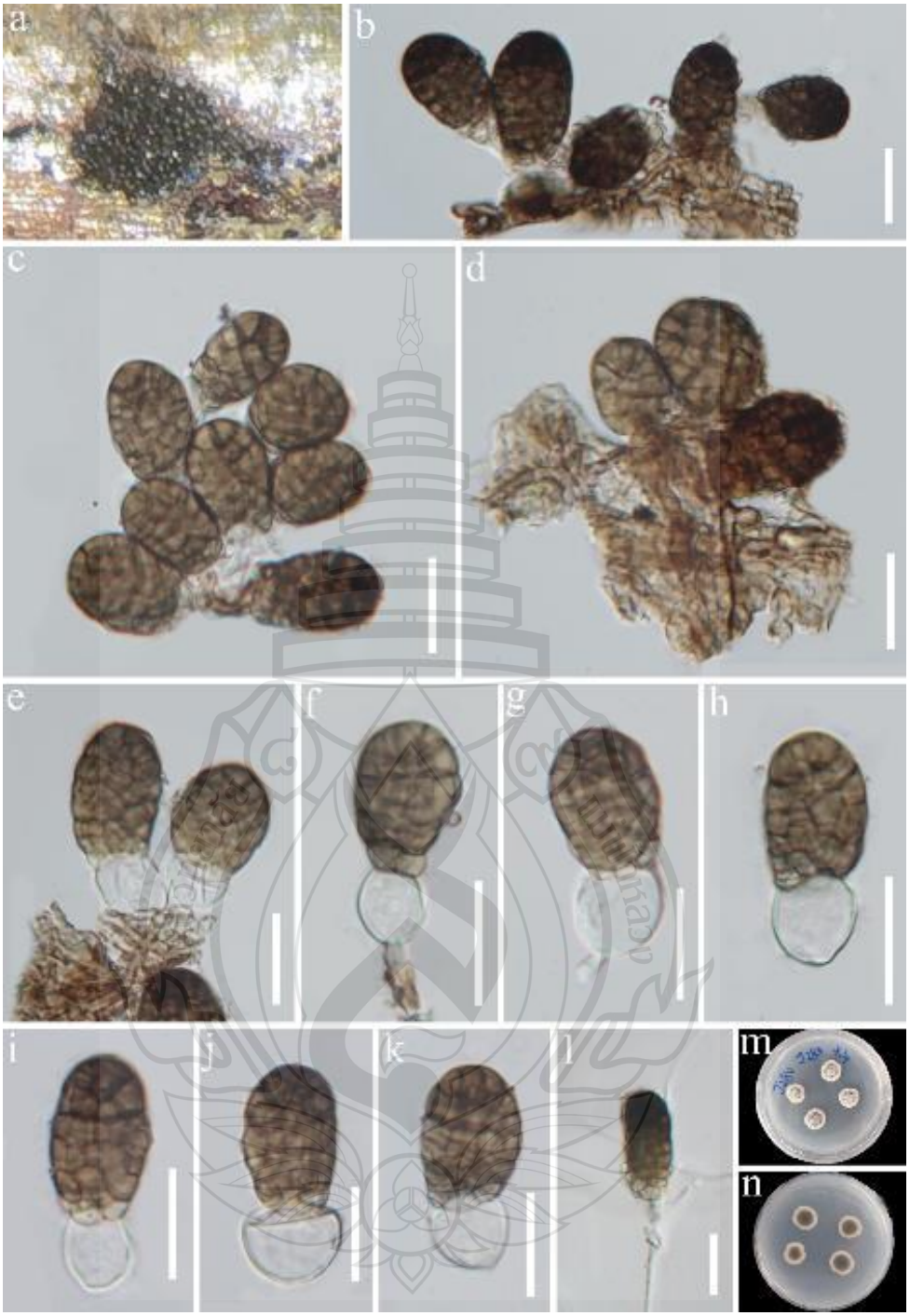
Type species: *Pleopunctum ellipsoideum* N.G. Liu, K.D. Hyde & J.K. Liu

Notes: The hyphomycetous genus, *Pleopunctum* in Phaeoseptaceae (Pleosporales, Dothideomycetes, Ascomycota) was established by Liu et al. (2019) to accommodate *P. ellipsoideum* and *P. pseudoellipsoideum* based on morphological evidence, multi-gene phylogenetic analysis, and divergence time estimates. Currently, ten species with morphology and molecular were accepted in *Pleopunctum* (Xu et al., 2023a). *Pleopunctum* is characterized by sporodochial conidiomata, macronematous, mononematous conidiophores, monoblastic conidiogenous cells produced muriform, ellipsoidal, brown conidia with a hyaline and subglobose basal cell (Liu et al., 2019; Phukhamsakda et al., 2020; Wanasinghe et al., 2020, 2022; Xu et al., 2023a; Pem et al., 2024). The species in this genus are saprobic and are typically found on decaying or submerged wood in terrestrial and freshwater habitats in China and Thailand (Dong et al., 2020; Wanasinghe et al., 2022; Xu et al., 2023a; Yang et al., 2023), with no reports of association with pteridophytes.



Note Phylogram generated from maximum likelihood analysis based on combined LSU, *tef1-α* and ITS sequence data. Bootstrap support values for ML equal to or greater than 70% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP. Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.29 Phylogenetic tree of *Pleopunctum*



Note a Colonies on the host. b–f Conidiophores and conidiogenous cells. g–k Conidia. l Germinated conidium. m, n Colonies on PDA from above and below. Scale bars: b–l = 20 μm

Figure 3.30 *Pleopunctum ellipsoideum* (HKAS 129765)

Pleopunctum ellipsoideum N.G. Liu, K.D. Hyde & J.K. Liu, Mycosphere 10(1): 767 (2019).

Index Fungorum number: IF556523; *Facesoffungi number*: FoF06114; Figure 3.29 and Figure 3.30

Holotype: MFLU 19–0685

Saprobic on dead frond stalks of *Woodwardia* sp. (Blechnaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrates superficial, sporodochial, punctiform, scattered, dark brown to black. *Mycelia* partly immersed, composed of 1.7–2.3 μm wide, septate, branched, brown hyphae. *Conidiophores* 2.9–4.3 μm ($\bar{x}$ = 3.5 μm, n = 10) wide, micronematous to macronematous, mononematous, cylindrical, brown. *Conidiogenous cells* monoblastic, integrated, terminal, smooth, cylindrical or subspherical, pale brown to brown. Conidia 34–47 × 14.5–20 μm ($\bar{x}$ = 26 × 17 μm, n = 30), acrogenous, solitary, muriform, oval to ellipsoidal, thick-walled, brown, darked at the upper part, paler at the base, often with a hyaline, subglobose to globose, 10–17 μm ($\bar{x}$ = 13 μm, n = 20) diam. basal cell.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from the basal cell of conidia. Colonies growing on PDA, reaching 9 mm diameter in 14 days at 25°C in natural light, circular, convex, entire margin with rough surface, velvet, dense, gray; dark gray to pale brown from center to edge in reverse, not producing pigmentation in culture.

Material examined: CHINA, Qianxinan Buyi and Miao Autonomous Prefecture, Zhenfeng County, Huanlian Township, Fengyouwan Village, (25°19'41‘’N,105°40'20‘‘E), on dead frond stalks of *Woodwardia* sp. (Blechnaceae), 17 March 2022, J.Y. Zhang, J280 (HKAS 129765), living culture KUNCC 23–13983. China, Yunnan Province, Dali City, on dead stems of *Hicriopteris yunnanensis* (Gleicheniaceae), 12 April 2022, H.W. Shen, YN041.

Known hosts: On decaying wood (Liu et al., 2019; Xu et al., 2023a; Yang et al., 2023); on bamboo culms (Jayawardena et al., 2022); on *Woodwardia* sp. and an unidentified fern (This study).

Distribution: China (Liu et al., 2019; Xu et al., 2023a; Yang et al., 2023; this study); Thailand (Jayawardena et al., 2022).

Notes: Phylogenetically, our isolate KUNCC23-13983 grouped with *Pleopunctum ellipsoideum* strains (GZCC 20–0502, MFLUCC 21–0064, GZCC 19–0506 and MFLUCC 19–0390). A comparison of nucleotide base pairs of ITS and *tef1-α* between our isolate KUNCC23-13983 and the type strain MFLUCC 19–0390 showed 13/526 bp (including 7 gap) and 9/955 (without gap) differences. Morphologically, our collection matches the original description of *P. ellipsoideum*. We therefore identified our taxon as *P. ellipsoideum*, which was reported as a saprobic fungus collected from decaying wood and dead bamboo culm from both freshwater and terrestrial habitats in China and Thailand (Liu et al., 2019; Jayawardena et al., 2022; Xu et al., 2023a; Yang et al., 2023). Our new collection was obtained from ferns in China, marking the first report of *P. ellipsoideum* from a fern.

Phaeosphaeriaceae M.E. Barr, Mycologia 71(5): 948 (1979)

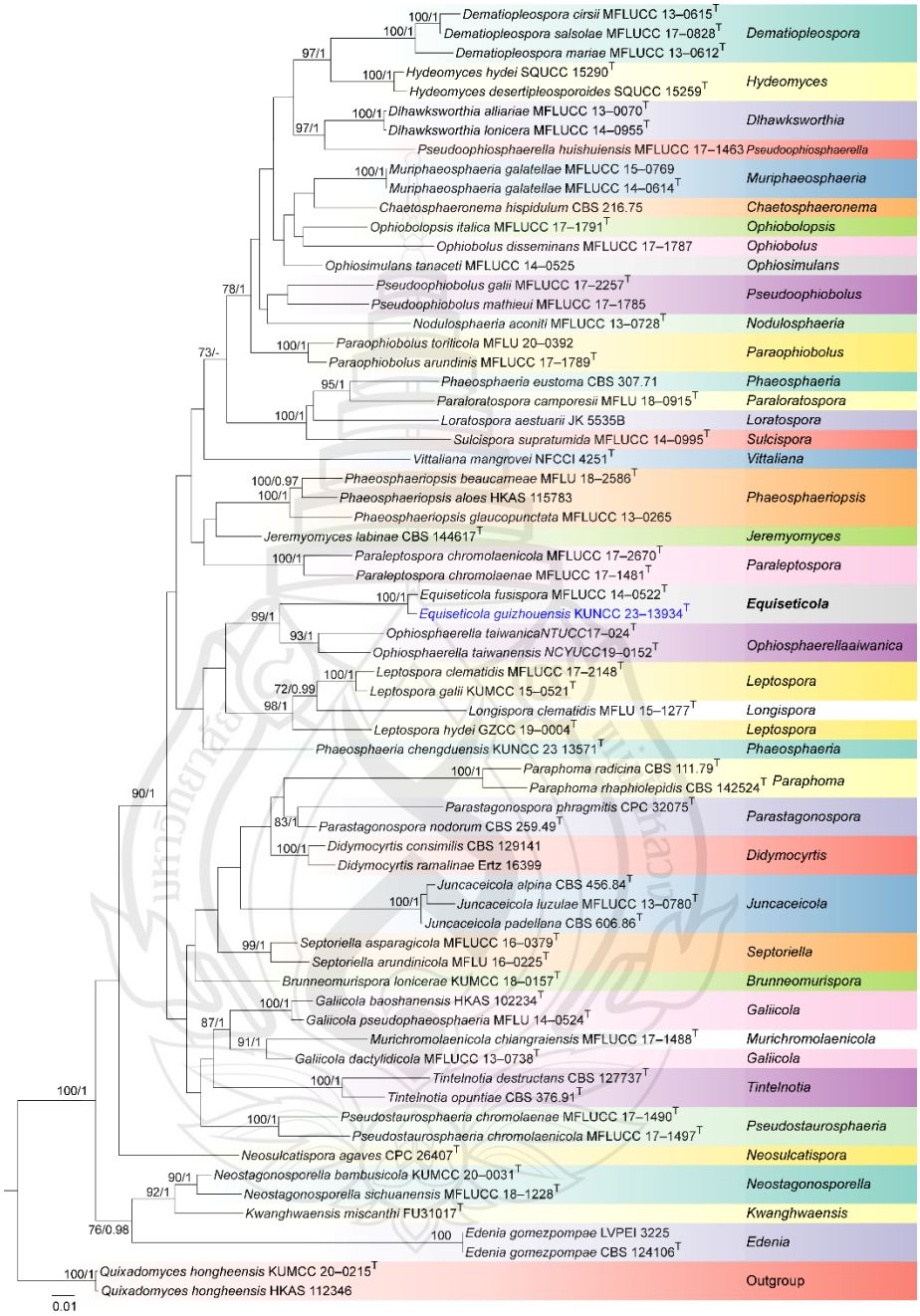
Equiseticola Abdelsalam, Tibpromma, Wanas. & K.D. Hyde, Phytotaxa 284(3): 173 (2016)

Index Fungorum number: IF 551562; *Facesoffungi number*: FoF 01242; two species associated with pteridophytes (including one species newly described in this study); Figure 3.31

Type species: *Equiseticola fusispora* Abdelsalam, Tibpromma, Wanasinghe & K.D. Hyde

Notes: Abd-Elsalam et al. (2016) introduced *Equiseticola* in Phaeosphaeriaceae (Pleosporales, Dothideomycetes, Ascomycota) to accommodate *E. fusispora* based on phylogeny and morphology. Currently, *Equiseticola* comprises a single species, *E. fusispora*, found on *Equisetum* sp. in Italy. In this study, we found a new *Equiseticola*

species from dead stems of *Equisetum ramosissimum* subsp. *debile* (Equisetaceae) in China (See Result part 2.1 for the detail notes).



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, SSU and *tef1-α* sequence data. The tree was rooted to *Quixadomyces hongheensis* (HKAS 112346 and KUMCC 20–0215).

Figure 3.31 Phylogenetic tree of *Equiseticola*

Note a–d Appearance of ascomata on host surface. e Ostiole. f Section through an ascoma. g Peridium. h Pseudoparaphyses. i–m Asci. n–r Ascospores. s Geminated ascospore. t Pure culture from above and below. Scale bars: e–g = 50 µm, h–m = 20 µm, n–s =10 µm

Figure 3.32 *Equiseticola guizhouensis* (HKAS 129740, holotype)

Equiseticola guizhouensis J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *sp. nov*.

Index Fungorum number: IF 903179; *Facesoffungi number*: FoF17029; Figure 3.32

Etymology: The species epithet "*guizhouensis*" refers to the collecting site of this fungus.

Holotype: HKAS 129740

Saprobic on dead stem of *Equisetum ramosissimum* subsp. *debile* (Equisetaceae). **Asexual morph:** Undetermined. **Sexual morph:** *Ascomycetes*. *Ascomata* 268–324 µm diam., 228–266 µm high ($\bar{x}$ = 287 × 248 µm), solitary, scattered to gregarious, uni-loculate, immersed beneath host epidermis, and erumpent to superficial, with a central papilla, ovoid or subglobose, ostiolate, black, dark red at the apical. *Peridium* 11–33 µm wide, thick-walled, composed of 3–7 layers of pale brown to brown cells of *textura angularis*. *Hamathecium* 1.6–3.5 µm ($\bar{x}$ = 2.2 µm, n = 20), dense, filamentous, smooth-walled, septate, no constricted at the septum, pseudoparaphyses, hyaline. *Asci* 96–126(–138) × 10–14.5 µm ($\bar{x}$ = 112.7 × 12.2 µm, n = 20), 8-spored, bitunicate, fissitunicate, cylindrical or cylindrical-clavate, straight to slight curve, pedicellate, with short knob-like pedicel, apically rounded, with indistinct ocular chamber. *Ascospores* 22.6–28.5(–33) × 6.7–8.3 µm ($\bar{x}$ = 26.4 × 7.5 µm, n = 30), overlapping 1–2-seriate, fusiform with rounded ends, straight to slight curve, (3–)5(6–)-septate, distinctly septate, constricted at the septa, with distinct guttules in each cell, smooth-walled, without mucilaginous sheath.

Culture characteristics: Ascospores germinating on WA within 18 h. and germ tube produced from both ends of ascospores. Colonies on PDA in natural light, reaching ca. 22 mm diameter in 15 days at 25°C, circular, flat with entire margin, dry, velvety, white, khaki in reverse, with a circle of brown edges, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang City, Aha Lake National Wetland Park, on dead stems of *Equisetum ramosissimum* subsp. *debile* (Equisetaceae), 9 January 2022, J.Y. Zhang, J148 (HKAS 129740, **holotype**; GZAAS 23–0688, **isotype**), ex-type living culture KUNCC 23–13934.

Notes: *Equiseticola guizhouensis* matches well with the genetic concept of *Equiseticola* in having immersed ascomata with a central papilla, bitunicate asci, and fusiform, mostly 5-septate ascospores (Abd-Elsalam et al., 2016). Phylogenetically, *E. guizhouensis* is sister to *E. fusispora*, which is a morphologically distinct species. *Equiseticola guizhouensis* has larger asci [96–126(–138) × 10–14.5 μm vs. 55–90 × 4–9 μm) with short knob-like pedicels and indistinct ocular chambers, and larger ascospores (22.6–28.5(–33) × 6.7–8.3 μm vs. 16–20 × 3–5 μm) that are obviously constricted at the septa. In contrast, *Equiseticola fusispora* is characterized by asci with long acute or knob-like pedicels and well-developed ocular chambers, and septate ascospores that are not constricted at the septa. In addition, ITS comparison between *E. guizhouensis* and *E. fusispora* showed that there are 10 bp (10/528 bp, 1.9 %) differences, reinforcing the notion that they are separate species (Jeewon & Hyde, 2016).

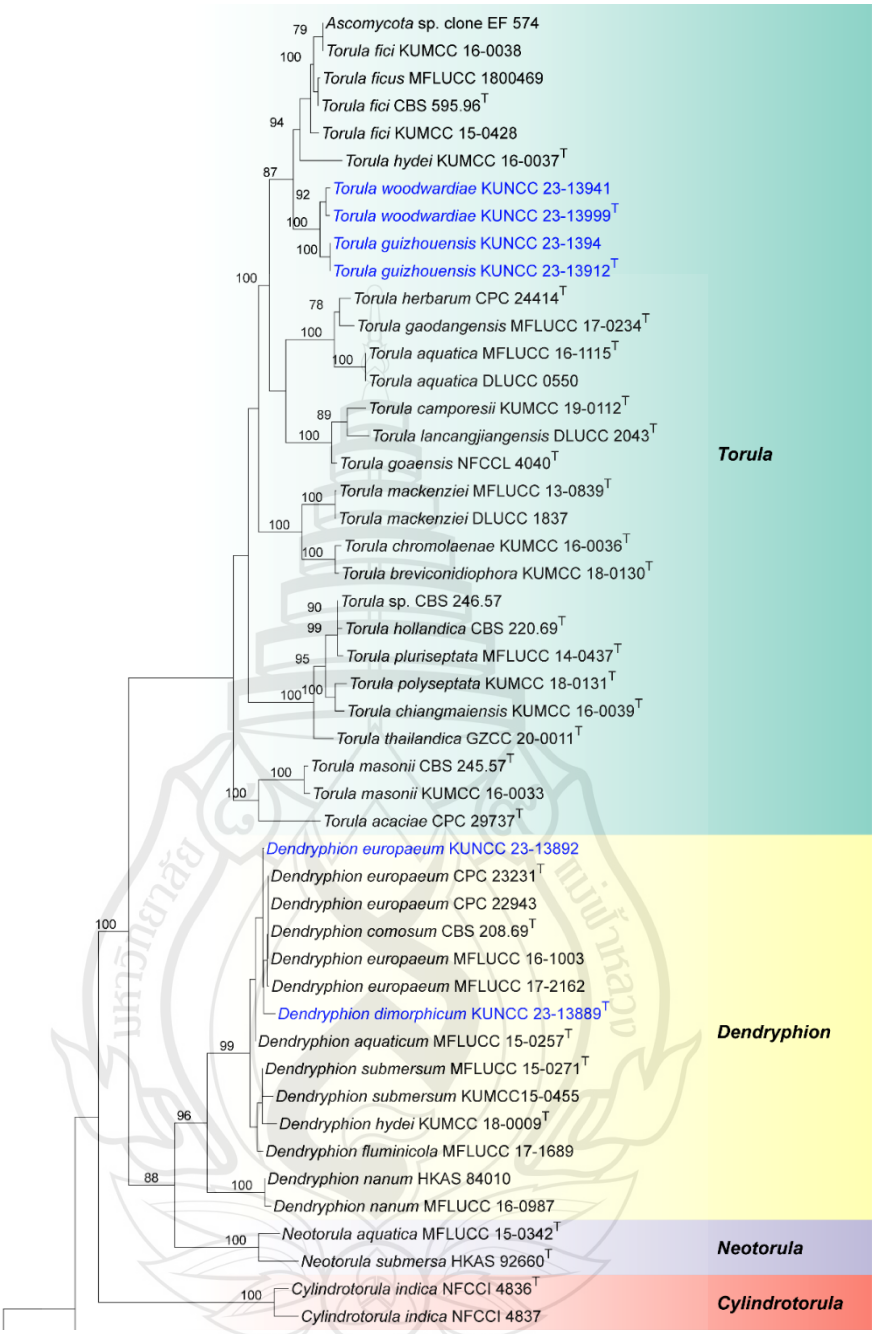
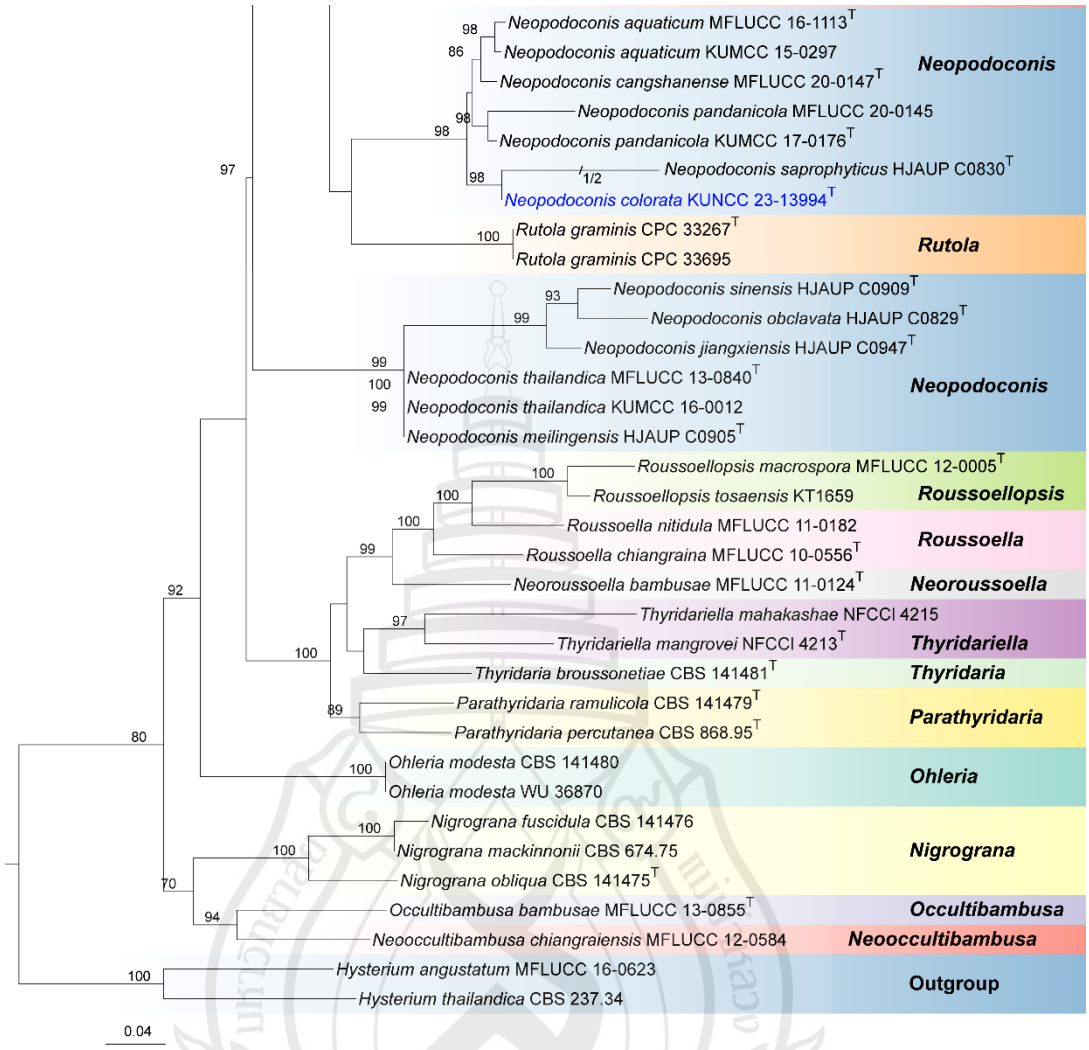


Figure 3.33 Phylogenetic tree of Torulaceae



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, *rpb2* and *tef1-α* 1sequence data. Bootstrap support values for ML equal to or greater than 70% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP. The tree was rooted to *Hysterium angustatum* (MFLUCC 16-0623) and *H. thailandica* (CBS 237.34). Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.33 (continued)

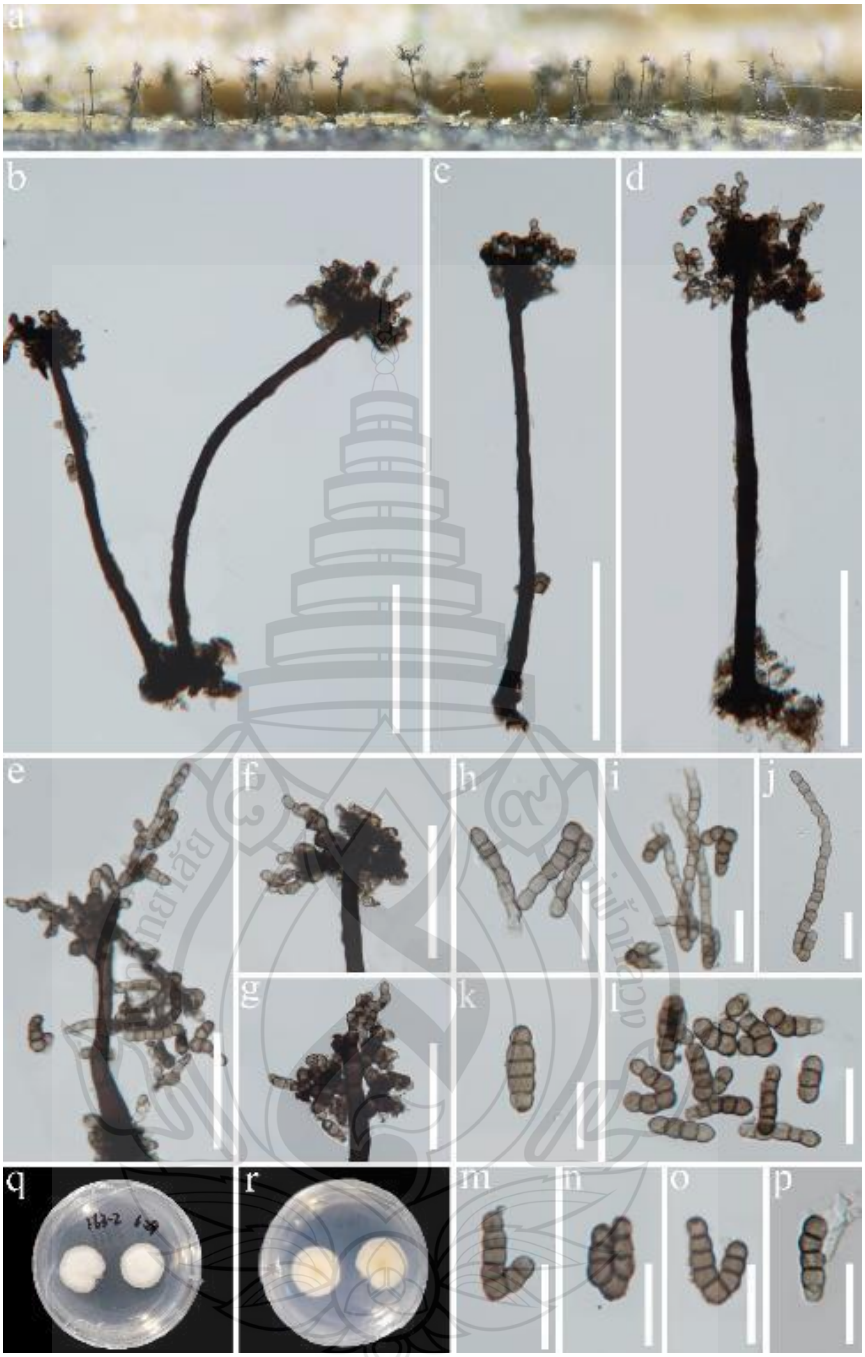
Torulaceae Corda, in Sturm, Deutschl. Fl., 3 Abt. (Pilze Deutschl.) 2: 71 (1829)

Dendryphion Wallr., Fl. crypt. Germ. (Norimbergae) 2: 300 (1833).

Index Fungorum number: IF7952; *Facesoffungi number*: FoF01740; one species associated with pteridophytes; Figure 3.33

Type species: *Dendryphion comosum* Wallr.

Notes: The hyphomycetous genus *Dendryphion* was established by Wallroth et al. (1833) for the species *D. comosum*. Crous et al. (2015) clarified the taxonomic placement of *Dendryphion* in the family Torulaceae (Pleosporales, Dothideomycetes, Ascomycota) based on phylogenetic affinities of LSU sequence data. The genus is characterized by macronematous conidiophores branched in upper part; polytretic, terminal and intercalary conidiogenous structure with pores encircled by dark scars, and solitary or catenate, septate (didymo, cheiro or other), brown conidia (Seifert et al., 2011; Crous et al., 2014; Su et al., 2018; Li et al., 2020c; Phukhamsakda et al., 2020). Currently, 85 epithets are listed under *Dendryphion* in Index Fungorum (August, 2024), and 35 species are listed in Species Fungorum, of which only seven species have molecular data (Su et al., 2016; Li et al., 2020c; Hongsanan et al., 2020a). Members of *Dendryphion* are commonly found as saprobes associated with herbaceous plants and decaying wood (Su et al., 2016, 2018; Li et al., 2017c; Hongsanan et al., 2020a). In this study, we document a new host range from a fern for *Dendryphion* species.



Note a Colonies on the host. b–d Conidiophores with attached conidia. e–g Conidiogenous cells and conidia. h–o Conidia (h–j long Conidia; k–o short conidia). p Germinated conidium. q, r Colonies on PDA from above and below. Scale bars: b–d = 100 µm, e–g = 50 µm, h–p = 20 µm

Figure 3.34 *Dendryphion europaeum* (HKAS 129712)

Dendryphion europaeum Crous & R.K. Schumach., in Crous et al., Persoonia 32: 243 (2014)

Index number: IF808927; *Facesoffungi number*: FoF07346; Figure 3.34

Holotype: CBS H-21705

Saprobic dead frond stalks of *Pteridium revolutum* (Dennstaedtiaceae) in terrestrial habitats (HKAS 129712). **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, hairy, dark brown. *Mycelium* partly immersed, partly superficial, composed of septate, branched, brown hyphae. *Conidiophores* 252–341 × 9–12 μm ($\bar{x}$ = 285.5 × 10.5 μm, n = 15), macronematous, mononematous, solitary, or 1−2 together on stroma, erect, straight or flexuous, cylindrical, with well-developed branch at the apex, thick-wall, smooth-walled, dark brown or black. *Conidiogenous cells* 4.5–10 × 4–7.5 μm ($\bar{x}$ = 6.2 × 5.5 μm, n = 20), polytretic, with well-defined conidial scars, integrated, terminal and intercalary on branches, sympodial, doliiform to ellipsoid to clavate, smooth, pale brown to brown. *Conidia* biform with phragmoconidia (short conidia) and scolecoconidia (long conidia); *short conidia* (10.5–)13–23.5 × 4–6.5 μm ($\bar{x}$ = 17 × 5 μm, n = 15), catenate in chain, phragmosporous, simple to forked, composed of 1–2 rows of up to 5 cells, 2–4-septate, constricted at the septa, smooth to slightly verruculose, thick-walled, brown; *long conidia* 18–74.5 × 3.5–6 μm ($\bar{x}$ = 46 × 4.5 μm, n = 15), solitary to catenate in chain, moniliform, constricted at the septa, straight or slightly curved arms, composed of 1–2 rows, each row composing up to 16 cells, complanate, elongated, clavate, smooth to minutely verruculose, subhyaline to pale brown or brown.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from conidia. Colonies growing on PDA under natural light, reaching 18 mm diameter in 14 days at 26℃, circular, flat with entire margin, cottony, fluffy, white from above; light cream-yellow from reverse with pale brown spot halo in the center, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Bijie City, Weining County, (26°44’19.66’’N, 104°32’3.9’’E), on dead frond stalks of *Pteridium revolutum* (Dennstaedtiaceae) in a distributed forest, 19 June 2022, J.Y. Zhang, F63-2 (HKAS 129712), living culture KUNCC 23–13889; CHINA, Guizhou Province, Bijie City, Weining County, (26°44‘19.66’‘ N, 104°32’3.9‘’E), on dead frond stalks of *Pteridium revolutum* (Dennstaedtiaceae) in a distributed forest, 19 June 2022, J.Y. Zhang, F72 (HKAS 129714), living culture KUNCC 23–13892.

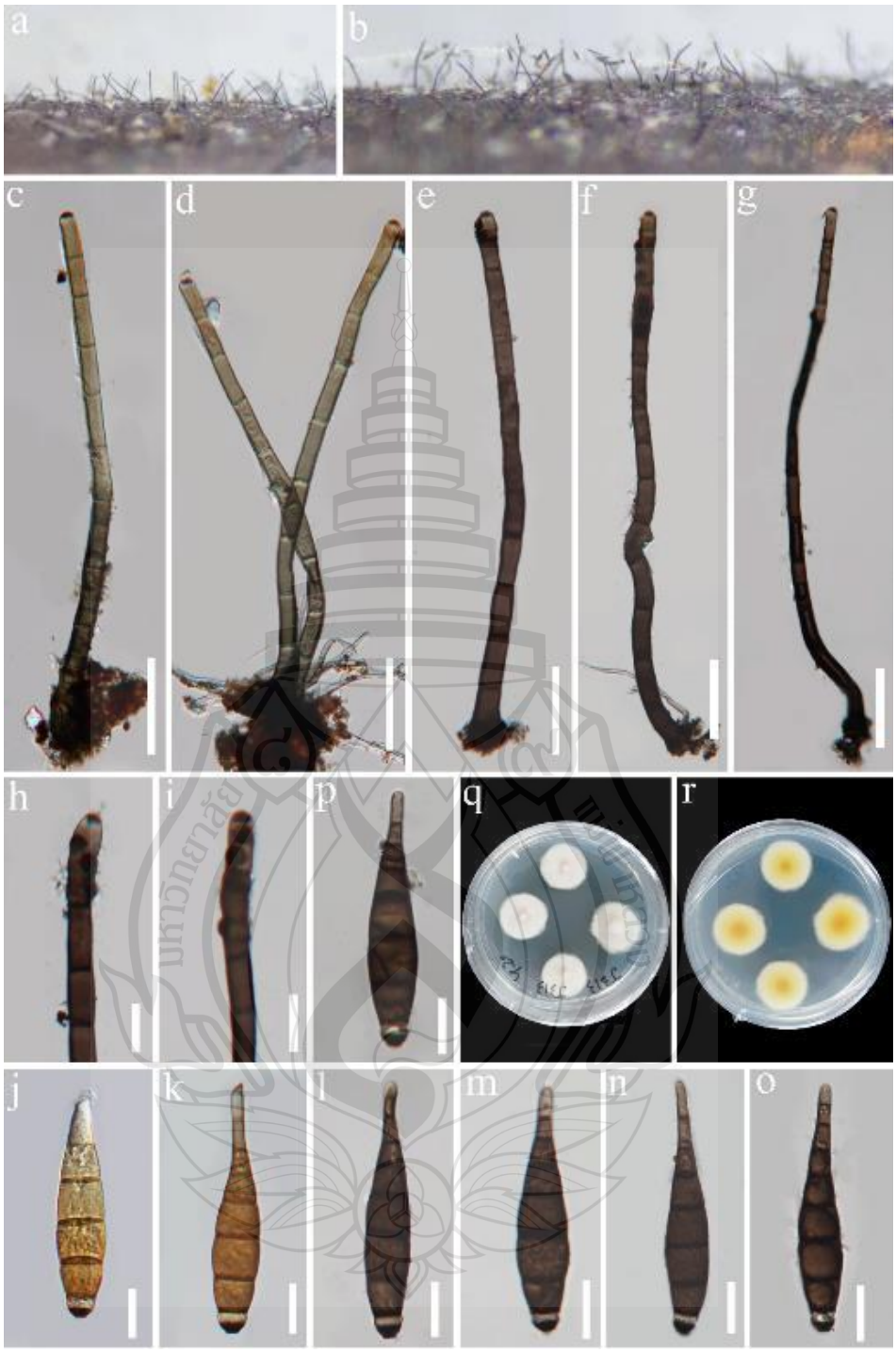
Known hosts: on dead stems of *Clematis virginiana* and *C. vitalba* (Phukhamsakda et al., 2020); on twig of *Hedera helix* (Araliaceae) and *Heracleum sphondylium* (Apiaceae) (Crous et al., 2014); *Pteridium revolutum* (Dennstaedtiaceae) (this study).

Distribution: Belgium and UK (Phukhamsakda et al., 2020); China (this study); Germany and Netherlands (Crous et al., 2014).

Notes: *Dendryphion europaeum* was introduced by Crous et al. (2014) and was obtained from *Hedera helix* and *Heracleum sphondylium*. Subsequently, Phukhamsakda et al. (2020) reported this species from *Clematis virginiana* and *C. vitalba*. In the phylogenetic analysis, two new strains clustered with four strains of *D. europaeum* (MFLUCC 17–2162, MFLUCC 16–1003, CPC 23231 and CPC 22943), and a strain of *D. comosum* (CBS 208.69) without any validated publications. Morphologically, our new collections (HKAS 129712 and HKAS 129714) share overlapping characteristics with isolates of *D. europaeum* (Table 3.5). However, a second type of conidia was observed in our new collection (HKAS 129712), which has not been reported in other specimens of *D. europaeum*. Additionally, there are no significant difference in the ITS, LSU and *tef1-α* regions between our new isolates and *D. europaeum*. Therefore, we identified our collections as *D. europaeum*, establishing the first-time link with ferns in China. The second type of conidia (long conidia) of *D. europaeum* was reported for the first time

Table 3.5 Synopsis of morphological features of *Dendryphion europaeum* collections

Species	Conidiophores (µm)	Conidiogenous cell (µm)	Conidia	Conidial septation	Host	Distribution	References
D. europaeum (CBS H-21705/ CPC 22943)	180–250 × 8–10	6–10 × 5–7	(15–)20–28(–33) × (6–)7 µm, subcylindrical, but also cheiroid	(2–)3(–5)	*Hedera helix* and *Heracleum sphondylium*	Germany, Netherlands	Crous et al. (2014)
D. europaeum (MFLU 17–1520/17–1462)	198–310×9–19.6	10–16 × 6–7	14–26(–28) × 2.5–8, cylindrical to oblong	2–5	*Clematis virginiana* and *C. vitalba*	Belgium, UK	Phukhamsakda et al. (2020)
HKAS 129712	252–341 × 9–12	4.5–10 × 4–7.5	Short conidia (10.5–)13–23.5 × 4–6.5 µm, simple to forked; Long conidia 18–74.5 × 3.5–6 µm, simple to forked	Short conidia: 2-4; Long conidia: up to 18-septate	*Pteridium revolutum*	China	This study
HKAS 129714	(168–)210–324 × 8–12.5	4.5–7 × 3.5–6.5	9–20.5 × 4–6 µm, subcylindrical,	1–4(-5)-septate	Pteridium revolutum	China	This study



Note a Colonies on the host. c–g Conidiophores with conidiogenous cells. h, i Conidiogenous cells. j–q Conidia. q, r Colonies on PDA from above and below. Scale bars: c–g = 50 µm, h–p = 20 µm

Figure 3.35 *Neopodoconis colorata* (HAKS 129770, holotype)

Neopodoconis Rifai, Reinwardtia 12(4): 277 (2008)

Index Fungorum number: IF 569714; *Facesoffungi number*: FoF17030; one species associated with pteridophytes.

Type species: *Neopodoconis ampullacea* (Petch) Rifai, Reinwardtia 12(4): 278 (2008)

≡ *Exosporium ampullaceum* (Petch) M.B. Ellis

≡ *Helminthosporium ampullaceum* Petch

Notes: The hyphomycetous genus *Neopodoconis* was established by Rifai (2008) to accommodate two exosporium-like species, *N. ampullacea* (as type species) and *N. megasperma*. Two genera, *Sporidesmioides* and *Rostriconidium*, were introduced based on sequence data without morphological comparison with the similar genus *Neopodoconis* (Li et al., 2016; Su et al., 2018). However, subsequent studies conducted morphological evidence and phylogenetic analysis, introducing five new species of *Neopodoconis* and synonymized *Sporidesmioides* and *Rostriconidium* under *Neopodoconis* (Qiu et al., 2022). Additionally, Qiu et al. (2022) clarified the taxonomic placement of *Neopodoconis* within Torulaceae (Pleosporales, Dothideomycetes, Ascomycota); however, it was found to be paraphyletic. Consequently, the type species of *N. ampullacea* needs to be restudied and re-analyzed with fresh collection and isolation, epitypified, and subjected to phylogenetic analysis. The genus is characterized by macronematous, mononematous, unbranched, septate conidiophores, mono- to polytretic, integrated, terminal and later intercalary, elongated sympodially, blackish conidiogenous cells producing acropleurogenous, pyriform to rostrate, euseptate conidia with a truncate dark scar at the base (Rifai, 2008; Su et al., 2018; Tibpromma et al., 2018; Shen et al., 2021; Qiu et al., 2022). A morphological synopsis of *Neopodoconis* species was provided by Qiu et al. (2022). Currently, 12 species have been accepted in this genus, with a wide distribution in China, Ghana, Java, Sierra Leone, Sri Lanka and Thailand, on dead stem or dried stick from both freshwater and terrestrial habitats (Rifai, 2008; Li et al., 2016; Qiu et al., 2022; Wang et al., 2023). In

this study, we introduced a new *Neopodoconis* species isolated from a fern in terrestrial habitat, making it the first link between *Neopodoconis* species and ferns.

Neopodoconis colorata J.Y. Zhang, K.D. Hyde & Y.Z. Lu, sp. nov

Index Forum number: IF903180; *Facesoffungi number*: FoF17031; Figure 3.35

Etymology: The species epithet "*colorata*" refers to its color conidiophores and conidia of this fungus.

Holotype: HKAS 129770

Saprobic on dead fronds of an unidentified fern in terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered, erect, hairy, dry, brown to black. *Mycelium* mostly immersed, composed of septate, smooth, unbranched or occasionally branched, hyaline hyphae. *Conidiophores* 247–405 × 9–12.5 µm ($\bar{x}$ = 307 × 10 µm, n = 15), macronematous, mononematous, solitary, erect, straight or slightly flexuous, cylindrical, unbranched, thick-walled, golden yellow to reseda green from the apex to base when young, black at the base, paler towards the apex when mature. *Conidiogenous cells* 12–30.5 × 7–10 µm ($\bar{x}$ = 20 × 8.5 µm, n = 15), mono- to polytretic, integrated, terminal, later becoming intercalary, cylindrical with thickened, circle-peak shape, black conidiogenous scars, pale brown to brown. *Conidia* 85–125.5 × 14.5–18.5 µm ($\bar{x}$ = 94 × 16.5 µm, n = 20), acropleurogenous, solitary, simple, obclavate, rostrate, straight or slightly flexuous, 6–10-septate (mostly 8), slightly constricted at some septa, with a thick, black truncate scar at the base and a light-colored cell above the scar, guttulate, smooth-walled, pale yellow to gold to dark brown, secession schizolytic.

Culture characteristics: Conidia germinating on WA within 16 h and growing on PDA under natural light, reaching ca.15 mm diameter in 14 days at 25°C, circular with entire margin, flat with a protuberance in the center, white from above; cream yellow to white from center to edge in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of an unidentified fern in a distributed forest, 27 March 2022, J.Y. Zhang, J313 (HKAS 129770, holotype; GZAAS 23–0707, isotype), ex-living culture KUNCC 23–13994.

Notes: *Neopodoconis colorata* matches well with the genetic concept in having macronematous, cylindrical conidiophores, mono- to polytretic, integrated, terminal to intercalary conidiogenous cells, and obclavate, rostrate, septate conidia with a thick, black scar at the base and a light-colored cell above the scar (Rifai, 2008; Su et al., 2018; Tibpromma et al., 2018; Shen et al., 2021; Qiu et al., 2022). However, *Neopodoconis colorata* is unique within the genus due to its colorful conidiophores (golden yellow to reseda green to black) and conidia, which display shades of pale yellow to gold to dark brown. Phylogenetic analysis showed that our collection clustered as a sister taxon to *N. saprophyticus*, with robust statistical bootstrap value support (98% ML/1.00 PP). *Neopodoconis colorata* differs from *N. saprophyticus* in having different colored conidiophores (golden yellow to reseda green vs. brown to dark brown) and conidia (pale yellow to gold to dark brown vs. brown to pale brown), as well as wider conidia (14.5–18.5 µm vs. 10–15 µm). (Qiu et al., 2022). Therefore, we introduce our collection as new species collected from a fern in China.

Torula Pers., Ann. Bot. (Usteri) 15: 25 (1795)

Index Fungorum number: IF10248; *Facesoffungi* number: FoF01740; three species associated with pteridophytes (including two species newly reported in this study).

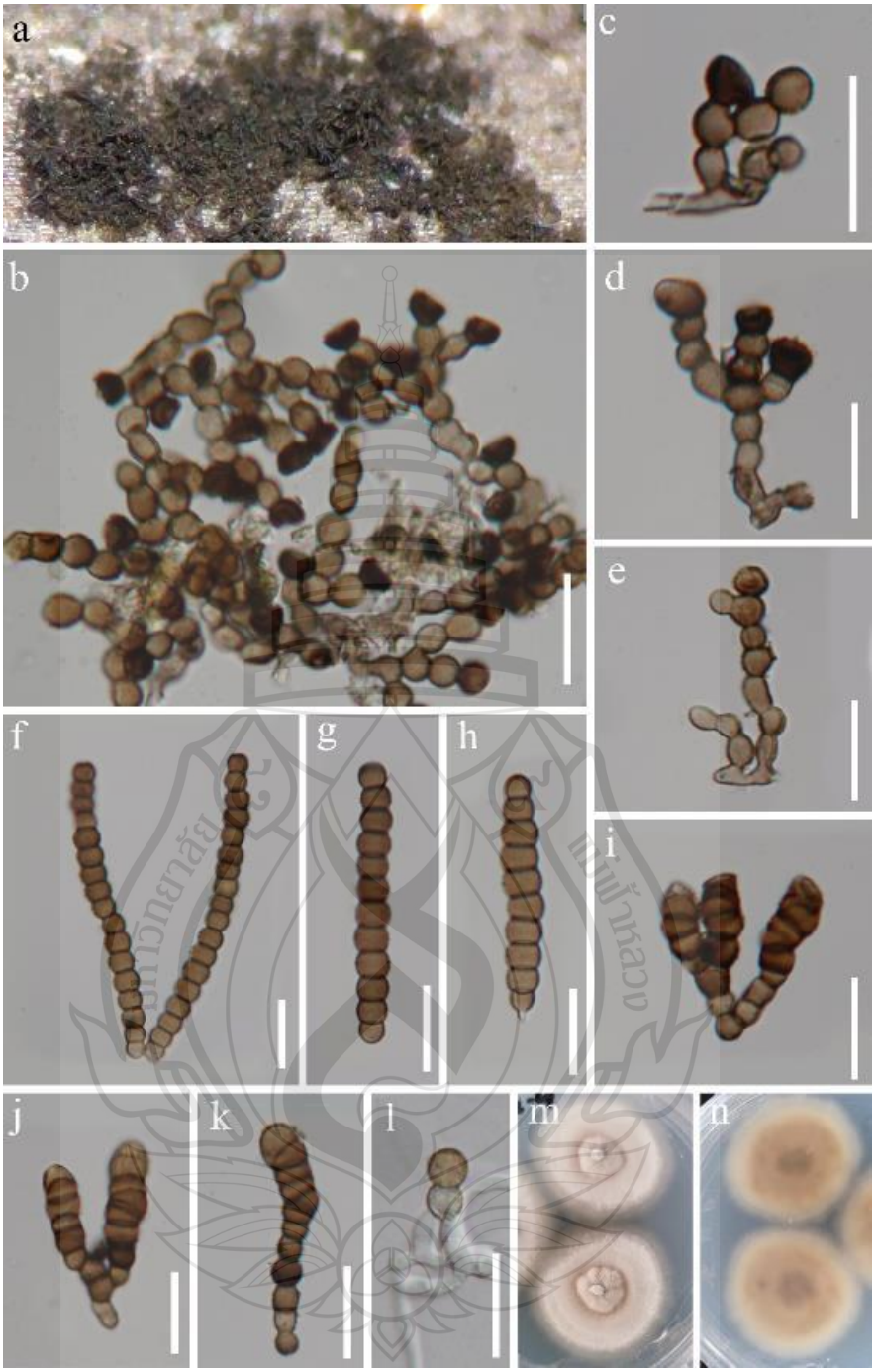
Type species: *Torula herbarum* (Pers.) Link

= *Torula monilis* Pers.

≡ *Monilia herbarum* Pers.

= *Torula herbarum f. quaternella* Sacc.

Notes: *Torula* was established by Persoon (1795) with *T. herbarum* as the type species. Phylogenetic relationships of *Torula* were clarified in Torulaceae (Pleosporales, Dothideomycetes) based on DNA sequence analyses (Crous et al., 2015b; Su et al., 2016; Li et al., 2017c; Dong et al., 2023). This genus is characterized by asexual morph with micronematous conidiophores sometimes reduced to conidiogenous cells or with one brown supporting cell, terminal or lateral, doliiform to ellipsoid or clavate, mono- or polyblastic, intact or cupulate conidiogenous cells producing phragmosporous, moniliform, smooth to verrucose, brown conidia (Scott et al., 2007; Crous et al., 2015b; Crane & Miller, 2016; Su et al., 2018; Mapook et al., 2020; Hyde et al., 2023). Over 500 epithets are listed under *Torula* in Index Fungorum (August 2023), but only 58 species are accepted in Species Fungorum. Given that most species of *Torula* were described before the widespread use of Sanger sequencing, there is limited molecular data available for them. Moreover, molecular data, conidial size and the number of septa and chains are the key for identification in *Torula* species (Crous et al., 2015b; Tian et al., 2023; Wang et al., 2023). *Torula* species are widely distributed from dead branches and submerged wood in terrestrial or freshwater habitats around the world (Crous et al., 2015b; Li et al., 2017c; Su et al., 2018; Phukhamsakda et al., 2020; Dong et al., 2023; Wang et al., 2023). *Torula herbarum* was the only record found on pteridophytes (*Pteridium aquilinum*, Dennstaedtiaceae) (Kirk & Spooner, 1984). In this study, two new *Torula* species isolated from ferns are newly introduced in China based on morphological characteristics and phylogenetic analysis of combined LSU, ITS, *tef1-α* and *rpb2* sequence data.



Note a, b Colonies on the host. b–e Conidiophores with conidiogenous cells. f–k Conidia (f–h Conidia type 1; i–k Conidia type 2). l Germinated conidium. m, n Colonies on PDA from above and below. Scale bars: b–l = 20 μm

Figure 3.36 *Torula guizhouensis* (HKAS 129724, holotype)

Torula guizhouensis J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *sp. nov*.

Index Fungorum number: IF 903181; F*acesoffungi number*: FoF17032; Figure 3.36

Etymology: The species epithet "*guizhouensis*" refers to the collecting site of this fungus.

Holotype: HKAS 129724

Saprobic on dead fronds of ferns in terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, powdery, velvety, brown. *Mycelium* partly immersed, partly surficial, composed of septate, hyaline to light brown, 1.6-3 um wide ($\bar{x}$ = 2.2) hyphae. *Conidiophores* micronematous, mononematous, arising from hypha, straight or slightly flexuous, septate, constricted at the septum, pale brown to brown. *Conidiogenous cell* 5.9–7.5 × 3.9–8.3 µm ($\bar{x}$ = 6.8 × 5.4 µm, n = 20), monoblastic, terminal, doliiform to subglobose, thick-wall, smooth to minutely verruculose, dark brown to black. *Conidia type 1* 11–107 × 7–9.8 µm ($\bar{x}$ = 54.5 × 8 µm, n = 22), acrogenous, solitary to catenate, phragmosporous, 1–19-septate, constricted at the septa, subcylindrical to clavate, elongated, moniliform, rounded at both ends, straight or slightly flexible, unbranched, smooth to minutely verruculose, light brown to brown; c*onidia type 2* 19.5–29 × 7.3–10.7 µm ($\bar{x}$ = 24.5 × 9.5 µm, n = 15), acrogenous, solitary to catenate, subcylindrical to clavate to palmate with slightly broadener towards the apex phragmosporous, with straight or curved, transverse, up to 12-septates, not constricted or slight constricted at the septa, slightly curved, unbranched to branched, smooth to minutely verruculose, light brown to dark brown.

Culture characteristics: Conidia germinating on WA within 16 h and germ tube produced from the cells of conidium. Colonies growing on PDA under natural light, reaching ca. 18 mm diameter in10 days at 25°C, circular, flat with a protuberance in the center and a circle sag in the surface, entirely to slightly filamentous at margin, Light brownish in above; in reverse, light brown in the center, paler towards the margin, not

producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead fronds of *Woodwardia unigemmata* (Blechnaceae), 13 December 2021, J.Y. Zhang, J106 (HKAS 129724, **holotype**; GZAAS 23–0679, **isotype**), ex-type living culture KUNCC 23–13912; CHINA, Guizhou Province, Guiyang City, Aha Lake National Wetland Park, on dead fronds of *Dryopteris erythrosora* (Dryopteridaceae), 9 January 2022, J.Y. Zhang, J215 (HKAS 129748 = GZAAS 23–0693), living culture KUNCC 23–13949.

Notes: In the phylogenetic analysis, *Torula guizhouensis* is closely related to *T. woodwardia* with 100% ML/1.00 PP support. However, *T. guizhouensis* has 1–19-septate, unbranched to branched, subcylindrical to clavate to palmate conidia, which are slightly broader towards the apex, while *T. woodwardia* is characterized by unbranched, micro-guttulate conidia composed of round cells, with 2–7 cells in total, the largest cell being in the middle and gradually smaller cells at both ends (this study). A comparison of ITS, *tef1-α* and *rpb2* between *T. guizhouensis* and *T. woodwardiae* shows that there are 1% (5/528 b, including 4 gaps), 1.73% (16/923 bp, including 2 gaps), 2.04 % (22/1077 bp, including 2 gaps) differences, respectively. Therefore, we introduce our new isolates as *Torula guizhouensis* sp. nov. based on evidence from morphology and phylogeny.

Note a Colonies on substrate. c–g Conidiophores with conidiogenous cells. h–p Conidia. q Germinated conidia. t, u Colonies on PDA from above and below. Scale bars: c = 50 µm, d–q = 20 µm

Figure 3.37 *Torula woodwardiae* (HKAS 129745, holotype)

Torula woodwardiae J.Y. Zhang, K.D. Hyde &Y.Z. Lu, *sp*. *nov*.

Index Fungorum number: IF 903182; *Facesoffungi number*: FoF17033; Figure 3.37

Etymology: The species epithet *woodwardiae* refers to the fungal host genus *Woodwardia***.**

Holotype: HKAS 129745

Saprobic on dead frond stalks of *Woodwardia unigemmata* (Blechnaceae) in terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, powdery, velvety, dark brown to black. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline to brown hyphae. *Conidiophores* 3.7–5.7 µm wide ($\bar{x}$ = 4.6 µm, n = 20), micro-macronematous, mononematous, solitary, arising from hypha, smooth, thick-walled, cylindrical, pale brown to dark brown. *Conidiogenous cell* 5.2–7.2 × 3.4–6 µm ($\bar{x}$ = 6.1 × 4.6 µm, n = 20), monoblastic, terminal, doliiform to subglobose, smooth to minutely verruculose, thick-wall, dark brown to black. *Conidia* 22–49 × 8.5–12.5 (–14) µm ($\bar{x}$ = 34.5 × 10.5 µm, n = 25), acrogenous, phragmosporous, moniliform, subcylindrical, composed of oval, up to 8 cells that the largest is in the middle, and the two ends are gradually smaller slightly, up to 7-septate, constricted at the septum, unbranched, smooth to minutely verruculose, micro-guttulate, light brown to dark brown.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from both end of conidia. Colonies growing on PDA under natural light, reaching ca.16 mm diameter in 10 days at 25℃, circular with emission at margin, flat with a protuberance in the center, from which several indentations extend outwards, and cut into fan shapes at the surface, brown in the center, pale brown with thin mycelia at the edge, not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Guiyang City, Aha Lake National Wetland Park, on dead frond stalks of *Woodwardia unigemmata* (Blechnaceae), 9 January 2022, J.Y. Zhang, J163 (HKAS 129745, **holotype**; GZAAS 23–0692,

isotype), ex-living culture KUNCC 23–13941; CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, on dead fronds of an unidentified ferns, 27 March 2022, J.Y. Zhang, J317 (HKAS 129773), living culture KUNCC 23–13999.

Notes: *Torula woodwardiae* is the most similar to *T. thailandicum* in the shapes of conidiophores, conidiogenous cells and conidia. However, the conidiophores of *T. woodwardia* are wider (3.7–5.7 μm vs. 1.4–4.2 μm) and conidia are larger (22–49 × 8.5–12.5 μm vs. 14–23 × 4.5–6.6 μm) compared to those of *T. thailandicum*. Phylogenetically, two strains (KUNCC 23-13941 and KUNCC 23-13999) representing *T. woodwardiae* sp. nov. formed a distinct clade sister to *T. guizhouensis* (see above for more details) with high support values, which confirmed they are separate species.

Xenoberkleasmiaceae J.Y. Zhang, Y.Z. Lu & Kevin D. Hyde, *fam. nov.*

Etymology: The epithet refers to the reflects the type genus

Type genus: *Xenoberkleasmium* N.G. Liu, Jian K. Liu & K.D. Hyde

Saprobic on dead plant substrate. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substratum, punctiform, superficial, compact, scattered, irregular, dark-brown to black, glistening. *Mycelium* parted immersed, partly superficial, septate, branched. *Conidiomata* sporodochial. *Conidiophores* micronematous, mononematous, reduced, hyaline. *Conidiogenous cells* holoblastic, monoblastic, integrated, terminal, determinate. *Conidia* acrogenous, solitary, broadly ellipsoidal to obovoid, muriform, guttulate, smooth-walled, brown, olivaceous green, with or without guttules, usually with conidiogenous cell attached.

Notes: Xenoberkleasmiaceae is introduced here to accommodate the genus *Xenoberkleasmium*, which is characterized by sporodochial conidiomata and muriform, brown conidia. This group forms a distinct and well-supported clade within Pleosporales and shares a close relationship with morphologically unrelated family Hypsostromataceae (Figure 3.16). Additionally, the molecular clock analysis with divergence time estimates in this study indicates that the crown age of Xenoberkleasmiaceae is 38 (22–58) MYA, while

the stem age is the stem age is 96 (71–124) MYA. These results align with the recommendations for family divergence times provided by Hyde et al. (2017), which suggested a stem age between 50–150 MYA, and by Liu et al. (2017), which recommends a crown age of 20–100 MYA (Figure 3.17). This alignment with established criteria supports the establishment of the new family, Xenoberkleasmiaceae.

Xenoberkleasmium N.G. Liu, Jian K. Liu & K.D. Hyde, Fungal Diversity 129: 1–281 (2024)

Type species: *Xenoberkleasmium chiangraiense* N.G. Liu, Jian K. Liu & K.D. Hyde 2024

Notes: *Xenoberkleasmium* was introduced as a monotypic genus to accommodate a *berkleasmium*-like species, *X. chiangraiense*, which is phylogenetically placed in Pleosporales (Liu et al., 2024). *Xenoberkleasmium chiangraiense* was found as a saprobe characterized by punctiform colonies, macronematous, mononematous conidiophores, monoblastic, integrated conidiogenous cells and muriform, oval to ellipsoidal, black conidia often with a bowl-shaped, hyaline, basal cell (Liu et al., 2024). In this study, *X. chiangraiense* clusters with *Berkleasmium crunisia, B. pandani* and *B. typhae*, with good support values (xx/xxPP), apart from the type species of *Berkleasmium*. Consequently, three *Berkleasmium* species are transferred to *Xenoberkleasmium* based on shared morphological characteristics and congeneric phylogenetic placement. Therefore, four species, *viz*., *X. chiangraiense*, *X. crunisia X. pandani* and *X. typhae* are now accepted in *Xenoberkleasmium*, which were all reported as saprobes from terrestrial habitats in China, Malaysia and Thailand (Somrithipol & Jones, 2003; Pinnoi et al., 2007; McKenzie, 2008).

Xenoberkleasmium crunisia **(**Pinnoi) J.Y. Zhang, Y.Z. Lu & Kevin D. Hyde, *comb. nov*.

≡ *Berkleasmium crunisia* Pinnoi, in Pinnoi, Jeewon, Sakayaroj, Hyde & Jones, Mycologia 99(3): 379 (2007)

Holotype: THAILAND. Satun: Khuan Ka Long, on decaying rachis *Calamus* sp., 10 December 2004, A. Pinnoi in BIOTEC Bangkok Herbarium (BBH13084, holotype), ex-type culture, BCC 17023, 17024.

Notes: *Berkleasmium crunisia* was introduced by Pinnoi et al. (2007), and was isolated from decaying rachis of *Calamus* sp. (Arecaceae) in Thailand. In our phylogenetic analysis, *Berkleasmium crunisia* (BCC 17023) formed a distinct clade nested within *Xenoberkleasmium*, Pleosporales. Morphologically, this species is characterized by sporodochial, punctiform colonies, macronematous, mononematous, clavate, nonseptate, hyaline conidiophores, holoblastic conidiogenous cells and muriform, oval to ellipsoidal, pale brown conidia (Pinnoi et al., 2007). These characteristics align with the generic concept of *Xenoberkleasmium*. Based on the molecular data and morphological characters, we therefore recognize *Berkleasmium crunisia* as a member of *Xenoberkleasmium*, proposing a new combination, *X. crunisia*.

Xenoberkleasmium pandani **(**McKenzie) J.Y. Zhang, Y.Z. Lu & Kevin D. Hyde, *comb. nov.*; Figure 3.38

≡ *Berkleasmium pandani* McKenzie, Mycotaxon 104: 24 (2008)

Holotype: MALAYSIA, Genting Highlands, Ganung Buah, in the dead leaves of *Pandanus species* (Pandanaceae), 18 August 1992, E.H.C. McKenzie (PDD 60532).

Saprobic on dead rachis o ferns. **Sexual morph**: Undetermined. **Asexual morph**: Hyphomycetous. *Colonies* on natural substrate superficial, effuse, sporodochial, brown to black, scattered to gregarious, velvety, punctiform. *Mycelium* mostly superficial, composed of septate, branched, hyaline to brown hyphae. *Conidiophores* up to 32 µm macronematous, mononematous, cylindrical, hyaline to middle brown. *Conidiogenous cells* 13–33 × (4–)8.5–12.8 µm ($\bar{x}$ = 23 × 10.5µm, n = 20), monoblastic, holoblastic, integrated, terminal, hyaline, smooth, wedge-shaped, inverted vase-like, clavate, narrowed towards the base, truncate at apex after conidial secession, with dense cytoplasm e. *Conidia* 25–35 × 15–21 µm ($\bar{x}$ = 30× 18 µm, n = 30), acrogenous, solitary, oval to ellipsoidal, usually broadly obtuse at apex and slightly truncate at base, muriform, not constricted or slightly constricted at the septa, sometime with a dark median septum, smooth-walled, brown.

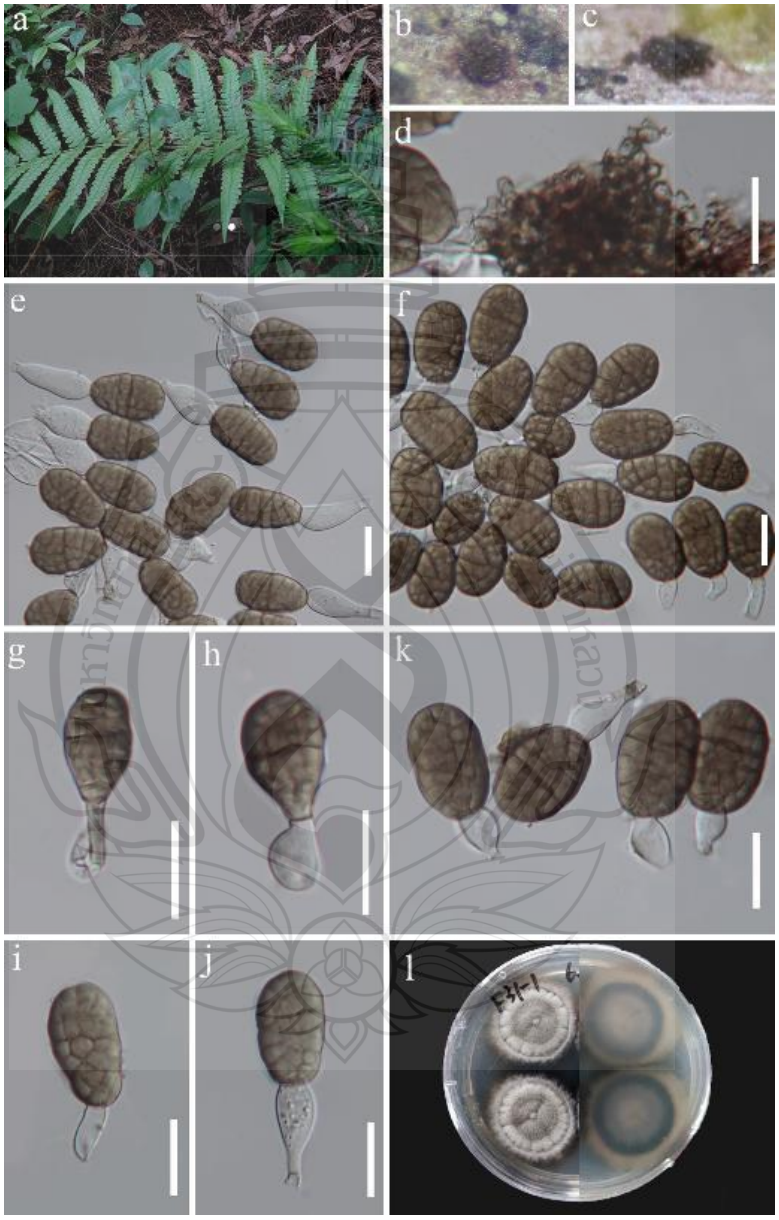
Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from the ends of conidia. Colonies growing on PDA, reaching about. 42 mm diameter in one month at 26℃, circular, with an indentation at the entire margin, flat, with a protuberance in the center, dry, celadon to gray from central part to margin from above; pale brown to celadon to brown from center towards the margin in reverse, and not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Tongren City, Jiangkou County, (27°46’38”N, 108°45’22”E), on dead shems of *Woodwardia japonica* (Blechnaceae) in a forest near the roadside, 21 May 2022, J.Y. Zhang, F31-1 (HKAS 147017, reference specimen designated here), ex-type living culture KUNCC23-13876; *ibid*., F32-1 (HKAS 129706 = GZAAS 23-0674), living culture, KUNCC23-13878; CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of *Blechnopsis orientalis* (Blechnaceae) in a forest, 27 March 2022, J.Y. Zhang, J352 (HKAS 147020), living culture KUNCC 23-14012.

Note: *Berkleasmium pandani* was introduced by McKenzie (2008), but no sequence data were provided. Morphological characters of our new collection align with the original diagnosis of the holotype (McKenzie, 2008), including conidial sizes (25–35 × 15–21 µm *vs*. 27–34 ×18–22.5 µm). Although there are slight differences in the sizes of conidiogenous cells (13–33 ×8.5–12.8 µm *vs*. up to 45 µm, this may be attributed to differences in host and environmental conditions. Thus, we identified our new collections as *Berkleasmium pandani* designated a reference specimen herein. The molecular data for this species is generated for the first time in this study. Phylogenetic analyses showed that our three new isolates constitute a distinct clade within *Xenoberkleasmium*. The characteristics of these new collections fit the generic concept of *Xenoberkleasmium*, and therefore, we transferred it to *Xenoberkleasmium*.

Notably, Verma et al. (2019) introduced a new geographical record for *Berkleasmium pandani* PAN (32722). However, based on the photographs and

descriptions provide by Verma et al. (2019), we found that the elliptical to globose basal cells attached to the conidia were incorrectly described as conidiogenous cells. We therefore consider that the identification of the specimen *Berkleasmium pandani* PAN (32722) requires reevaluation, and we do not accept this specimen PAN (32722) provided by Verma et al. (2019) as a valid record of *Berkleasmium pandani*.



Note a The host. b, c Colonies on the host substrate. d Mycelium. c–j Conidiogenous cells and conidia. d–j = 20 µm

Figure 3.38 *Xenoberkleasmium pandani* (Reference specimen designated here)

Xenoberkleasmium typhae **(**Somrith. & E.B.G. Jones) J.Y. Zhang, Y.Z. Lu & Kevin D. Hyde, *comb*. *nov*.

≡ *Berkleasmium typhae* Somrith. & E.B.G. Jones, Fungal Diversity 12: 170 (2003)

Holotype: THAILAND, Pathum Thani, Klong Luang, in the decaying leaves of *Typha angustifolia*, August 2002, S. Somrithipol (SFC 1610 in BBH, holotype), ex-type living culture, BCC 12536 in BCC.

Notes: *Berkleasmium typhae* was introduced Somrithipol and Jones (2003) based on morphological data alone. Pinnoi et al. (2007) provided sequence data for this species, demonstrating that *B*. *typhae* is closely related to *B*. *crunisia* (as *Xenoberkleasmium crunisia*) (Figure 3.16). In our study, *B*. *typhae* clustered with three other *Xenoberkleasmium* species, prompting us to transfer it to *Xenoberkleasmium* as *X*. typhae. *Xenoberkleasmium typhae* matches well with generic concept in having sporodochial, punctiform colonies, macronematosa, mononematosa conidiophores, as well as oval to ellipsoidal, muriform, brown conidia (Pinnoi et al., 2007; Liu et al., 2024).

Muyocopronales Mapook, Boonmee & K.D. Hyde, in Mapook, Hyde, Dai, Li, Gareth Jones, Bahkali & Boonmee, Phytotaxa 265(3): 230 (2016)

Muyocopronaceae Luttr. [as 'Myiocopronaceae'], Univ. Mo. Stud. 24(3): 87 (1951)

Cyatheomyces J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *gen*. *nov.*

Etymology: Named after the host genus Cyathea, combined with “myces” for fungi.

Type species: *Cyatheomyces* synnemata J.Y. Zhang, Y.Z. Lu & Kevin D. Hyde

Saprobic on dead stems of *Cyathea* spp. Sexual morph: Undetermined. Asexual morph: Hyphomycetous. *Colonies* on natural substrate effuse, visible as solitary, brown conidiophores with white conidial masses at the apex. Mycelium partly immersed, partly superficial, composed of hyaline to pale brown, branched, smooth hyphae. Synnemata hairy, scattered, dark brown to hyaline towards the apex, composed of

fasciculate, compact appressed conidiophores. Conidiophores macronematous, fasciculate, erect, smooth-walled, aseptate, cylindrical, brown to hyaline towards the apex. Conidiogenous cells polyblastic, integrated, terminal, to hyaline or pale brown, smooth-walled, sympodially extending with numerous denticles. Conidia obovoid to ellipsoidal, septate, hyaline, sometime pale brown.

Cyatheomyces synnematosa J.Y. Zhang, Y.Z. Lu & Kevin D. Hyde, *sp. nov.*; Figure 3.39

Etymology: The species epithet "*synnematosa*" reflects to the synnematous conidiomata

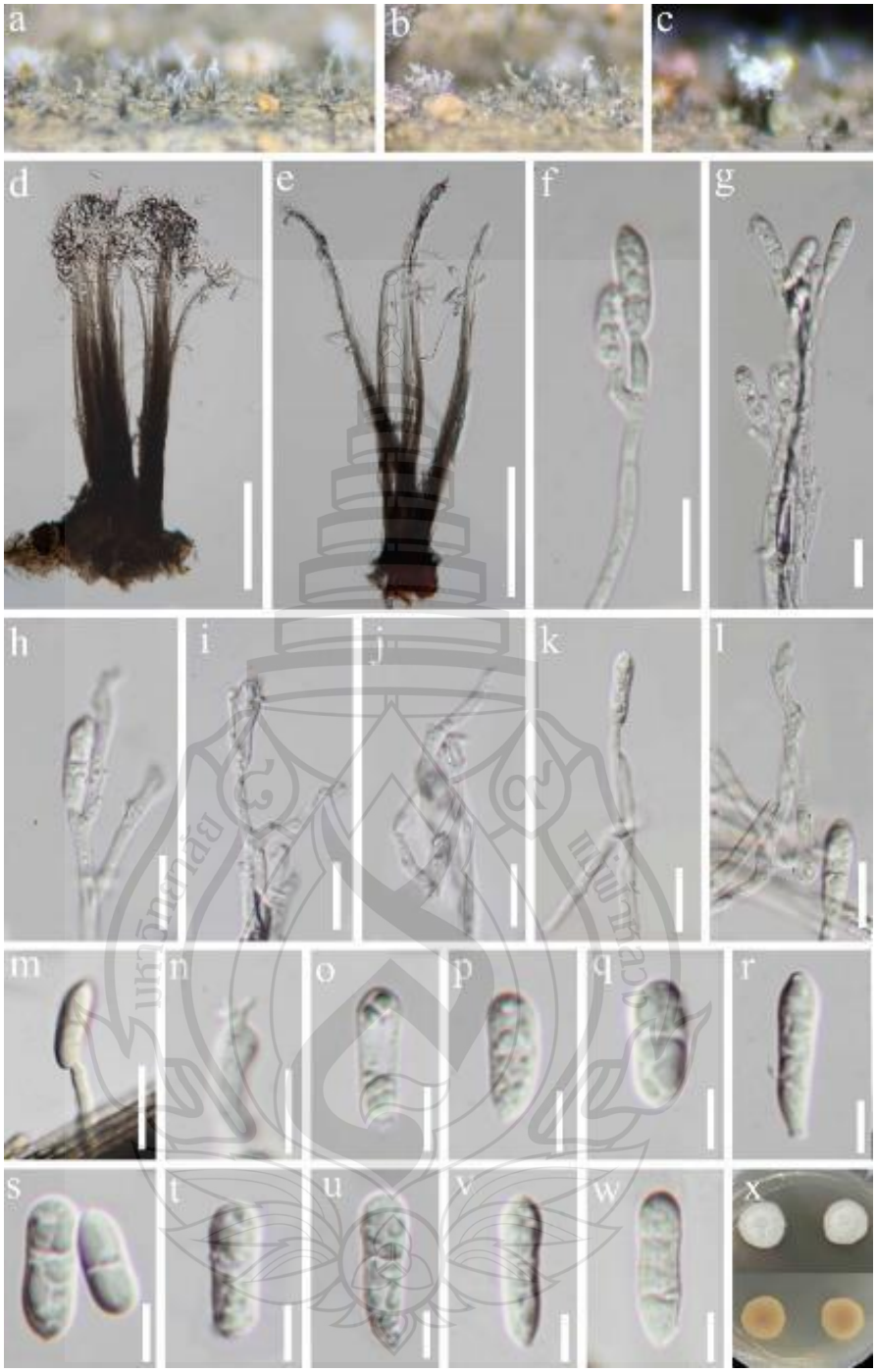
Saprobic on dead stems of *Cyathea* spp. in terrestrial habitats. Sexual morph: Undetermined. Asexual morph: Hyphomycetous. *Colonies* on natural substrate effuse, visible as solitary, brown conidiophores with white conidial masses at the apex. Mycelium partly immersed, partly superficial, composed of hyaline to pale brown, branched, septate, smooth hyphae. *Synnemata* up to 78 µm wide near the base, hairy, scattered, dark brown to hyaline towards the apex, with terminal of conidiophores slightly splaying out as a flared head. *Conidiophores* 158–362 µm × 1.3–2.5 µm ($\bar{x}$ = 281 × 1.8, n = 20), macronematous, fasciculate, erect, smooth-walled, aseptate, cylindrical, brown to hyaline towards the apex, compact appressed forming synnemata. *Conidiogenous cells* 1.3–2.5 µm wide near the conidiogenous loci, integrated, terminal, polyblastic, hyaline or subhyaline or pale brown, smooth-walled, sympodially extending with numerous denticles. *Conidia* 11–15 × (2.5–)3.7–5 µm ($\bar{x}$ = 13 × 4.4 µm, n = 25), obovoid to ellipsoidal, 1(–2)-septate, not constricted at the septum, guttulate, hyaline, rarely pale brown.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from conidia. Colonies growing on PDA, grown slowly, reaching 11–13 mm diameter after one month at room temperature (ca. 26°C), circular with entire margin, flat with a protuberance in the center, veined, from which several indentations extend

outwards, and cut into fan shapes at the surface, white form above; claybank form below, and not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Zunyi city, Chishui County, Hushi Town, Chishui Alsophila Natural Reserve, on dead frond stalks of *Cyathea* sp. (Cyatheaceae), 27 July 2022, J.Y. Zhang, CX4 (HKAS 129699, holotype; GZAAS 23-0669, isotype); *ibid*., 22 September 2019, J.Y. Zhang, C4 (HKAS 129695= GZAAS 23-0776, paratype), paratype living culture, T20-0523; *ibid*., 14 April 2023, J.Y. Zhang, ZY16 (HKAS 129859, paratype), paratype living culture, KUNCC 23-14156; *ibid*., ZY18 (HKAS 147029, paratype), paratype living culture, KUNCC 23-14159.

Notes: Four strains representing *Cyatheomyces synnematosa* formed a phylogenetically distinct, independent clade within Muyocopronaceae, and are described as a new genus. Phylogenetic analysis showed that *Cyatheomyces synnematosa* is closely related to *Pseudopalawanella woodwardiae* with good support (Figure 3.16), but *P. woodwardiae* only presents sexual morph that we cannot compare their morphology. *Cyatheomyces synnematosa* has a unique morphology, characterized by macronematous, synnematous conidiophores, which are notably distinguishes it from any other existing hyphomycetous genera in this family with being typically solitary, mocro- or macronematous, mononematous conidiophores (Crous et al., 2018; Hernãndez-Restrepo et al., 2019; Xu et al., 2024). The morphological characteristics with synnematous, dark brown to hyaline conidiophores, polyblastic conidiogenous cells with sympodially extending with numerous, conspicuous denticles scattered or clustered in the apical region, and hyaline conidia are similar to species in *Phaeoisaria* and *Rhamphoriopsis*, but phylogenetic analysis showed that *Phaeoisaria* was placed in Pleurotheciaceae, Pleurotheciales, Sordariomycetes and *Rhamphoriopsis* in Rhamphoriaceae, Rhamphoriale, Sordariomycetes. Therefore, we introduce a new genus *Cyatheomyces* to accommodate our unique taxon and assign it to Muyocopronaceae (Muyocopronales, Dothideomycetes) based on evidence of morphology and phylogeny.



Note a–c Colonies on host substrate. d, e Conidiophores. f–l Conidiogenous cells. m, n Conidiogenous loci. o–w Conidia. x Pure culture from above and reverse. Scale bar: d, e = 100 μm f–m =10 μm, n–w =5 μm

Figure 3.39 Cyatheomyces *synnemata* (CX4, holotype)

Pseudopalawanella J.Y. Zhang, Kevin D. Hyde & Y.Z. Lu, gen. nov.

Etymology: The generic epithet refers to the similarity to *Pseudopalawania*

Type species: Pseudopalawanella woodwardiae J.Y. Zhang, Y.Z. Lu & Y.Z. Lu

Saprobic on dead ferns in terrestrial habitats. **Sexual morph**: *Ascomata* superficial, solitary or scattered, sub-carbonaceous to carbonaceous, flattened or raised, dark brown to black spots, with a poorly developed basal layer and an irregular margin. *Peridium* comprising dark brown or black cells of *textura angularis*. *Hamathecium* cylindrical to filiform, septate, branched, pseudoparaphyses, hyaline. *Asci* 8-spored, bitunicate, fissitunicate, cylindric-clavate, apically rounded, straight or slightly curved, sessile or short pedicelate. *Ascospores* overlapping, irregularly arranged, ellipsoid to broadly fusiform, with rounded ends, 1-septate, constricted at the septum, straight or slightly curved, guttulate, hyaline. **Asexual morph**: Undetermined.

Pseudopalawanella woodwardiae J.Y. Zhang, Kevin D. Hyde & Y.Z. Lu, *sp. nov.*; Figure 3.40

Etymology: The species epithet "*woodwardiae*" refers to this fungal host "*Woodwardia japonica*"

Holotype: HKAS 129705

Saprobic on dead rachis of *Woodwardia japonica*. **Sexual morph**: *Ascomata* 139–189 µm diam. × (73–)85–111.5 µm high ($\bar{x}$ = 163 × 97 µm, n = 15), superficial, solitary or scattered, raised, rarely flattened, sub-carbonaceous to carbonaceous, appearing as circular, flattened, dark brown to black spots, covering the host, with a poorly developed basal layer and an irregular margin. *Ostioles* central. *Peridium* 13–22.5 µm wide, comprising dark brown or black cells of textura angularis. *Hamathecium* 1–2(–2.6) µm wide, cylindrical to filiform, septate, pseudoparaphyses, hyaline. *Asci* 46–53 × 9.5–12 µm ($\bar{x}$ = 47.5 × 10.5 µm, n = 20), 8-spored, bitunicate, fissitunicate, cylindric-clavate, straight or slightly curved, sessile or inconspicuous pedicelat, apically rounded, with an inconspicuous ocular chamber, hyaline. *Ascospores* 14.6–

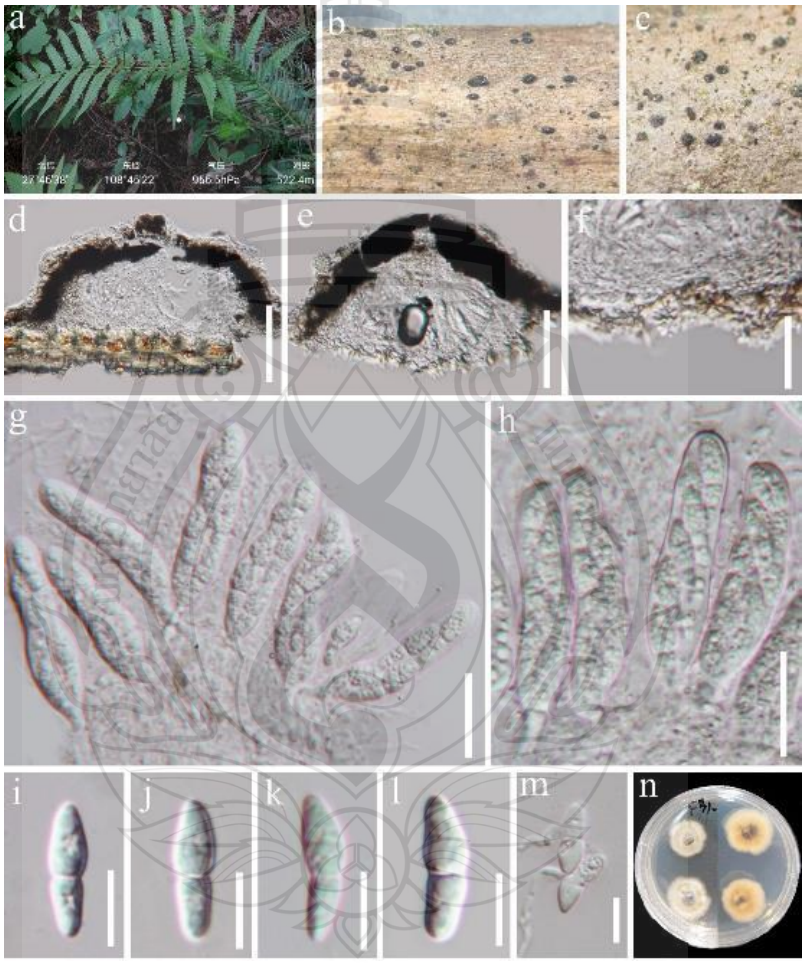
19.7 × 4.7–6.5 µm ($\bar{x}$ = 16.8× 5 µm, n = 20), overlapping, 2–3-seriate, ellipsoid to broadly fusiform, inequilateral, obtuse ends, straight or slightly curved, 1-septate, 3.5–6.5 wide at septum, constricted at the septum, with a slightly small lower cell, hyaline or subhyaline. **Asexual morph**: Undetermined.

Culture characteristics: Ascospores germinating on WA within 15 h at 26℃. Colonies on PDA, circular with slight wavy margin, flat with protuberance and wrinkle in the center, veined, yellowish white with ashen in the center from above; beige with dark brown in the middle in reverse, and not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Tongren City, Jiangkou County, (27°46’38”N, 108°45’22”E), on dead leaf axis of *Woodwardia japonica* (Blechnaceae) in a forest near the roadside, 21 May 2022, J.Y. Zhang, F31-3 (HKAS 129705, holotype; GZAAS 23-0673, isotype), ex-type living culture KUNCC23-13877.

Notes: *Pseudopalawanella* resemles *Pseudopalawania* in having superficial, sub-carbonaceous to carbonaceous ascomata covering the host, cylindric-clavate asci with an ocular chamber, and hyaline, 1-septate ascospores. However, they are phylogenetically distinct and also differ in its shape of ascomata (Raised *vs*. Flattened), asci and ascospores characteristics (asci without distinct ocular chambers; ellipsoid to broadly fusiform ascospores with obtuse ends *vs*. asci with distinct ocular chambers; fusiform to inequilateral ascospores with pointed ends). Multigene phylogenetic analysis based on combined LSU, ITS, *rpb2* and *tef1-α* sequence data shows that *Pseudopalawanella woodwardiae* forms an independent clade in Muyocopronaceae sister to *Cyatheomyces synnematosa* with good bootstrap support (Figure 3.16). However, we cannot compare the morphological characteristics of these two species as *Pseudopalawanella woodwardia*e shares a sexual morph in nature while *Cyatheomyces synnematosa* exhibits an asexual morph. Attempts were made to culture the asexual morph in *Pseudopalawanella woodwardiae* and sexual morph in *Cyatheomyces synnematosa*, but it is failed. Therefore, there is no morphological evidence to prove that the two species belong to the same genus. Furthermore, a comparison of nucleotide

base pairs of LSU, ITS, *RPB2* and *tef1-α Pseudopalawanella woodwardiae* (F31-3) and *Cyatheomyces synnematosa* (CX4strain) shows 27/833 bp (3.2%, including 3 gaps), 97/839 (11.6%, including 42 gaps), 95/1079 bp (8.8%, without gap) and 45/991 bp (4.5%, without gap) differences. Thence, to avoid taxonomic confusion, we introduce *Pseudopalawanella* as a new genus to accommodate *P. woodwardiae* with sexual morph in Muyocopronaceae (Muyocopronales). Further morphological investigations together with more collections and molecular data are needed.



Note a The host. b, c Colonies. D, e, h Section through ascomata. f The peridium mixed with host substrate at the base of an ascoma. g, h Asci and psudoparaphyses. i–l Ascospores. m Geminated ascospores. n Pure culture from above and below. Scale bar: d, e= 50 µm, f–h=20 µm, i–m = 10 µm

Figure 3.40 *Pseudopalawanella woodwardiae* (HKAS 129705, holotype)

Pleosporales genera incertae sedis

Microlepicola J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *gen. nov*.

Etymology: The generic epithet refers to the fungal host "*Microlepia marginata*"

Type species: Microlepicola guizhouensis J.Y. Zhang, Y.Z. Lu & K.D. Hyde

Saprobic on decaying plants in terrestrial habitats. **Sexual morph**: *Ascomata* immersed, solitary or scattered, visible as dark spots which are slight raised. *Ascomatal wall* coriaceous, thin-walled, of *textura angularis to textura prismatica* in surface view. *Hamathecium* filiform, pseudoparaphyses, hyaline. *Asci* 8-spored, bitunicate, cylindric-clavate, straight or slightly curved, with a short pedicel, apically rounded, with an ocular chamber. *Ascospores* overlapping, 2–3-seriate, fusiform, straight or slightly curved, 1-septate, not constricted at the septum, guttulate, surrounded by a thin and inconspicuous mucilaginous sheath. **Asexual morph**: Undetermined.

Microlepicola guizhouensis J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *sp. nov.*; Figure 3.41

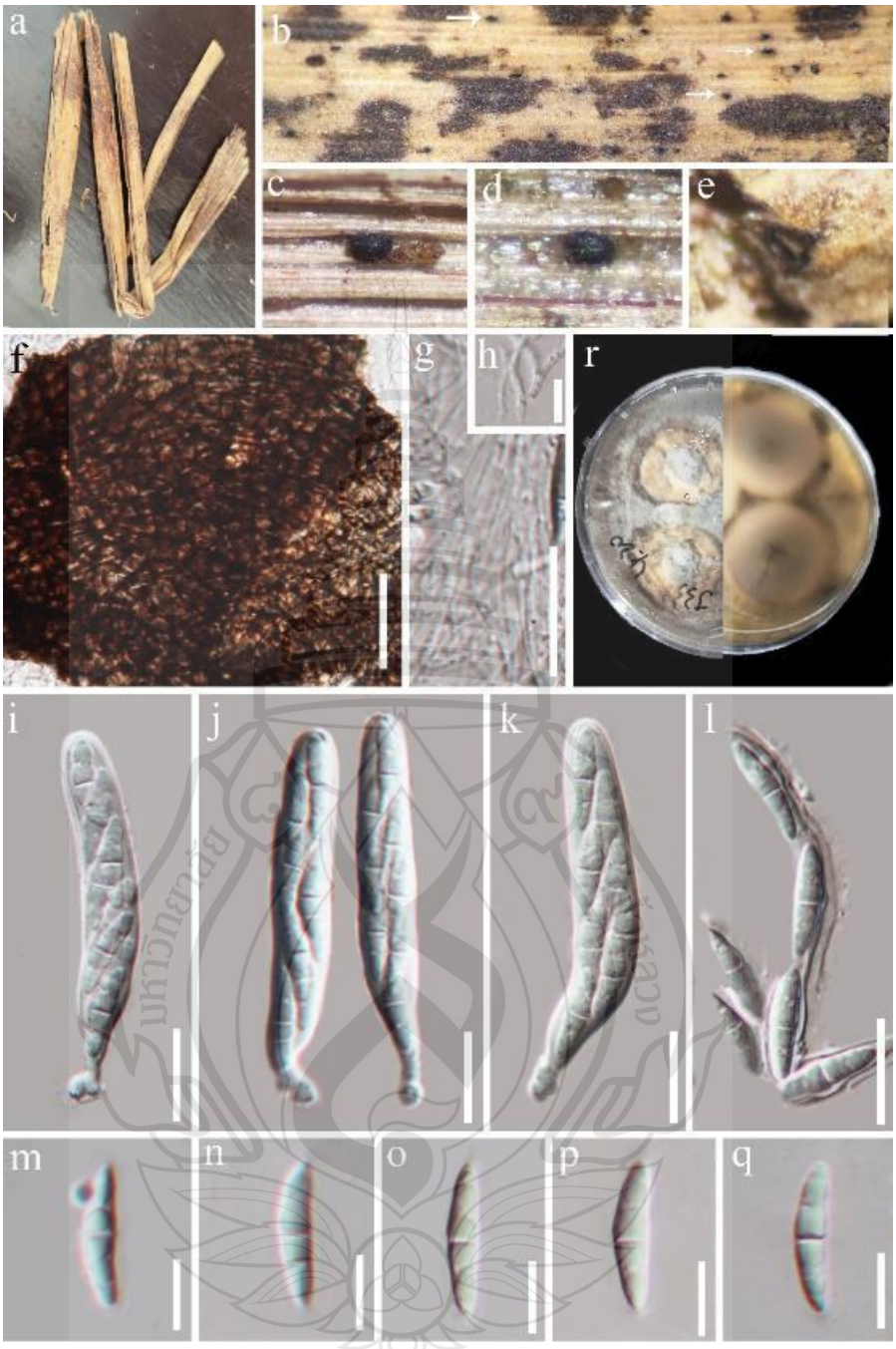
Etymology: The species epithet refers to the collecting site, Guizhou province, China.

Saprobic on dead rachis of *Microlepia marginata*. **Sexual morph**: Ascomata deeply immersed, solitary or scattered, visible as dark spots which are slightly raised, which ascocarp passes through the thin host epidermis, exposing the mostly whole ascomata from the reverse side of hosts. *Ascomatal wall* coriaceous, thin-walled, of *textura angularis to textura prismatica* in surface view., *Hamathecium* 1.3–2.6 µm wide, filiform, remotely separate, pseudoparaphyses, hyaline. *Asci* 68–85(–91) × 10.5–15.5 µm ($\bar{x}$ = 78 × 12.8 µm, n = 25), 8-spored, bitunicate, cylindric-clavate, straight or slightly curved, with a short pedicel, apically rounded, with an ocular chamber. *Ascospores* 18.4–21.7 × 4–5.5 µm (x = 20× 4.7 µm, n = 25), overlapping, 2–3-seriate, fusiform, straight or slightly curved, 1-septate, not constricted at the septum, guttulate, surrounded by a thin and inconspicuous mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: Ascospores germinating on WA within 13 h at 26°C. Colonies on PDA, circular with entire margin, flat with raise in the center, dry, cotton, ashen in the center, khaki to grey towards the margin; light brown to brown yellow in reverse, and not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of *Microlepia marginata* (Dennstaedtiaceae) near a river in a forest, 27 March 2022, J.Y. Zhang, J333 (HKAS 129777, holotype; GZAAS 23-0715, isotype), ex-type living culture KUNCC23-14007.

Notes: In the phylogenetic analysis, our new isolate (J333) forms a monophyletic clade in Pleosporales. *Microlepicola guizhouensis* exhibits some morphological similarities with several groups in the Pleosporales, such as *Pseudopolyplosphaeria* and *Neobambusicola*, in the shapes of hamathecium, asci and ascospores (Mapook et al., 2020a; Yu et al., 2024; Zhang et al., 2024). However, these groups are phylogenetically distinct and also differ in some morphologic characteristics. *Microlepicola guizhouensis* differs from the two aforementioned genera in having an immerse ascomycota with clearly visible epidermal cell composition, ranging from *textura angularis* to *textura prismatica* (Figure 3.41). To avoid establishing a new family for a single species, *Microlepicola* was introduce as a new monotypic genus and assign it to Pleosporales genera *incertae sedis*. Notably, we failed to culture the asexual morph, highlighting the need for additional collections to establish its connection with the sexual morph and to develop a more comprehensive generic concept for *Microlepicola*.



Note a Host substrate. b Colonies on the host above. c, d Colonies from the reverse side of the host epidermis f The surface of Ascoma. g, h Psudoparaphyses. i–k. Asci. l–q. Ascospores. r Pure culture. Scale bar: e, f = 30 µm. h, m–q = 10 µm, i–l=20 µm

Figure 3.41 *Microlepicola guizhouensis* (HKAS 129777, holotype)

Xenopleopunctum J.Y. Zhang, Y.Z. Lu & K.D. Hyde, gen. nov.

Etymology: referring to the similar genus *Pleopunctum*

Type species: *Xenopleopunctum sporodochiale* J.Y. Zhang, Y.Z. Lu & K.D. Hyde

Saprobic on dead rachis o ferns. **Sexual morph**: Undetermined. **Asexual morph**: Hyphomycetous. *Colonies* on natural substrate superficial, effuse, sporodochial, brown to black, scattered to gregarious, punctiform. *Mycelium* partly superficial, partly immersed, composed of septate, branched, hyaline to brown hyphae. *Conidiophores* micro- to macronematous, mononematous, cylindrical, brown, often reduced to conidiogenous cells. *Conidiogenous cells* integrated, monoblastic, terminal, cylindrical, smooth-walled, brown. *Conidia* acrogenous, solitary, muriform, constricted at septa, mostly oval to ellipsoidal, smooth-walled, brown to dark brown, sometime slightly darked at the upper part, clearly darked at the septum, paler at the base, often with a bowl-shaped to subglobose hyaline basal cell.

Notes: *Xenopleopunctum* is introduced as a new genus to accommodate taxa exhibiting *pleopunctum*-like asexual morphology, collected from ferns. *Xenopleopunctum* resembles *Pleopunctum* in having punctiform, brown colonies, monoblastic conidiogenous cells and muriform, oval to ellipsoidal and dematiaceous conidia with a hyaline basal cell (Liu et al., 2019; Boonmee et al., 2021; Xu et al., 2023; Yang et al., 2023). However, they are phylogenetically distinct, with *Pleopunctum* belonging to Phaeoseptaceae and *Xenopleopunctum* belonging to Pseudomassarinaceae. In the phylogenetic tree of combined LSU, *RPB2*, SSU and *tef1-α* sequence data, the two new species of *Xenopleopunctum* clusters as a distinct, well-supported clade, sharing a sister relationship with *Pseudomassarina* with good statistical support. *Pseudomassarina* is a sexually morphic genus that cannot be compared morphologically to *Xenopleopunctum*. Therefore, we hereby introduced a new hyphomycetous genus, *Xenopleopunctum*, in Pleosporales based on evidence from morphology and phylogeny.

Xenopleopunctum sporodochiale J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*; Figure 3.42

Etymology: referring to its sporodochial conidiomata

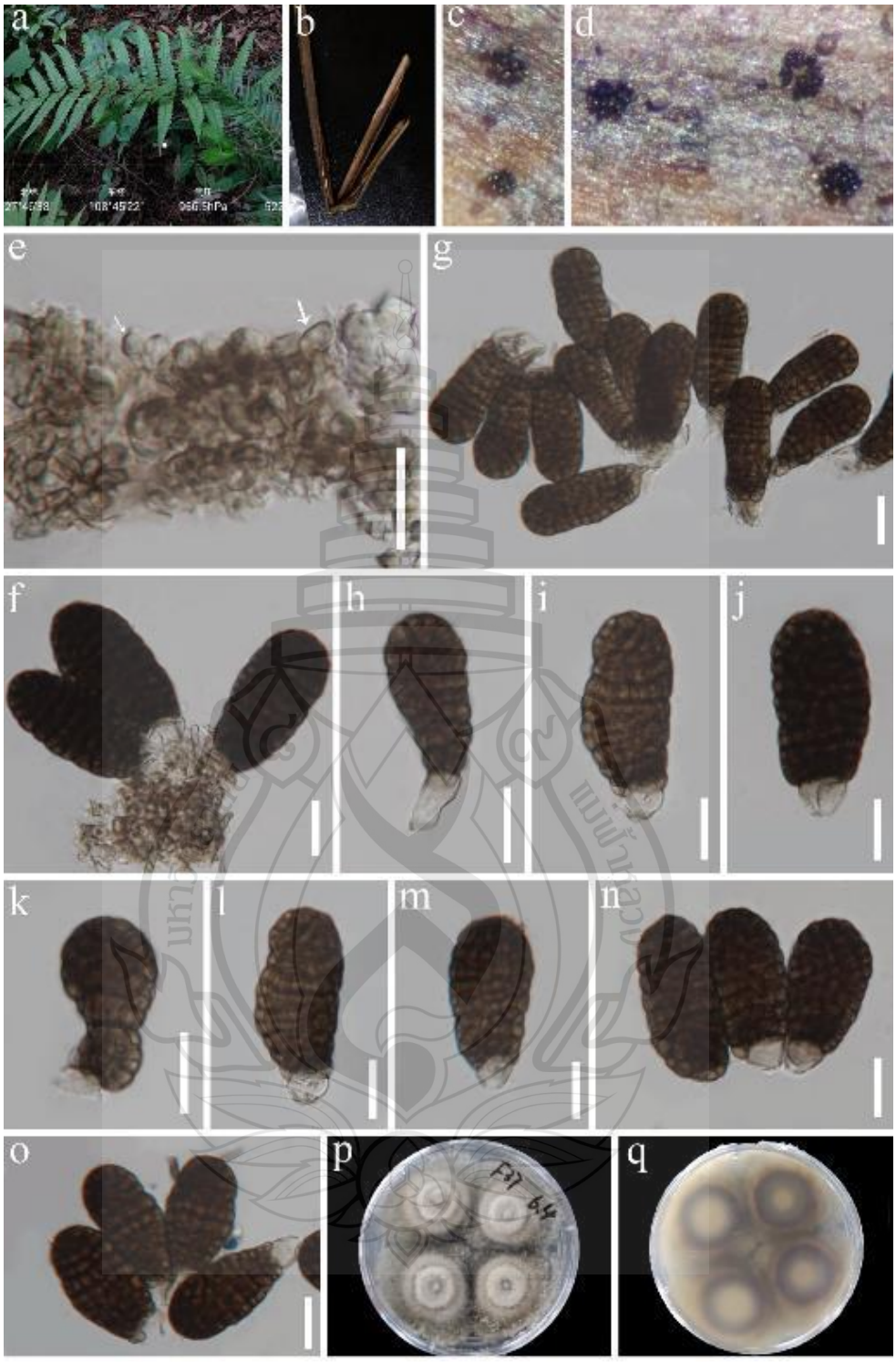
Holotype: HKAS 12970

Saprobic on dead rachis o ferns. Sexual morph: Undetermined. Asexual morph: Hyphomycetous. *Colonies* on natural substrate superficial, effuse, sporodochial, brown to black, scattered to gregarious, punctiform. *Mycelium* mostly superficial, composed of septate, branched, hyaline to brown hyphae. *Conidiophores* micro- to macronematous, mononematous, cylindrical, brown, often reduced to conidiogenous cells. *Conidiogenous cells* 4–6.5 µm ($\bar{x}$ = 5.1 µm, n = 20) wide, integrated, monoblastic, terminal, cylindrical, smooth-walled, brown. *Conidia* 46.5–66.5 × 22–32.5 µm ($\bar{x}$ = 53.5 × 26.3 µm, n = 30), acrogenous, solitary, muriform, constricted at septa, cylindrical to oval to irregular ellipsoidal, smooth-walled, brown to dark brown, sometime slightly darked at the upper part, often with a bowl-shaped to subglobose, 8.5–14 × 6–15 µm, hyaline or subhyaline to pale brown basal cell.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from the base of conidia. Colonies growing on PDA under natural light, reaching ca. 36 mm diameter after one month at 26 °C, circular with entire margin, flat with a protuberance in the center, dry, velvety, offwhite to taupe brown in concentric circles from center towards margin in the front; pale brown in the center, followed by brown to pale brown in concentric circles towards the edge, and not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Tongren City, Jiangkou County, 27°46‘38’‘N, 108°45’22‘’E 522M, on dead petiole of Woodwardia japonica, in a distributed forest, 21 May 2022, J.Y. Zhang, F37 (HKAS 129707, Holotype; GZAAS 23-0675,isotype), ex-type living culture KUNCC23-13881; *ibid.*, F34 (KUNCC23-13880); *ibid.*, F38-1 (HKAS 129708, paratype), paratype living culture, KUNCC23-13882.

Notes: Three collections representing *Xenopleopunctum sporodochiale* sp. nov. form an independent lineage that is sister to *X. guizhouensis* with strong support values. *Xenopleopunctum sporodochiale* and *X. guizhouensis* share a similar morphology in having sporodochial, punctiform colonies, integrated, monoblastic, brown conidiogenous cells and muriform, brown conidia with hyaline or subhyaline to pale brown basal cell. However, *Xenopleopunctum sporodochiale* differs from *X. guizhouensis* in having larger conidia (46.5–66.5 × 22–32.5 µm *vs*. 35–45(–47.8) × 18.3–25.5 µm) with more varied shaped in shapes (cylindrical to oval to irregular ellipsoidal vs. oval to ellipsoidal). Additionally, a comparison of nucleotide base pairs of ITS, LSU, *RPB2*, SSU and *tef1-α* between *X. sporodochiale* differs (F37-KUNCC23-13881) and *X. guizhouensis* (C22-xx) shows 27/469 bp (6%, including 4 gap), 12/857 (1%, with 2 gap), 60/1062 (6%, 0 gap), 2/1022 (-%, 0 gap), and 50/908 (6%, with 1 gap) differences, confirming they are distinct species.



Note a The host. b Host substrate c, d Colonies on the host substrate. e, f Mycelium and conidiogenous cells. g–o Conidia. c–i = 20 μm

Figure 3.42 *Xenopleopunctum sporodochiale* (HKAS 129707, holotype)

Xenopleopunctum guizhouensis J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*; Figure 3.43

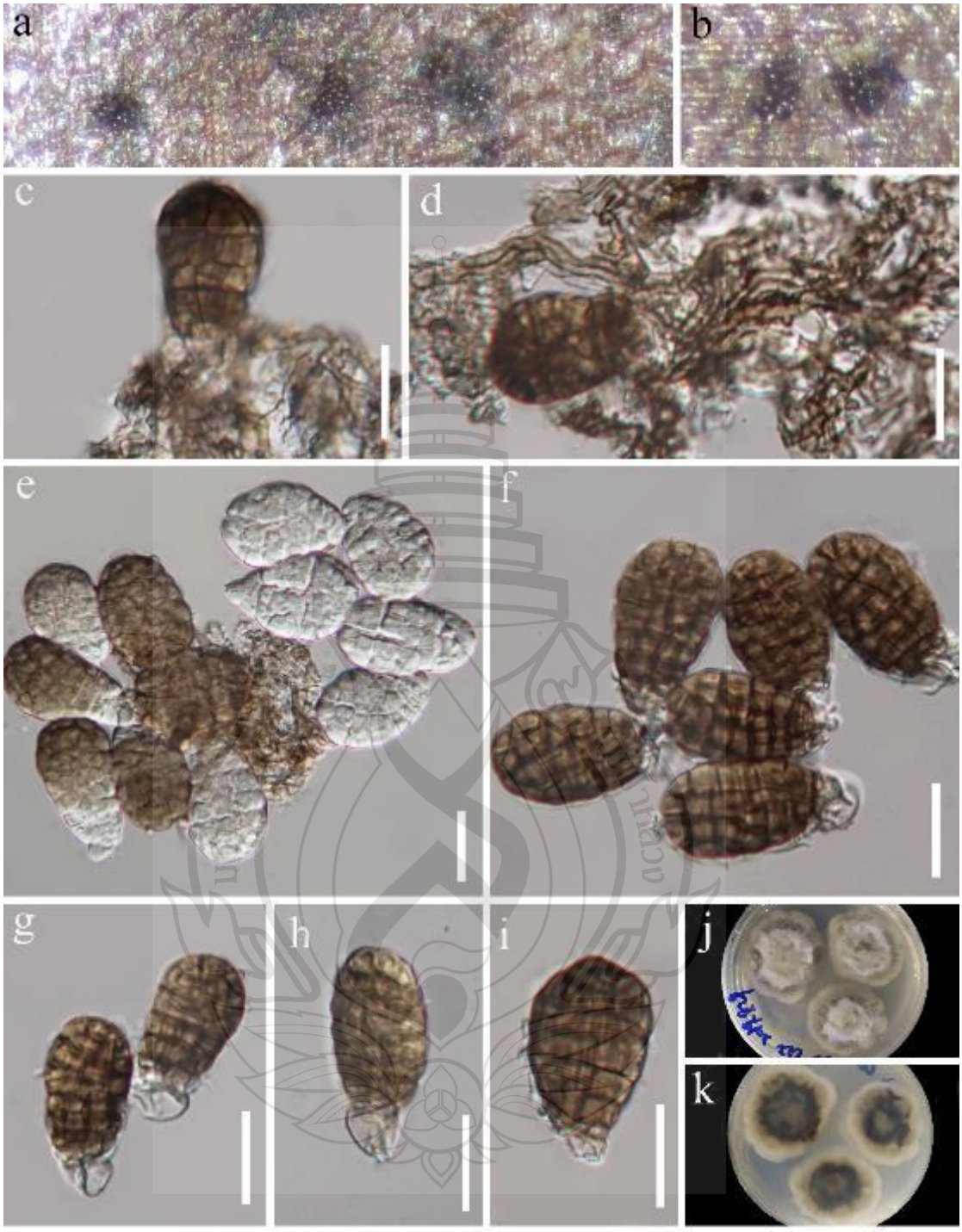
Etymology: referring to its collecting site.

Saprobic on dead rachis of Cyatheaceae sp. Sexual morph: Undetermined. Asexual morph: Hyphomycetous. *Colonies* on natural substrate superficial, effuse, sporodochial, brown to black, scattered to gregarious, punctiform. *Mycelium* partly superficial, partly immersed, composed of septate, branched, hyaline to brown hyphae. *Conidiophores* micronematous, mononematous, reduced to conidiogenous cells. *Conidiogenous cells* 3–6.2 × 2.5–3.1 µm ($\bar{x}$ = 4.6 × 2.8 µm, n = 15), integrated, monoblastic, terminal, cylindrical, smooth-walled, brown. *Conidia* 35–45(–47.8) × 18.3–25.5 µm ($\bar{x}$ = 40.7× 21.5 µm, n = 30), acrogenous, solitary, muriform, slightly constricted at septa, oval to ellipsoidal, smooth-walled, hyaline or subhyaline when immature, hyaline to brown from base to upper part during maturation, brown when mature, darked at the septum, often with a bowl-shaped to subglobose, 7.5–12 × 7.3–12 µm ($\bar{x}$ = 9.8 × 10.9 µm, n = 20), hyaline or subhyaline to pale brown basal cell.

Culture characteristics: Conidia germinating on WA within 13 h and germ tube produced from the base of conidia. Colonies growing on PDA under natural light, reaching ca. 26 mm diameter after one month at 26°C, irregular or subrotund in shape with lobate edge, raised with convex in the center, dry, fluff, white to pale brown towards the edge from the front; middle brown to dark brown to white from the center to margin in reverse, and and not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Zunyi city, Chishui County, Hushi Town, Chishui Alsophila Natural Reserve, on dead frond stalks of Cyatheaceae sp., 22 September 2019, J.Y. Zhang, C22 (HKAS 129694, holotype, GZAAS 23-0774, isotype), paratype living culture, T20-0531.

Notes: *Xenopleopunctum guizhouensis* formed a distinct clade and shared a sister relationship with *X. sporodochiale*, which confirmed they are separate species. The difference between these two species was mentioned above.



Note a, b Colonies on the host substrate. c, d Mycelium. e–i Conidia. c–i = 20 μm

Figure 3.43 *Xenopleopunctum guizhouensis* (HKAS 129694, holotype)

Eurotiomycetes O.E. Erikss. & Winka, Myconet 1(1): 6 (1997)

Chaetothyriales M.E. Barr, Mycotaxon 29: 502 (1987)

Cyphellophoraceae Réblová & Unter., PLoS One 8 (5): 10 (2013)

Cyphellophora G.A. de Vries, Mycopath. Mycol. appl. 16(1): 47 (1962)

Index Fungorum number: IF 7885; *Facesoffungi number*: FoF 10359; four species associated with pteridophytes (including three species newly reported in this study); Figure 3.44

Type species: *Cyphellophora laciniata* G.A. de Vries

Notes: The black yeast-like genus *Cyphellophora* (Cyphellophoraceae, Chaetothyriales, Eurotiomycetes) was established by De Vries (1962) with *Cyphellophora laciniata* as the type species (Réblová et al., 2013). The morphological traits are commonly known from its asexual morph produced in cultures, characterized by septate, branched hyphae, simple, intercalary, terminal, or lateral phialides producing multiseptate, oblong to fusiform or vermiform, curved, hyaline or pale brown conidia (De Vries, 1962; De Vries et al., 1986; Cheewangkoon et al., 2009; Réblová et al., 2013; Gao et al., 2015; Crous et al., 2023). The sexual morph of *Cyphellophora* is represented by *C. filicis*, *C. hongheensis*, *C. jingdongensis* described as subglobose to globose, dark brown ascomata with inconspicuous ostioles, ellipsoidal to cylindrical to ampulliform, bitunicate asci with short pedicel, and septate, hyaline ascospores (Yang et al., 2018a; Phookamsak et al., 2019; Yang et al., 2022a). Currently, more than 30 species are accepted in the genus, reported as pathogens, saprobes, and endophytes on plant materials, soil, river sediments, mammal's skin and nails, and food worldwide (Decock et al., 2003; Feng et al., 2013; Mayfield et al., 2013; Feng et al., 2014; Gao et al., 2015; Madrid et al., 2016; Yang et al., 2018a; Torres-Garcia et al., 2023). The saprobe of *Cyphellophora filicis* with a sexual morph was found on dead fronds of an unidentified fern in Thailand (Phookamsak et al., 2019), marking the only record of *Cyphellophora* species associated with pteridophytes. In this study, five new collections obtained from ferns, representing three new species *viz*., *Cyphellophora alsophilae*,

C. guizhouensis and *C. multiseptata*, were introduced in the genus *Cyphellophora* based on morphology and congeneric phylogeny. We therefore expand the generic concept of *Cyphellophora* with macronematous, septate, dematiaceous conidiophores and polyblastic conidiogenous cells based on the morphological features of our new species, isolated from natural substrates.

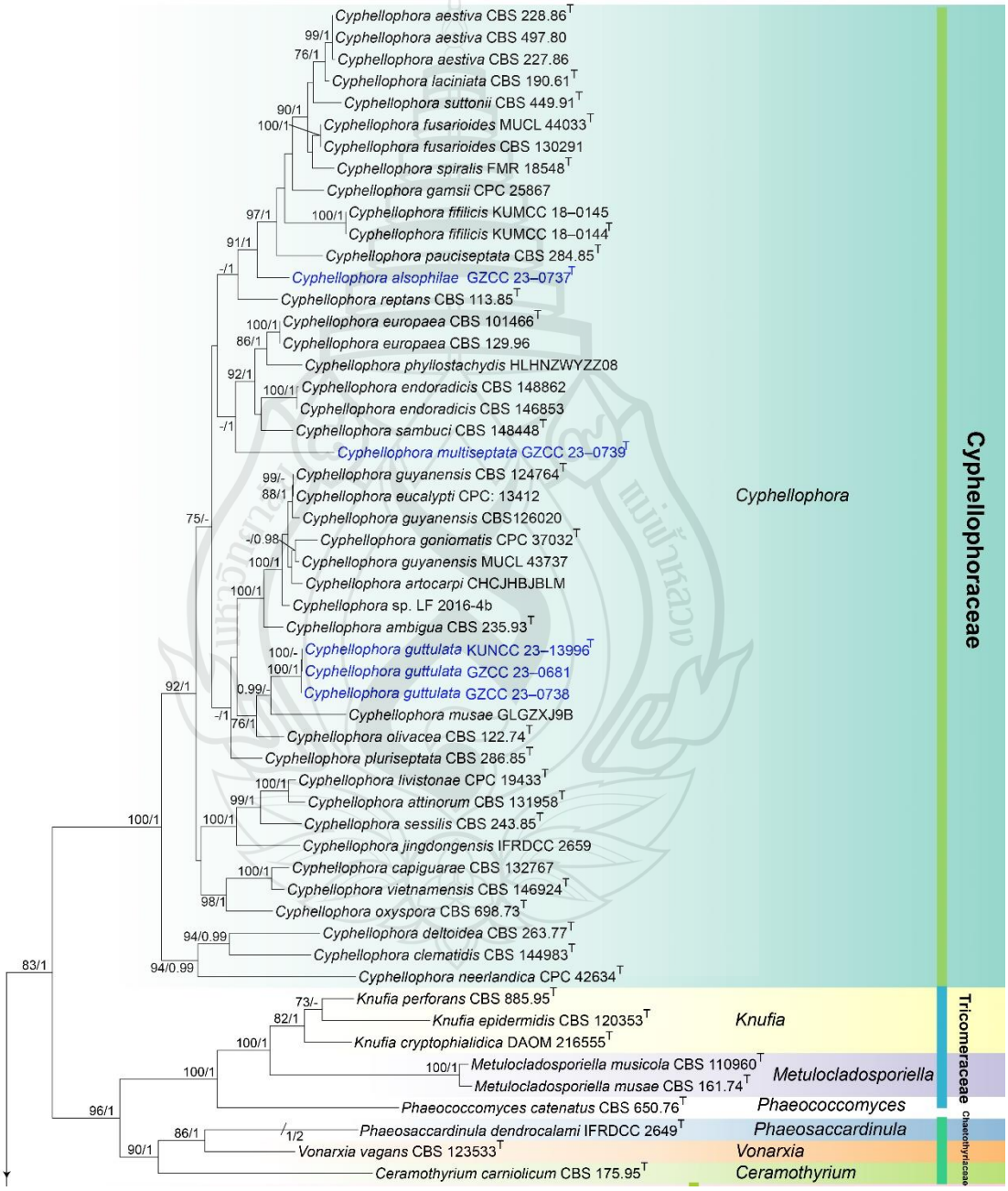
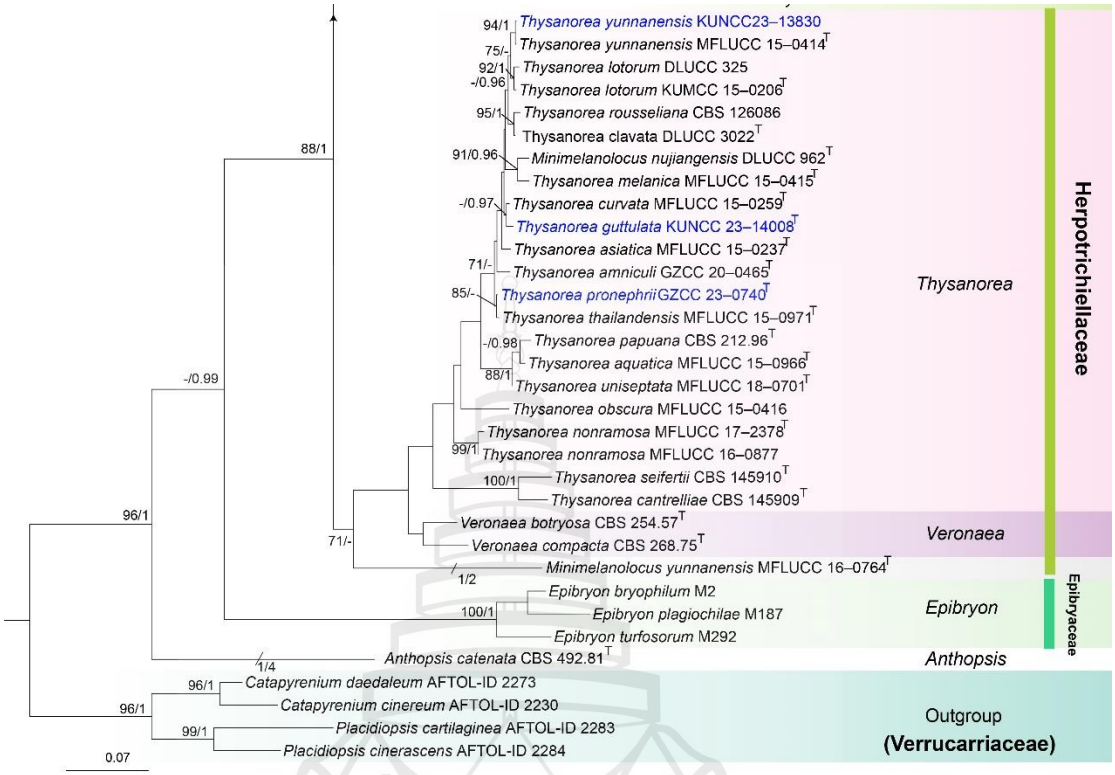
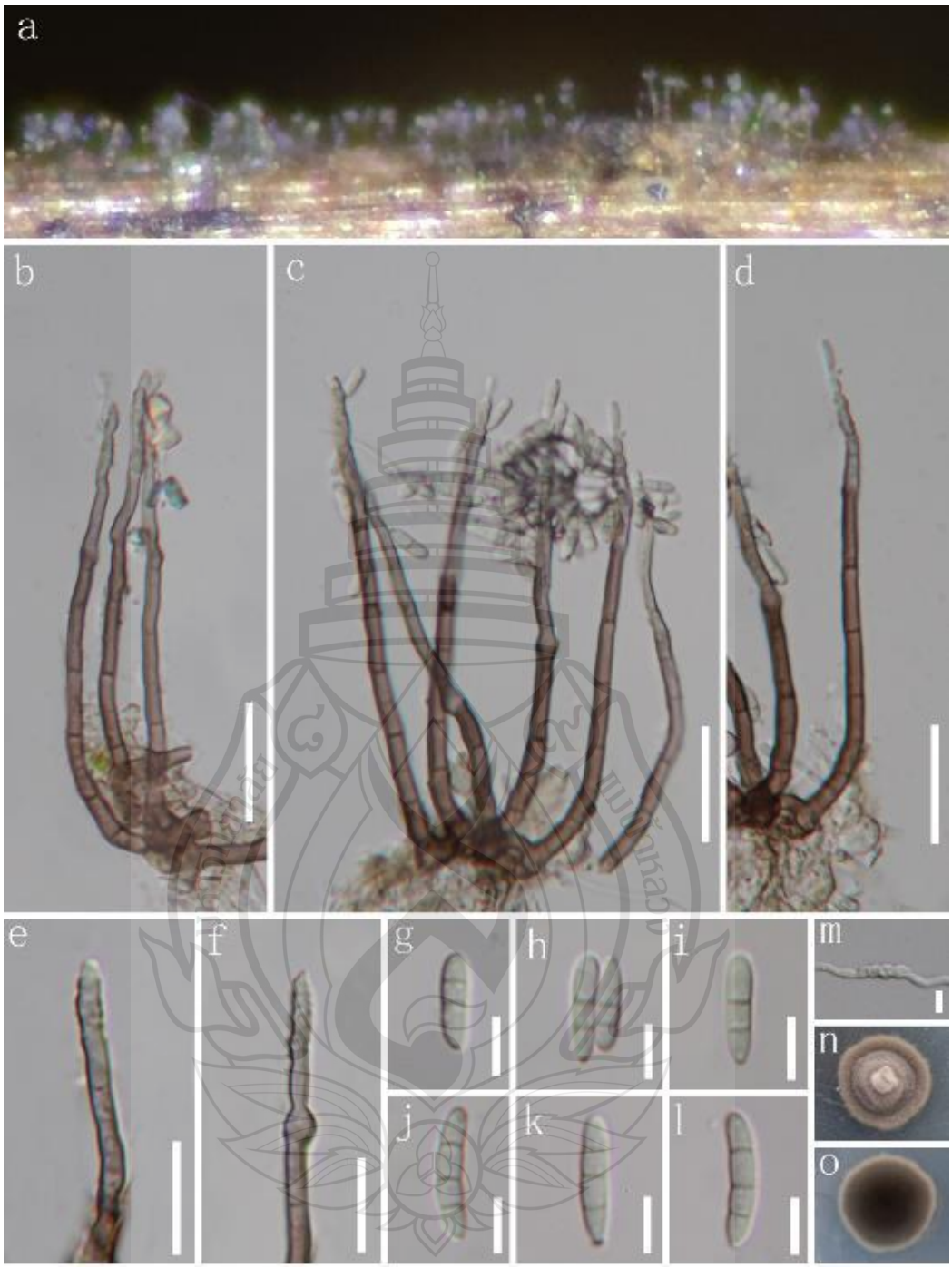


Figure 3.44 Phylogenetic tree of Cyphellophoraceae



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS and SSU sequence data. 87 taxa were included in the combined analyses, which comprised 2473 characters (LSU = 855 bp, ITS = 626 bp, SSU = 992 bp) after alignment. The best scoring RAxML tree with a final likelihood value of -19593.232306 is presented. The tree was rooted to *Placidiopsis cinerascens* AFTOL-ID 2284, *P. cartilaginea* AFTOL ID-2283, *Catapyrenium cinereum* AFTOL-ID 2230 and *C. daedaleum* AFTOL-ID 2273. Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.44 (continued)



Note a Colonies on substrate. b–d Conidiophores with attached conidia. e–f Conidiogenous cells. g–l Conidia. m Germinated conidium. n, o Colony on PDA from above and below. Scale bars: b–d = 20 μm, e, f = 10 μm, g–m = 5 μm

Figure 3.45 *Cyphellophora alsophilae* (HKAS 129820, holotype)

Cyphellophora alsophilae J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903183; *Facesoffungi number*: FoF17034; Figure 3.45

Etymology: The species epithet "*alsophilae*" refers to the host genus.

Holotype: HKAS 129820

Saprobic on dead frond stalks of *Alsophila metteniana* (Cyatheaceae) in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered or in small groups, dark brown, with pale yellow masses of conidia at the apex of conidiophores. *Mycelium* mostly composed of pale brown, septate hyphae. *Conidiophores* (59–)64.5–85.5 × 2.5–3.6 μm ($\bar{x}$ = 72.5 × 3 μm), macronematous, mononematous, solitary or aggregated in cluster from the mycelial knots, erect, straight or slightly flexuous cylindrical, up to 9-septate, smooth-walled, brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 11–30.5 × 1.5–2.9 μm ($\bar{x}$ = 21.5 × 2.2 μm), integrated, polyblastic, terminal, occasional swelling at the middle, pare brown to subhyaline towards apex, sympodial. *Conidia* 7.8–12.5 × 1.8–2.8 μm ($\bar{x}$ = 9.5 × 2.3 μm, n = 20), oblong, rounded at the apex, narrow and slightly truncate at the base with a darkened hilum sometimes, straight or slightly curved, 2–3-septate when mature, not constricted or slightly constricted at the septa, smooth, hyaline to subhyaline.

Culture characteristics: Conidia germinating on PDA within 15 h and germ tubes produced from the base and the upper part. Colonies growing on PDA in natural light, reaching 18 mm diameter in 10 days at 25°C, circular, flat, without veined and wrinkle, entire margin, taupe with brown edges from above; black, paler to margin, with white mycelium in the outer ring in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Alsophila metteniana* (Cyatheaceae), 13 December 2021, J.Y. Zhang, J80-1 (HKAS 129820, holotype; GZAAS 23–0778, isotype), ex-type living culture GZCC 23–0737.

Notes: *Cyphellophora alsophilae*, isolated from natural substrate, is distinguishable from other *Cyphellophora* species by the presence of macronematous, septate, brown conidiophores and polyblastic conidiogenous cells, which resemble some *Nothodactylaria* species, such as *Nothodactylaria guizhouensis*, and *N. woodwardiae* (this study). However, molecular analyses revealed that *Nothodactylaria* is placed in Nothodactylariaceae (Amphisphaeriales, Sordariomycetes), which is distinct from *C. alsophilae* in Cyphellophoraceae (Chaetothyriales, Eurotiomycetes, Ascomycota) (Crous et al., 2019b). In our phylogenetic tree, *C. alsophilae* formed a separate clade within the genus *Cyphellophora*, and basal to eight *Cyphellophora* species characterized by phialidic conidiogenous cells.

Note a, b Colonies on substrate. c–g Conidiophores with conidiogenous cells. h–j Conidia. k Germinated conidium. l Colonies on PDA from above and below. Scale bars: c–g = 20 µm, h–k = 10 µm

Figure 3.46 *Cyphellophora guizhouensis* (HKAS 129771, holotype)

Cyphellophora guizhouensis J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 903184; Facesoffungi number: FoF17035; Figure 3.46

Etymology: The species epithet "*guizhouensis*" refers to the collecting site.

Holotype: HKAS 129771

Saprobic on dead frond stalks of ferns in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered or in small groups, dark brown, shiny. *Mycelium* mostly composed of hyaline to pale brown, septate hyphae. *Conidiophores* 65.5–98 × 2.7–4.4 μm ($\bar{x}$ = 84 × 3.5 μm), macronematous, mononematous, mostly solitary, erect, straight or slightly flexuous cylindrical, up to 11-septate, thick-walled, smooth-walled, dark brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 5.3–13.7(–25) × 2–2.9 μm ($\bar{x}$ = 9.9 × 2.5 μm), integrated, polyblastic, terminal, pare brown to subhyaline towards apex, slightly sympodial. *Conidia* 15.5–21.8 × 1.6–2.6 μm ($\bar{x}$ = 18.2 × 2.2 μm, n = 20), acrogenous, spindly, subcylindrical to fusiform, straight or slightly curved, with light truncate at base, 1–2-septate when mature, not constricted at the septa, smooth-walled, guttulate, hyaline to subhyaline.

Culture characteristics: Conidia germinating on PDA within 15 h and germ tubes produced from the ends of conidium. Colonies growing on PDA in natural light, reaching 22 mm diameter in 15 days at 25 °C, circular, flat, without veined and wrinkle, entire margin, taupe from above; black or dark brown with middle brown edges in reverse side, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of an unidentified fern in a distributed forest, 27 March 2022, J.Y. Zhang, J313-2 (HKAS 129771, holotype; GZAAS 23–0708, isotype), ex-living culture KUNCC 23–13996; CHINA, Guizhou Province, Qiannan Buyi and Miao Autonomous Prefecture, Sandu Shui Autonomous County, on dead fronds of

unidentified fern, 13 August 2021, J.Y. Zhang, J58-9 (HKAS 129803), living culture GZCC 23–0681; CHINA, Guizhou Province, Qiandongnan Miao and Dong autonomous Prefecture Zhenyuan County (108°24'2‘’E, 27°6’34”N), on the dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae), 12 August 2023, J.Y. Zhang, TX04-2 (HKAS GZAAS 23–0816), living culture GZCC 23–0738.

Notes: Phylogenetically, *Cyphellophora guizhouensis* nested within *Cyphellophora*, forming a distinct clade that is sister to the clade containing *C. olivacea* CBS 122.74 and *C. musae* GLGZXJ9B (Figure 3.73). Morphologically, *Cyphellophora guizhouensis* is similar to *C. alsophilae* with macronematous, unbranched, brown conidiophores, terminal, polyblastic conidiogenous cells and septate, hyaline conidia (this study). However, it differs in having darker, solitary conidiophores (mostly solitary vs. solitary to aggregated in groups) and longer conidia with different shapes (spindly, subcylindrical to fusiform, 15.5–21.8 µm vs. oblong, rounded at the apex, narrow and slightly truncate at the base, 7.8–12.5 µm).

Cyphellophora multiseptata J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903185; *Facesoffungi number*: FoF17036; Figure 3.47

Etymology: The species epithet “*multiseptata*” refers to the multiseptate conidia.

Holotype: HKAS GZAAS 23–0817

Saprobic on dead fronds of *Blechnopsis* sp. (Blechnaceae) in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, hairy, scattered or in small groups, dark brown. *Mycelium* mostly composed of hyaline to pale brown, septate hyphae. *Conidiophores* 99–154 × 3.7–5.8 µm ($\bar{x}$ = 124 × 4.5 µm), macronematous, mononematous, mostly solitary, erect, straight or slightly flexuous cylindrical, multiseptate, thick-walled, smooth-walled, guttulate sometime, brown or dark brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* (10–)19.5–25.6 × 2.1–3.9 µm ($\bar{x}$ = 21.7 × 2.7 µm), integrated, polyblastic, terminal, pare brown to subhyaline towards apex. *Conidia* 19–27.5 × 1.9–

2.9 µm ($\bar{x}$ = 24 × 2.5 µm, n = 20), acrogenous, spindly, filiform to fusiform, straight or slightly curved, with truncate at the base, up to 7-septate when mature, not constricted or slightly constricted at the septa, smooth-wall, occasionally guttulate, hyaline to subhyaline.

Note a The host. b Colonies on substrate. c–f Conidiophores with conidiogenous cells. g–i Conidia. j Germinated conidium. k, l Colony on PDA from above and below. Scale bars: c–f = 30 µm, g–i = 10 µm, j = 20 µm

Figure 3.47 *Cyphellophora multiseptata* (GZAAS 23–0817, holotype)

Culture characteristics: Conidia germinating on WA within 15 h and germ tubes produced from the ends of conidium. Colonies growing on PDA under natural light, reaching 28 mm diameter in 20 days at 26°C, circular with entire margin, flat with a knobby protuberance, without veined and wrinkle, taupe from above; black or dark brown with light brown edge in reverse side, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiannan Buyi and Miao Autonomous Prefecture, Duyun City, Yaoren Mountain Reserve, 107° 51‘51’‘E, 26°1’7’’N, on dead fronds of *Blechnopsis* sp. (Blechnaceae), 4 October 2023, X. J. Xiao, YW2 (GZAAS 23–0817, holotype), ex-type living culture GZCC 24–0095.

Notes: Morphologically, *Cyphellophora multiseptata* resembles *C. guizhouensis* in the shapes of conidiophores, conidiogenous cells and conidia. However, *C. multiseptata* can be distinguished from *C. guizhouensis* by the sizes of its microstructures. *Cyphellophora multiseptata* has longer conidiophores (99–154 μm vs. 65.5–98 μm), conidiogenous cells (19.5–25.6 μm vs. 5.3–13.7 μm) and conidia (19–27.5 vs. 15.5–21.8) with more septa (up to 7-septa vs. 1–2-septa). Phylogenetically, *Cyphellophora multiseptata* shares a sister relationship with the clade including *C. endoradicis*, *C. europaea*, *C. phyllostachydis*, and *C. sambuci*, it constitutes a distinct lineage.

Herpotrichiellaceae Munk, Dansk bot. Ark. 15(no. 2): 131 (1953)

Thysanorea Arzanlou, W. Gams & Crous, in Arzanlou, Groenewald, Gams, Braun, Shin & Crous, Stud. Mycol. 58: 80 (2007)

Index Fungorum number: IF504555; *Facesoffungi number*: FoF 10384; 3 species associated with pteridophytes in this study.

Type species: *Thysanorea papuana* (Aptroot) Arzanlou, W. Gams & Crous

≡ *Periconiella papuana* Aptroot, in Aptroot & Iperen

Notes: *Thysanorea* was introduced by Arzanlou et al. (2007b) to accommodate *Thysanorea papuana* (Basonym: *Periconiella papuana*) based on phylogenetic analysis and the morphologic characteristic of branched conidiophores at the apex. However, it was later revealed that this trait of conidiophores was accidental, depending on the

growth substrate and period (Kirschner, 2016; Hernández-Restrepo et al., 2020). The discovery of novel species from subsequent studies also supported this result (Liu et al., 2015; Dong et al., 2018; Hernández-Restrepo et al., 2020; Yang et al., 2023). Traditionally, the phylogenetic placement of *Thysanorea* species group within the *Minimelanolocus* clade in Herpotrichiellaceae has been a subject of confusion (Dong et al., 2018; Hyde et al., 2019). It was not until Hernández-Restrepo et al. (2020) proposed nine new combinations from *Minimelanolocus* to *Thysanorea* based on their congeneric phylogenetic placement. However, this delineation was not accepted by Wan et al. (2021) due to the lack of molecular data for the type species, *M. navicularis* (R.F. Castañeda) R.F. Castañeda. Therefore, the type species for *M. navicularis* needs to be restudied and re-analyzed with fresh collection and isolation, epitypified, and subjected to phylogenetic analysis. Currently, 15 species areaccepted in *Thysanorea*, characterized by branching pattern of conidiophores and terminal or intercalary, polyblastic, prominent denticle-like conidiogenous loci, cylindrical to fusiform to subpyriform, septate conidia (Arzanlou et al., 2007b; Liu et al., 2015; Dong et al., 2018; Yang et al., 2023; Hernández-Restrepo et al., 2020). Members of *Thysanorea* have been reported as saprobic fungi on dead woody substrates or submerged wood, mainly distributed in freshwater habitats (Arzanlou et al., 2007b; Liu et al., 2015; Wang et al., 2019; Hernández-Restrepo et al., 2020; Yang et al., 2023). Additionally, the phylogeny in the current study suggests that LSU and ITS sequences cannot fully resolve interspecific relationships within *Thysanorea*, and more sequences, especially protein coding, are needed to help clarify the phylogenetic placement (Wang et al., 2019). In this study, we follow the treatment of Hernández-Restrepo et al. (2020), and describe three *Thysanorea* species found on ferns for the first time.

Note a Colonies on the host. b–e Conidiophores with conidiogenous cells. f Conidiogenous cells. g–i Conidia. j Germinated conidium. k, l Colonies on PDA from above and below. Scale bars: b–e = 30 µm, f–j = 10 µm

Figure 3.48 *Thysanorea pronephrii* (GZAAS 23–0818, holotype)

Thysanorea pronephrii J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 903186; *Facesoffungi number*: FoF 17548; Figure 3.48

Etymology: The species epithet "*pronephrii*" refers to the fungal host genus *Pronephrium*.

Holotype: GZAAS 23–0818

Saprobic on dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae) in a terrestrial habitat. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate, superficial, effuse, single, velvety, hairy, brown. *Mycelium* partly immersed, partly surficial, composed of brown, septate, branched hyphae. *Conidiophores* (98–)135–195 µm long, 6.5–7.7 µm wide near the base ($\bar{x}$ = 152 × 7.2 µm), macronematous, mononematous, solitary, erect, straight or slightly flexuous, cylindrical, unbranched, 7–14-septate, thick-walled, smooth-walled, brown or dark brown at the base, paler to subhyaline towards the apex. *Conidiogenous cells* 15.8–29.8 × 3.7–4.9 µm ($\bar{x}$ = 22.8 × 4.2 µm), denticulate, polyblastic, integrated, terminal, sympodial, cylindrical, wavy on the surface, pare brown to subhyaline towards apex. *Conidia* 19.6–27 × 3.3–4.5 µm ($\bar{x}$ = 22.8 × 3.9 µm, n = 25), phragmospores, clavate to fusiform, tapering and rounded at the apex, narrow and truncate at the base with a darkened hilum sometimes, straight or straight curved, 1–2-septate when young, 3(–4)-septate when mature, not constricted at the septa, smooth-walled, rarely guttulate, hyaline or subhyaline.

Culture characteristics: Conidia germinating on water agar within 13 h and germ tubes produced from the conidia within 13 h. Colonies growing on PDA at 25°C in natural light, reaching 10 mm diameter in two weeks, circular, with umbonate surface, without wrinkle, edge entire, gray to brownness from above; sepia in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong autonomous Prefecture Zhenyuan County, on dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae), 12 August 2023, J.Y. Zhang, TX04 (GZAAS 23–0818, holotype), ex-type living culture GZCC 23–0740.

Notes: Our collection resembles *Thysanorea clavata* in the shapes of conidiophores, conidiogenous cells and conidia, but differs in sizes (Wan et al., 2021). Our new collection has shorter and narrower conidiophores [(98–)135–195 μm × 6.5–7.7 μm vs. 150–230 × 7–9 μm] and smaller conidia (19.6–27 × 3.3–4.5 μm vs. 31–41 × 5–7 μm) than *T. clavata*. The phylogenetic tree depicted that our new collection is closely related to *T. thailandensis* (MFLUCC 15–0971) with 85% ML support (Figure 3.73). However, our new collection differs from *T. thailandensis* in having longer and wider conidiophores [(98–)135–195 μm × 6.5–7.7 μm vs. 130–150 × 3.5–5 μm] and larger conidia (19.6–27 × 3.3–4.5 μm vs. 9–11 μm × 3.6–3.8 μm) with more septa [3(–4)-septate vs. (1–)2(–3) septate] (Dong et al. 2018). A comparison of nucleotide base pairs between our newly isolated strain and *T. thailandensis* reveals a difference of 1.5% (9/615 bp, including 6 gaps) in the ITS sequence. Therefore, we introduce our new collection as *Thysanorea pronephrii* sp. nov.

Thysanorea guttulata J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

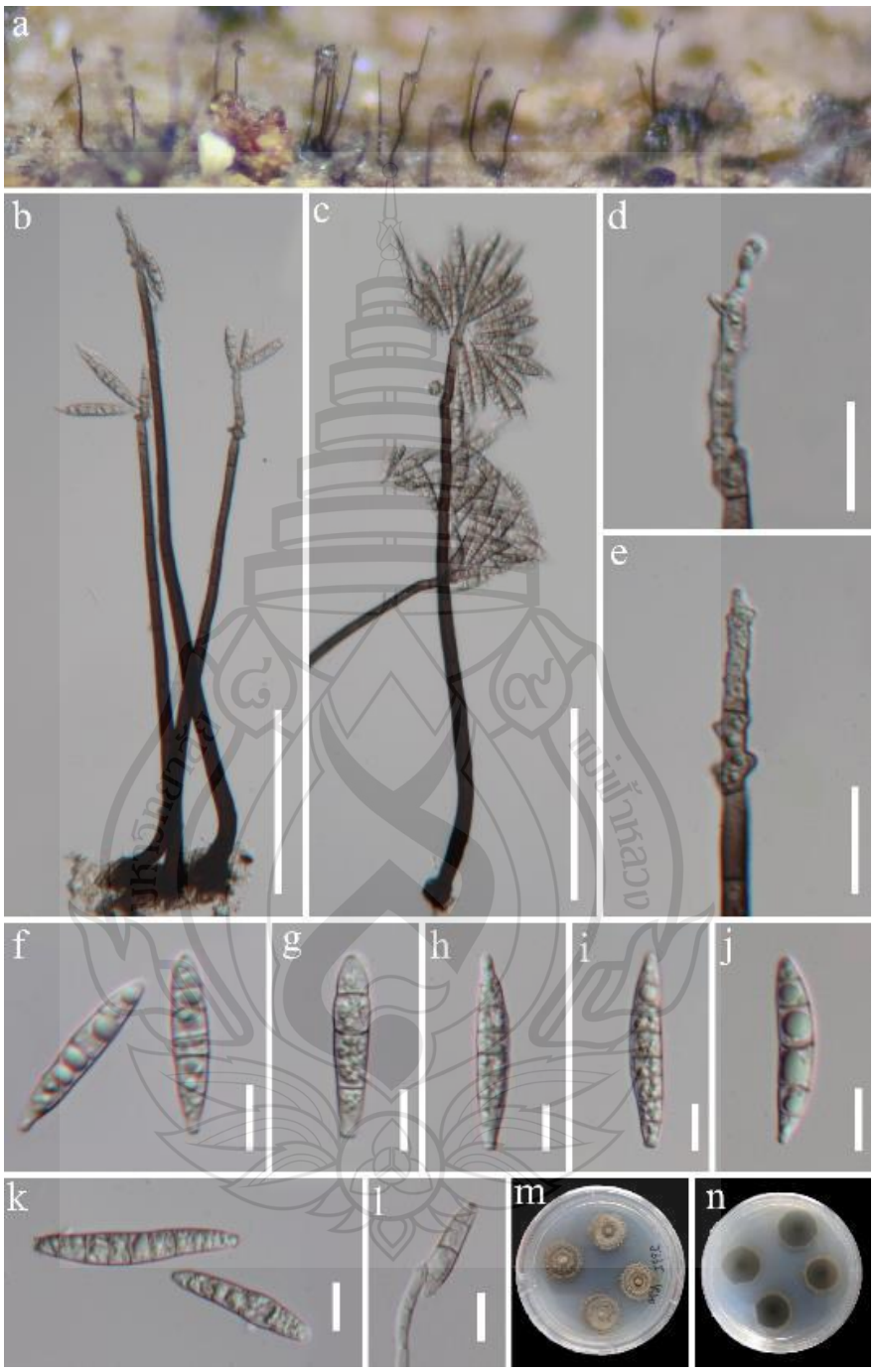
Index Fungorum number: IF 90318; *Facesoffungi number*: FoF16103; Figure 3.49

Etymology: The species epithet "*guttulate*" refers to the guttulate conidia.

Holotype: HKAS 129778

Saprobic on dead frond stalks of *Microlepia marginata* (Dennstaedtiaceae) in a terrestrial habitat. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, single, hairy, brown. *Mycelium* partly immersed, partly surficial, composed of pale brown, septate hyphae. *Conidiophores* 250–370 × 8–10 μm ($\bar{x}$ = 307 × 9 μm, n = 15), macronematous, mononematous, solitary, erect, straight or slightly flexuous, unbranched, cylindrical, septate, thick-walled,

smooth-walled, percurrent proliferation after breaking off, black or dark brown at the base, paler to pale brown or subhyaline towards the apex.



Note a Colonies on the substrate. b, c Conidiophores with attached conidia. d, e Conidiogenous cells. f–k Conidia. l Germinated conidium. m, n Colonies on PDA from above and below. Scale bars: b, c = 100 µm, d, e = 20 µm, f–l = 10 µm

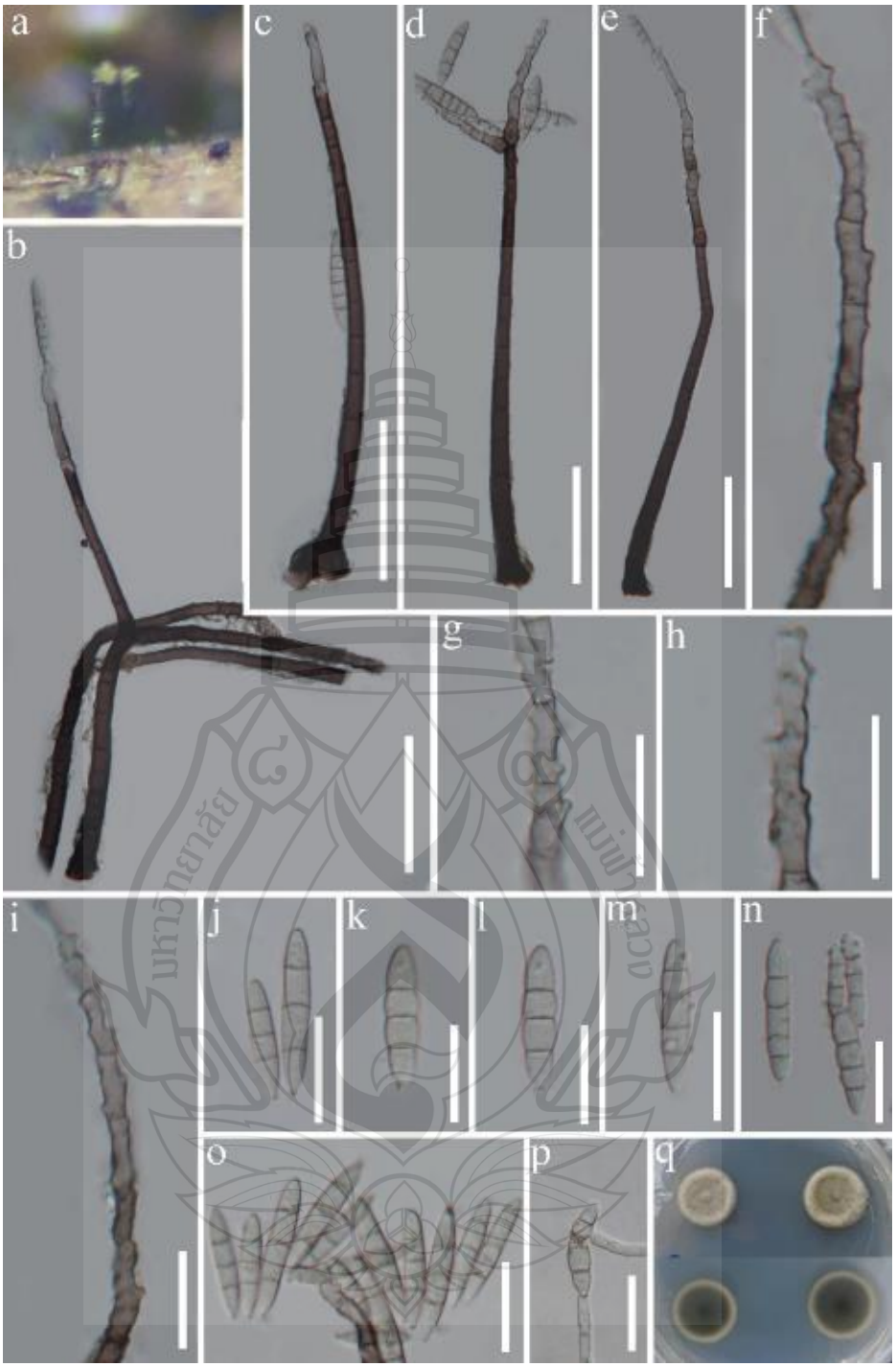
Figure 3.49 *Thysanorea guttulata* (HKAS 129778, holotype)

Conidiogenous cells 10.9–29 × 4.3–5.8 µm ($\bar{x}$ = 19.3 × 5 µm, n = 20), holoblastic, polyblastic, terminal to integrated, occasionally sympodially proliferating, denticulate, cylindrical, pare brown to subhyaline towards apex. *Conidia* 31–48 × 5.7–7.8 µm ($\bar{x}$ = 38.7 × 6.5 µm, n = 25), phragmospores, clavate to fusiform, tapering towards both sides, slightly truncate at the base occasionally, straight or slightly curved, 1–7-septate, not constricted at the septum, smooth, guttulate, hyaline to pale brown.

Culture characteristics: Conidia germinating on WA within 15 h and germ tubes produced from both ends of conidia. Colonies growing on PDA, reaching 22 mm diameter in 15 days at 25 °C, circular, entirely to slightly filamentous, flat, with a gray, velvety protuberance in the center, brownness from above; black to middle brown from center towards the edge in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of *Microlepia marginata* (Dennstaedtiaceae) near a river in a forest, 27 March 2022, J.Y. Zhang, J335 (HKAS 129778, holotype), ex-type living culture KUNCC 23–14008.

Notes: *Thysanorea guttulata* aligns well with the characteristics of the genus *Thysanorea* and is distinct from other *Thysanorea* species by its relatively large conidia filled with guttules. Phylogenetically, *T. guttulata* forms a distinct clade that is sister to *T. curvata* (MFLUCC 15–0259), which is notably distinct (Liu et al. 2015). *Thysanorea guttulata* has longer and wider conidiophores (250–370 × 8–10 µm vs. 163–207 × 6–8 µm), bigger conidia (31–48 × 5.7–7.8 µm vs. 16–18 × 6.5–7.5. µm) with more septa (1–7-septate vs. 3-septate). Furthermore, our new species *T. guttulata* has clavate to fusiform conidia, while *T. curvata* has oval conidia, which are slightly tapered at both ends and curved at the base. In addition, ITS comparison between our strain and *T. curvata* (FMR 16234) shows that there are 13 bp (13/612 bp, 2.1%) differences, reinforcing the notion that they are separate species.



Note a Colonies on the host. b–e Conidiofores. f–i Conidiogenous cells. j–o Conidia. p Germinated conidium. q Colonies on PDA from above and below. Scale bars: b–e = 50 µm, f–p = 20 µm

Figure 3.50 *Thysanorea yunnanensis* (HKAS 129674)

Thysanorea yunnanensis Hern.-Restr. & Crous, Fungal Systematics and Evolution 6: 21 (2020)

= *Minimelanolocus aquaticus* Hong Y. Su, Udayanga & K.D. Hyde

Index Fungorum number: IF551164; *Facesoffungi number*: FoF00647; Figure 3.50

Holotype: HKAS 84017

Saprobic on dead frond stalks of unidentified ferns in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, single, brown. *Mycelium* partly immerse, partly surficial, composed of pale brown, septate hyphae. *Conidiophores* 176–247 × 6–10 µm ($\bar{x}$ = 221.5 × 7.5 µm), macronematous, mononematous, solitary, erect, cylindrical, straight to flexuous, unbranched to branched occasionally, dark brown or black at the base, becoming paler to subhyaline towards the apex, septate, thick-walled, smooth-walled. *Conidiogenous cells* 10.5–18.5 × 3.2–4.8 µm ($\bar{x}$ = 14.5 × 4.1 µm), denticulate, polyblastic, integrated, terminal and intercalary, cylindrical, wavy on the surface, brown to subhyaline towards apex, sympodially proliferating. *Conidia* 27–34 × 4.5–7 µm ($\bar{x}$ = 30.5 × 5.4 µm, n = 20), phragmospores, fusiform, rounded at the apex, subtruncate at base, straight or curved, 3–4(–5)-septate, slightly or moderate constricted at the septum, smooth-walled, hyaline to pale brown.

Culture characteristics: Conidia germinating on PDA within 13 h and germ tubes produced from conidia. Colonies growing on PDA, reaching 19 mm diameter in 10 days at 25 °C, circular, brownness with a protuberance in the center, flat with a raised and offwhite edges from above; sepia with offwhite margin in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Baiyun District, Changpolin Forest Park, on dead frond stalks of ferns, in a distributed forest near the roadside, 26 June 2022, J.Y. Zhang, A11 (HKAS 129674), living culture KUNCC 23–13830.

Know hosts: Dead wood (Liu et al., 2015), unidentified fern (this study).

Distribution: China (Liu et al., 2015, this study).

Notes: Phylogenetically, our new isolate (KUNCC23–13830) clusters together with *Thysanorea yunnanensis* (= *Minimelanolocus aquaticus*). *Thysanorea yunnanensis* was introduced by Liu et al. (2015), isolated from decaying wood from freshwater habitat in China, and later was transferred to *Thysanorea* (*T. yunnanensis*, non *Thysanorea aquatica* W. Dong, H. Zhang and K.D. Hyde, 2018) based on generic concept and phylogenetic relationships. The morphology of our isolate and the holotype (HKAS 84017) are similar characterized by mononematous, unbranched conidiophores, polyblastic conidiogenous cells with sympodially proliferating, and septate, hyaline to pale brown conidia. Even though there are some morphological differences between these two specimens (Table 3.6), they are insufficient to conclusively distinguish these strains as different species. We therefore identified our new isolates as *T. yunnanensis*, marking the first report of a fern as the host of *Thysanorea* species in terrestrial habitats.

Table 3.6 A morphological comparison between two isolates of *Thysanorea yunnanensis*

Taxa	Conidiophores	Condiogenous cell	Conidial characteristic	Habitats	References
KUNCC23-13830	176–247 × 6–10 µm,unbranched to branched occasionally	10.5–18.5 × 3.2–4.8 µm, terminal to intercalary	27–34 × 4.5–7 µm, 3–4(–5)-septate, slightly or moderate constricted at the septum	Terrestrial	This study
MFLUCC 15-0414	147–169 × 4.5–5.5 µm, unbranched	Terminal	16–(21–33)–37 × 4–(5–7)–8, 3–7-septate, not constricted	Freshwater	Liu et al. (2015b)

Orbiliomycetes O.E. Erikss. & Baral, Myconet 9: 96 (2003)

Orbiliales Baral, O.E. Erikss., G. Marson & E. Weber, Myconet 9: 96 (2003)

Orbiliaceae Nannf., Nova Acta R. Soc. Scient. upsal., Ser. 48: 250 (1932)

Arthrobotrys Corda, Pracht-Fl. Eur. Schimmelbild: 43 (1839); Figure 3.51

Notes: Arthrobotrys was introduced by Corda (1839), with *A*. *superba* Corda as the type species and belongs in Orbiliaceae, Orbiliales, Orbiliomycetes (Wijayawardene et al., 2022; Hyde et al., 2024b). *Arthrobotrys* is characterized by simple or branched conidiophores and obovoid, elliptic, pyriform, 0–3-septate conidia growing asynchronously on the nodes or short denticles of conidiophores (Yu et al., 2014; Zhang et al., 2022a, b, 2023a, 2024; Yang et al., 2023a; Jin et al., 2024). *Arthrobotrys* is the most complex and largest genus among Orbiliaceae nematode-trapping fungi, comprising 78 accepted species characterized by producing adhesive networks to capture nematodes (Li et al., 2005; Yang et al., 2012; Yu et al., 2014; Zhang & Hyde, 2014; Jiang et al., 2017; Zhang et al., 2023a, 2024; Thiyagaraja et al., 2024). These fungal species mainly occur in soil or sediment in various ecosystems such as farmland, forests, mangroves, and freshwater. They have also been recorded in hot springs, animal waste, and tree trunks worldwide (Duddington, 1954; Swe et al., 2008; Kim et al., 2001; Kumar et al., 2011; Yu et al., 2014; Jiang et al., 2017; Zhang et al., 2022a, 2022b).

Arthrobotrys angiopteridis J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp*. *nov*.

MycoBank No: 902682; *Facesoffungi number*: FoF 16618; Figure 3.52

Etymology. Named after the fungal host genus *Angiopteris*.

Holotype. HKAS 129855

Saprobic on dead rachis of *Angiopteris fokiensis* in terrestrial habitats. **Sexual morph** Undetermined. **Asexual morph** *Colonies* on natural substrate superficial, effuse, hyaline, with white and glistening masses of conidia on the apex of conidiophores. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth hyphae. *Conidiophores* 345–502 µm long, 6–8.5 µm wide at the base ($\bar{x}$ = 418 × 6.9 µm, n = 20), macronematous,

mononematous, solitary, erect, straight or slightly flexuous, unbranched, cylindrical, septate, smooth-walled, hyaline. *Conidiogenous cells* 95–176 × 2–4.5 µm ($\bar{x}$ = 129 × 3.5 µm, n = 20), polyblastic, producing 1–5 separate nodes by the repeated elongation, with multi polyblastic denticles at each node, hyaline. *Conidia* 25–35 × 8–11 µm ($\bar{x}$ = 28.8 × 9 µm, n = 25), aseptate, or 1-septate at the median to submedian, not constricted or slightly constricted at the septum, clavate to elongate pyriform, broadly rounded at apex, pointed or sometimes truncate at the base, sometimes with a bud-like projection at base, straight or slightly curved, smooth-walled or rough walled, guttulate, hyaline.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from conidia. *Colonies* growing on PDA, reaching 60 mm diameter in 10 days at 26°C, circular, cottony, white, and not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Zunyi City, Xishui County (28°22'19"N, 106°0'35"E), on dead rachis of *Angiopteris fokiensis* (Marattiaceae) in a disturbed forest nearby the roadside, 13 April 2023, J.Y. Zhang, ZY06 (HKAS 129855, holotype; GZAAS 23–0758, isotype), ex-type living culture, KUNCC 23–14121; *ibid*., ZY02 (HKAS 129854, paratype), ex-paratype living culture, KUNCC 23–14119. Additional sequence: KUNCC 23–14121: PQ346313 (SSU) and PQ346310 (LSU); KUNCC 23–14119: PQ346312(SSU) and PQ346309 (LSU).

Notes: Phylogenetically, the new isolates KUNCC 23–14121 and KUNCC 23–14119 of *Arthrobotrys angiopteridis* clustered together formed a separate clade with 100% ML/1.00 PP bootstrap support and are sister to *A. pyriformis* (Figure 3.1). A comparison of nucleotide base pairs between them reveals differences of 30/459 (6.5%, including 15 gaps) and 82/730 bp (11%, no gap) in the ITS and *rpb2* sequences, respectively. This indicates that they are distinct species. Morphologically, *A. angiopteridis* aligns well with the generic concept and resembles *A. oligospora* in having hyaline conidiophores with the successive production of additional denticle nodes (Yu et al., 2014). However, *A. angiopteridis* can be easily distinguished from *A. oligospora* by its longer conidiophores (345–502 µm vs. 110–440 µm) and clavate

to elongate pyriform conidia, with 0–1 septate near the middle, whereas *A*. *oligospora* has pyriform or obovoid conidia with 1-septate near the base. Therefore, we introduce *A*. *angiopteridis* as a novel species based on its distinct morphological and phylogenetic evidence following the guidelines of Maharachchikumbura et al. (2021).

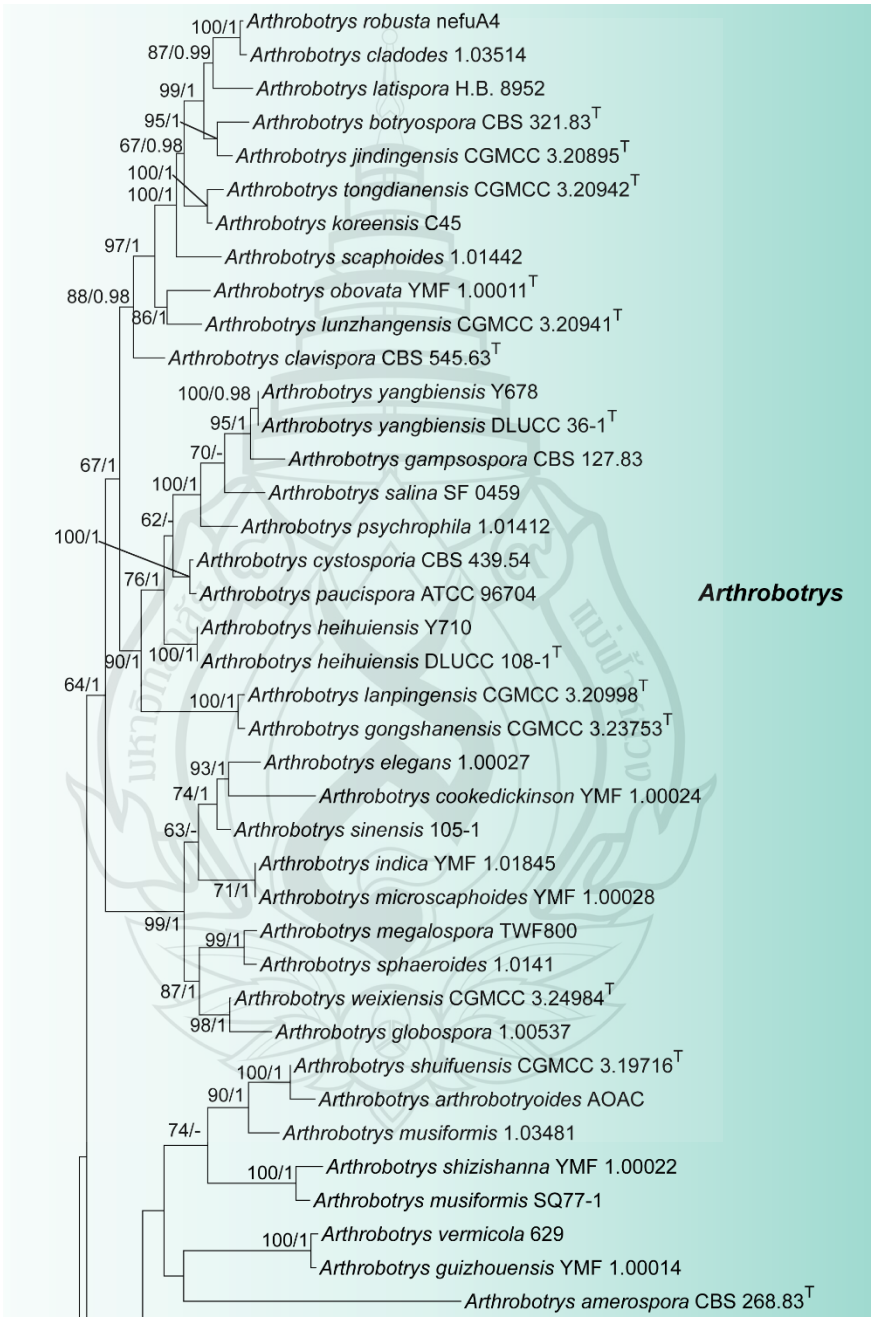
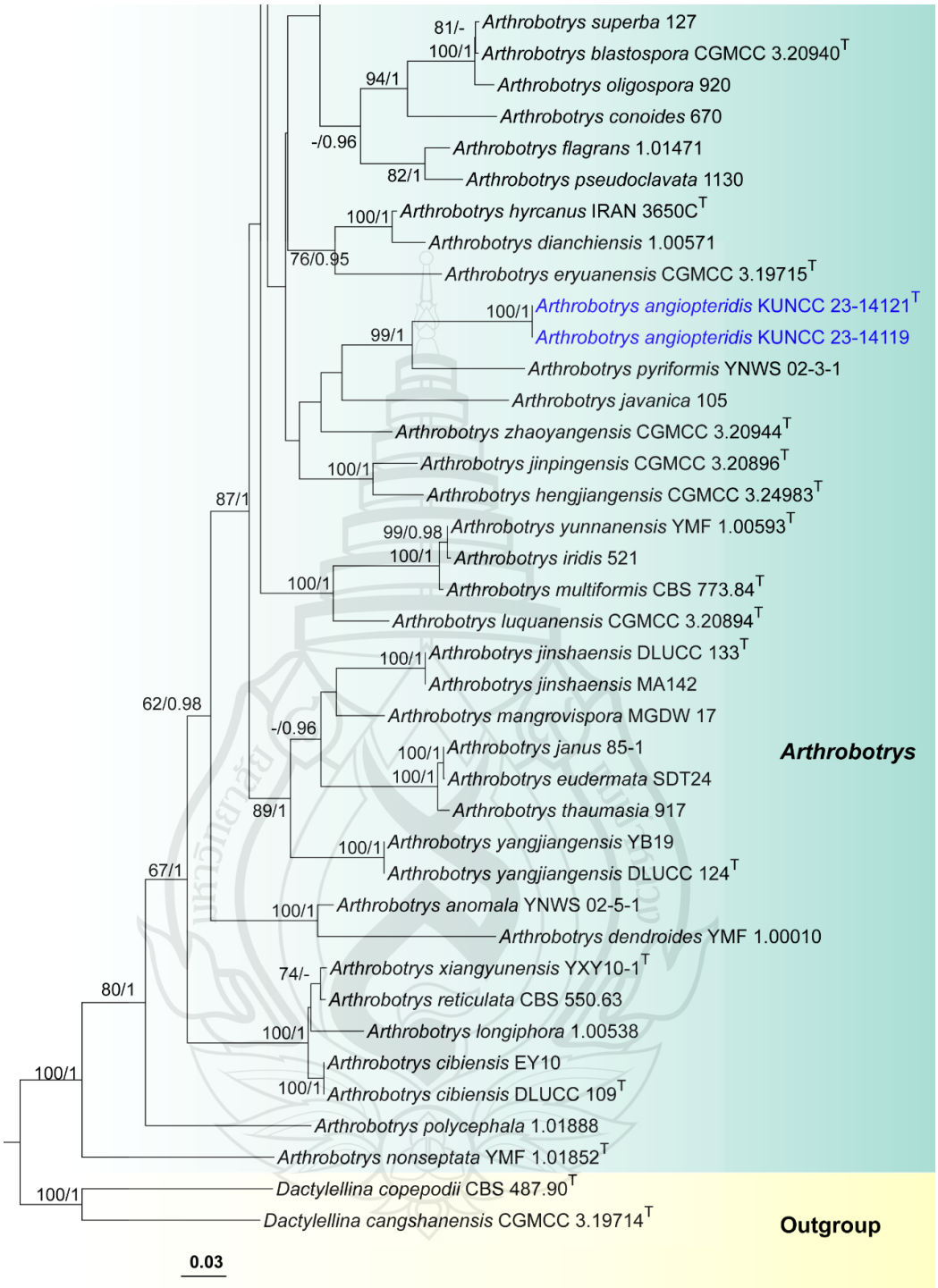
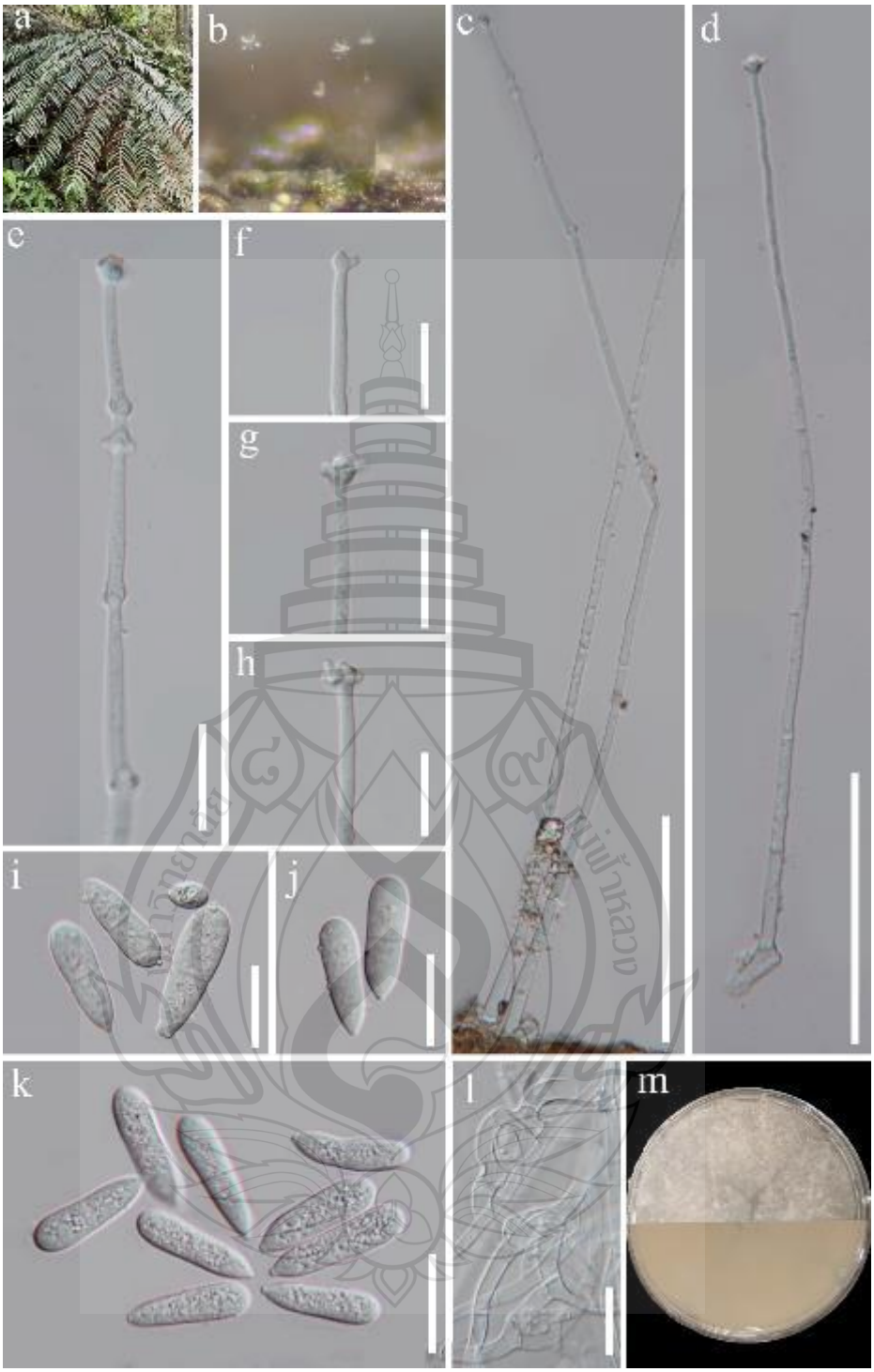


Figure 3.51 Phylogenetic tree of *Arthrobotrys*



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *tef1-α* and *rpb2* sequence data. The tree was rooted to *Dactylellina copepodii* (CBS 487.90) and *D. cangshanensis* (CGMCC 3.19714). The newly generated sequences are indicated in blue.

Figure 3.51 (continued)



Note a The host b Colonies on the host c, d Conidiophores with conidiogenous cells e–h Conidiogenous cells i–k Conidia l Trapping mycelia: adhesive networks m Pure culture from front and reverse. Scale bar: 100 µm (c, d); 20 µm (e–l).

Figure 3.52 *Arthrobotrys angiopteridis* (HKAS 129855, holotype)

Sordariomycetes O.E. Erikss. & Winka, Myconet 1(1): 10 (1997)

Amphisphaeriales D. Hawksw. & O.E. Erikss., Syst. Ascom. 5(1): 177 (1986)

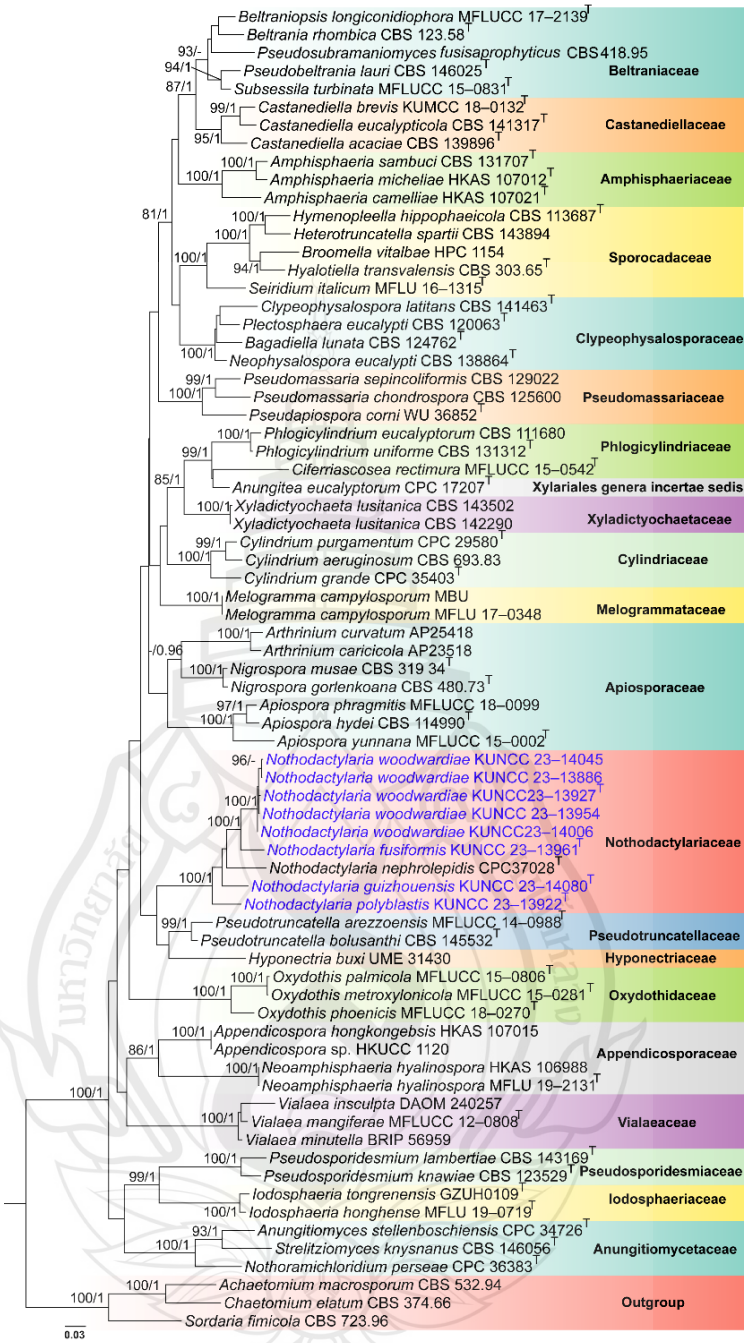
Nothodactylariaceae Crous, Persoonia 43: 297 (2019)

Nothodactylaria Crous, Persoonia 43: 297 (2019)

Index *Fungorum* number: IF833023; *Facesoffungi number*: FoF 17037; five species associated with pteridophytes (including four species newly described in this study); Figure 3.53

Type species: *Nothodactylaria nephrolepidis* M.J. D'souza, Boonmee & K.D. Hyde.

Notes: In this study, we have obtained eight new collections representing four new species isolated from ferns, which confirms the host preference of *Nothodactylaria* species is restricted to ferns, especially Blechnaceae. A morphological comparison of the five accepted *Nothodactylaria* species, including four new species *viz*., *N*. *fusiformis*, *N*. *guizhouensis*, *N*. *polyblastis* and *N*. *woodwardiae*, is provided in this study (Table 3.7). See above (Chapter 1) for details.



Note Phylogram generated from maximum likelihood analysis based on combined LSU, *rpb2* and ITS sequence data. The tree was rooted to *Achaetomium macrosporum* (CBS 532.94), *Chaetomium elatum* (CBS 374.66) and *Sordaria fimicola* (CBS 723.96). Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.53 Phylogenetic tree of *Nothodactylaria*

Table 3.7 A morphological comparison of five accepted species of *Nothodactylaria*

Species	Conidiophores/µm	Conidiogenous cells/µm	Conidia/µm	Distribution	Substrate/Hosts	References
N. fusiformis	145–195 × 3–5	23–33 × 2.5–4 µm, without swelling	16.5–23 × 2–3 µm, fusiform	China	Natural substrate on *Blechnum orientale*	This study
N. guizhouensis	75–115.5 × 2.65–3.7	16–25 × 2.7–3.7, often swelling at the apex	7.4–8.86 × 2.5–3.3 µm, 0–2-septate, obovoid to broad fusiform with obtuse ends	China	Natural substrate on *Pronephrium* sp.	This study
N. nephrolepidis	30–50 × 3–4.5	-, without swelling	7–)12–16(–18) × 2(–2.5) µm, subcylindrical to fusoid-ellipsoid	South Africa	In the culture, isolated from *Nephrolepis exaltata*	Crous et al. (2019b)
N. polyblastis	(98–)122–168 × 2.5–3.6	(14–)31–60 × 2.1–2.8, without swelling	6.2–8(–10.33) × 2–3.6, ovoid	China	Natural substrate on *Alsophila podophylla*	This study
N. woodwardiae	147–207.5(–263.5) × 3.8–5.5 µm	21.5–41 × 2.35–4, often swelling at the apex	9.5–14 × 2.76–3.9, obovoid to broad, fusiform with rounded at the apex, narrow and slightly truncate at the base	China	Natural substrate on *Woodwardia japonica* and *Blechnopsis orientalis*	This study

Nothodactylaria fusiformis J.Y. Zhang, Y.Z. Lu &K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 903188; *Facesoffungi number*: FoF 17038; Figure 3.54

Etymology: The species epithet "*fusiformis*" refers to the fusiform conidia.

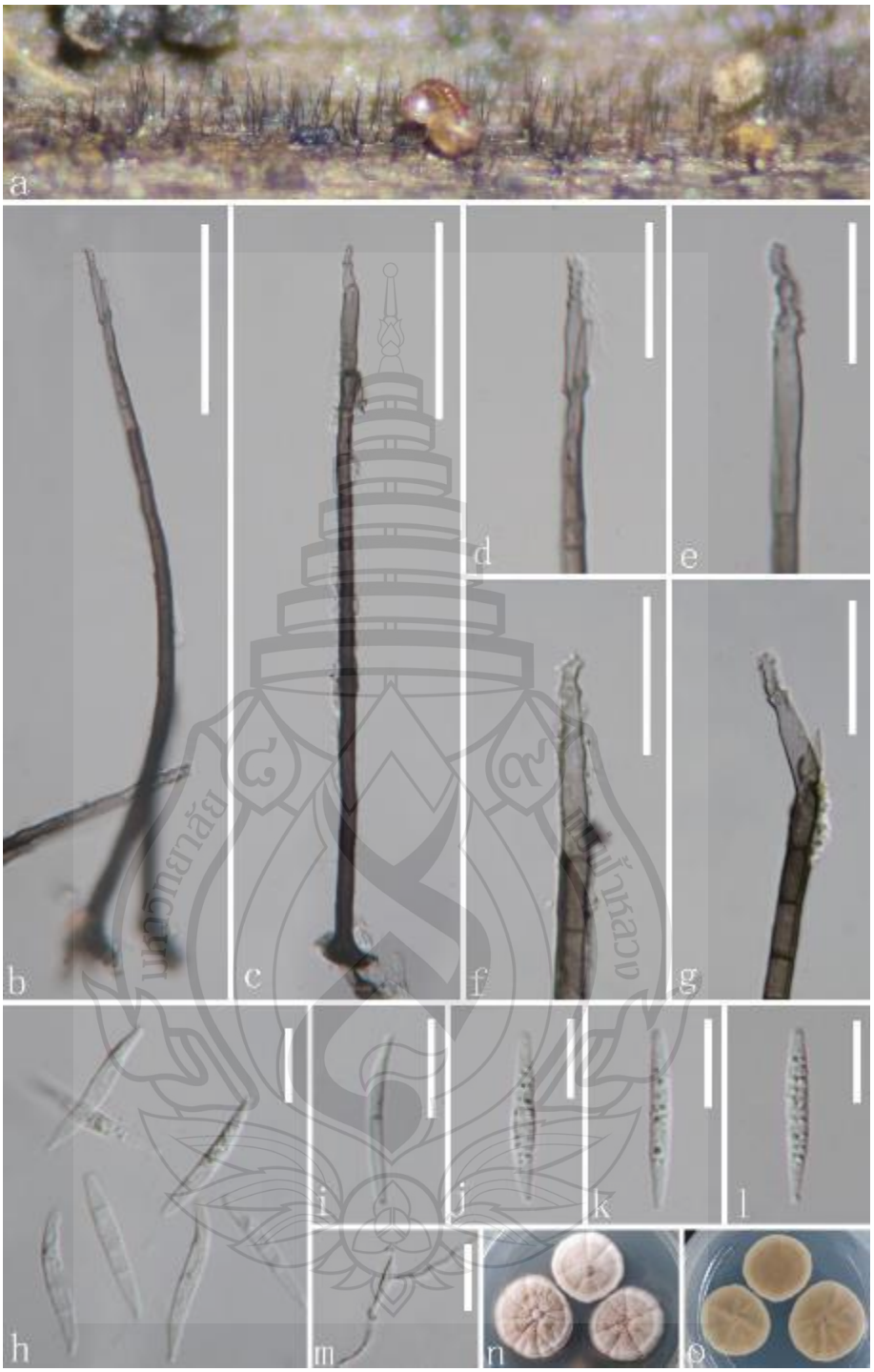
Holotype: HKAS 129753

Saprobic on dead rachis of *Blechnum orientale* in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on the natural substrate effuse, hairy, brown. *Mycelium* mostly immersed, composed of branched, septate, smooth, pale brown hyphae. *Conidiophores* 145–195 × 3–5 μm ($\bar{x}$ = 166.7 × 4.2 μm), macronematous, mononematous, solitary, erect, straight or slightly flexuous, unbranched, cylindrical, septate, thick-walled, smooth-walled, percurrent proliferation after breaking off, dark brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 23–33 × 2.5–4 μm ($\bar{x}$ = 27 × 3 μm), integrated, polyblastic, terminal, pare brown to subhyaline towards apex, sympodial. *Conidia* 16.5–23 × 2–3 μm ($\bar{x}$ = 20.5 × 2.5 μm, n = 20), fusiform, straight or slightly curved, (0)1–3-septate, not constricted at the septum, smooth, solitary, smooth or rough walled, hyaline.

Culture characteristics: Conidia germinating on PDA within 13 h and germ tubes produced from the base and the upper part. Colonies growing on PDA, reaching 19 mm diameter in 10 days at 25°C, circular, flat, section to fan shape at the surface, veined and without wrinkle, white from above; black circle in the center, brown to orange in the middle and white mycelium in the outer ring in reverse, not produce pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang city, Guizhou Xianheping National Forest Park, on dead rachis of *Blechnum orientale* (Blechnaceae), 16 March 2022, Jing-Yi Zhang, J240 (HKAS 129753, holotype; GZAAS 23–0696, isotype), ex-type living culture KUNCC 23–13961.

Notes: The morphological characteristics of our new isolate match well with the generic concept and is similar to the type species *Nothodactylaria nephrolepidis* in having subcylindrical, unbranched, septate conidiophores, subcylindrical, polyblastic, sympodial conidiogenous cells and hyaline, smooth and fusiform conidia (Crous et al., 2019b). However, they are distinct in both morphology and phylogeny. *Nothodactylaria fusiformis* can be distinguished from *N. nephrolepidis* by its darker, longer conidiophores (145–195 × 3–5 vs. 30–50 × 3–4.5 µm) and larger conidia (16.5–23 × 2–3 µm vs. (7–)12–16(–18) × 2(–2.5) µm). Furthermore, *N. fusiformis* is nested within *Nothodactylaria* and forms a distinct clade, which is sister to *N. woodwardiae* with 100% ML/1.00 PP support. The LSU, ITS and *rpb2* sequence identity of *N. fusiformis* and the type strain of *N. woodwardiae* was 99.49% (786/790 bp including 2 bp gaps), 93.25% (497/533 bp including 11 bp gaps) and 90.79% (956/1053 bp, no gap), respectively. Thus, a new species, *Nothodactylaria fusiformis*, is introduced in this study.



Note a Colonies on host substrate. b, c Conidiophores. d–g Conidiogenous cells. h–l Conidia. m Germinating conidium. n, o Culture on PDA from above and below. Scale bars: b, c = 50 µm, d–g, m = 20 µm, h–l = 10 µm

Figure 3.54 *Nothodactylaria fusiformis* (HKAS 129753, holotype)

Nothodactylaria guizhouensis J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 903189; *Facesoffungi number*: FoF17039; Figure 3.55

Etymology: The species epithet "*guizhouensis*" refers to the province "Guizhou", where this species was collected.

Holotype: HKAS 129830

Saprobic on dead petioles of *Pronephrium* sp. in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, scattered or in small groups, dark brown, with merdoie masses of conidia at the apex of conidiophores. *Mycelium* mostly immersed, composed of brown, septate hyphae. *Conidiophores* 75–115.5 high, 2.65–3.7 μm diam at the base ($\bar{x}$ = 97.1 × 3 μm), macronematous, mononematous, solitary or aggregated in cluster, erect, straight or slightly flexuous, smooth, unbranched, cylindrical, brown at the base, becoming paler to subhyaline towards the apex, septate, thick-walled. *Conidiogenous cells* 16–25 × 2.7–3.7 μm ($\bar{x}$ = 19 × 3.2 μm), integrated, polyblastic, forming a rachis with numerous, often swelling at the apex, terminal, denticulate, pale brown to subhyaline towards apex, sympodial. *Conidia* 7.4–8.8 × 2.5–3.3 μm ($\bar{x}$ = 8.2 × 2.84 μm, n = 20), 0–2-septate, not constricted at the septa, smooth, solitary, obovoid when young, becoming broad fusiform with obtuse ends when mature, smooth walled, hyaline.

Culture characteristics: Conidia germinating on PDA within 15 h and germ tubes produced from the base and the upper part. Colonies growing on PDA, reaching 22 mm diameter in 10 days at 25°C, circular, flat, section to fan shape at the surface, veined and without wrinkle, white from above; black circle in the center, brown to orange in the middle and white mycelium in the outer ring in reverse, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang city, Guizhou Medicinal Botanical Garden, on dead petioles of *Pronephrium* sp. (Thelypteridaceae), 13 December 2021, Jing-Yi Zhang, J99-2 (HKAS 129830, holotype; GZAAS 23–0744, isotype), ex-type living culture KUNCC 23–14080.

Notes: In the phylogeny (Figure 3.80), *Nothodactylaria guizhouensis* (KUNCC 23–14080) nested within *Nothodactylaria* and was sister to the clade containing *N. fusiformis*, *N. nephrolepidis* and *N. woodwardiae*. Morphologically, our new isolate fits well with the generic concept and is most similar to *N. woodwardiae* in having macronematous, unbranched, septate conidiophores, polyblastic, terminal, denticulate conidiogenous cells often swelling at the apex (Table 3.7). However, *N. guizhouensis* has shorter conidiophores (75–115.5 × 2.65–3.7 vs. 147–207.5(–263.5) × 3.8–5.5 μm), smaller conidiogenous cells (16–25 × 2.7–3.7 μm vs. 21.5–41 × 2.35–4), and conidia (7.4–8.8 × 2.5–3.3 vs. 9.5–14 × 2.76–3.9 μm). Furthermore, *N. guizhouensis* differs from existing *Nothodactylaria* species by its 0–2-septate, obovoid to broad fusiform conidia with obtuse ends.

Nothodactylaria polyblastis J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903190; *Facesoffungi number*: FoF 17040; Figure 3.56

Etymology: The species epithet "*polyblastis*" refers to the polyblastic conidiogenous cell.

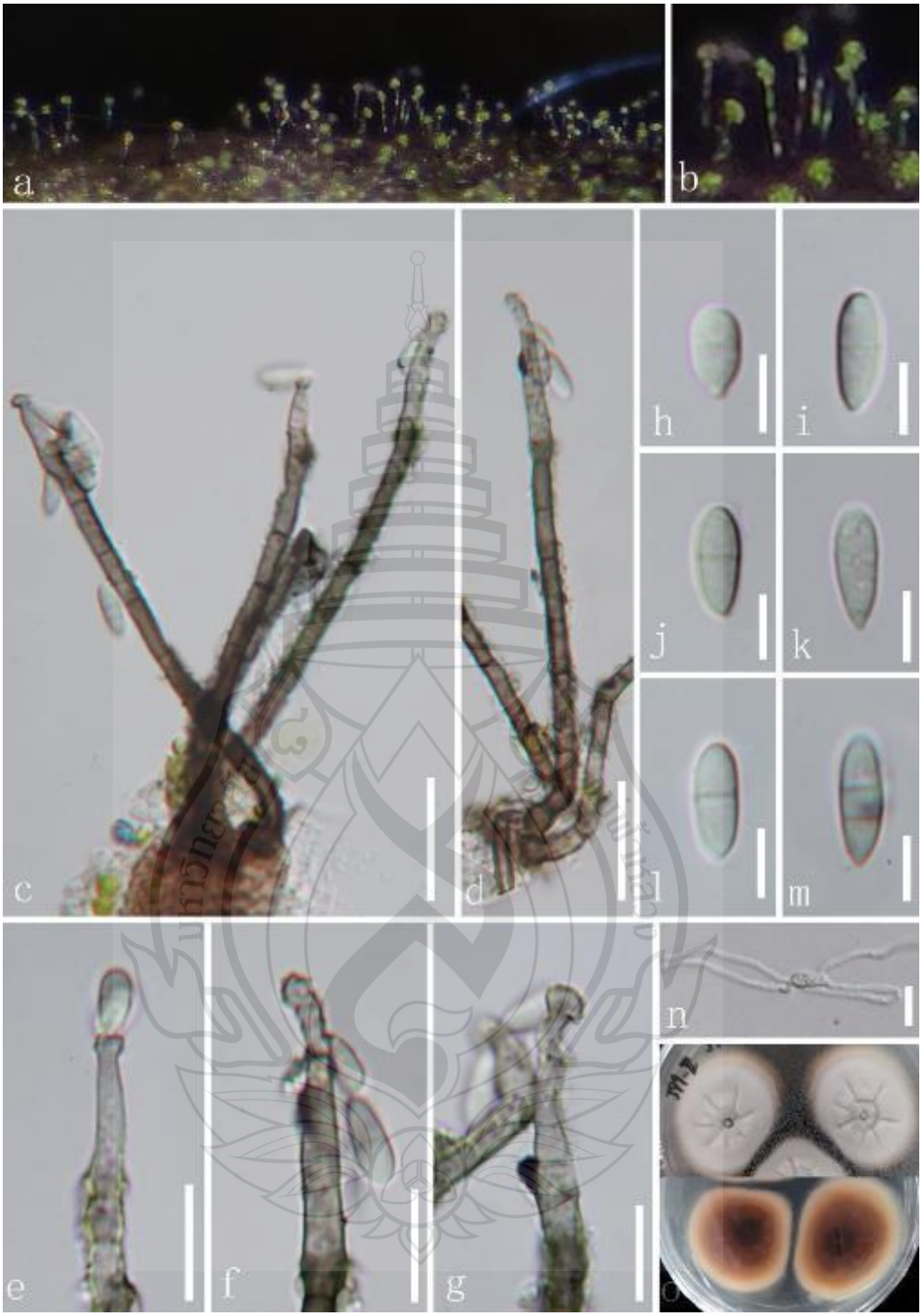
Holotype: HKAS 129732

Saprobic on dead rachis of fern in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, single, dark brown, with yellow masses of conidia at the apex of conidiophores. *Mycelium* mostly immersed, composed of pale brown, septate hyphae. *Conidiophores* (98–)122–168 × 2.5–3.6 μm ($\bar{x}$ = 143.5 × 3.1 μm), macronematous, mononematous, solitary, erect, straight, or slightly flexuous, smooth, unbranched, cylindrical, without a swelling at the apex, brown at the base, becoming paler to subhyaline towards the apex, septate, thick-walled. *Conidiogenous cells* (14–)31–60 × 2.1–2.8 μm ($\bar{x}$ = 47.3 × 2.5 μm), integrated, polyblastic, forming a rachis with pimple-shaped denticles, subcylindrical, terminal, pare brown to subhyaline towards apex, sympodial. *Conidia* 6.2–8(–10.33) × 2–3.6 μm ($\bar{x}$ = 7.3 × 2.5 μm, n = 20), ovoid, rounded at the apex, pointed at the base, 2-celled, 1-septate, constricted at septum, smooth-walled, sometimes guttulate, hyaline.

Culture characteristics: Conidia germinating on PDA within 13 h and germ tubes produced from the base and the upper part. Colonies growing on PDA, reaching 19 mm diameter in 10 days at 25°C, circular, flat, section to fan shape at the surface, veined and without wrinkle, white from above; black circle in the center, brown to orange in the middle and white mycelium in the outer ring in reverse, not producing pigmentation in culture.

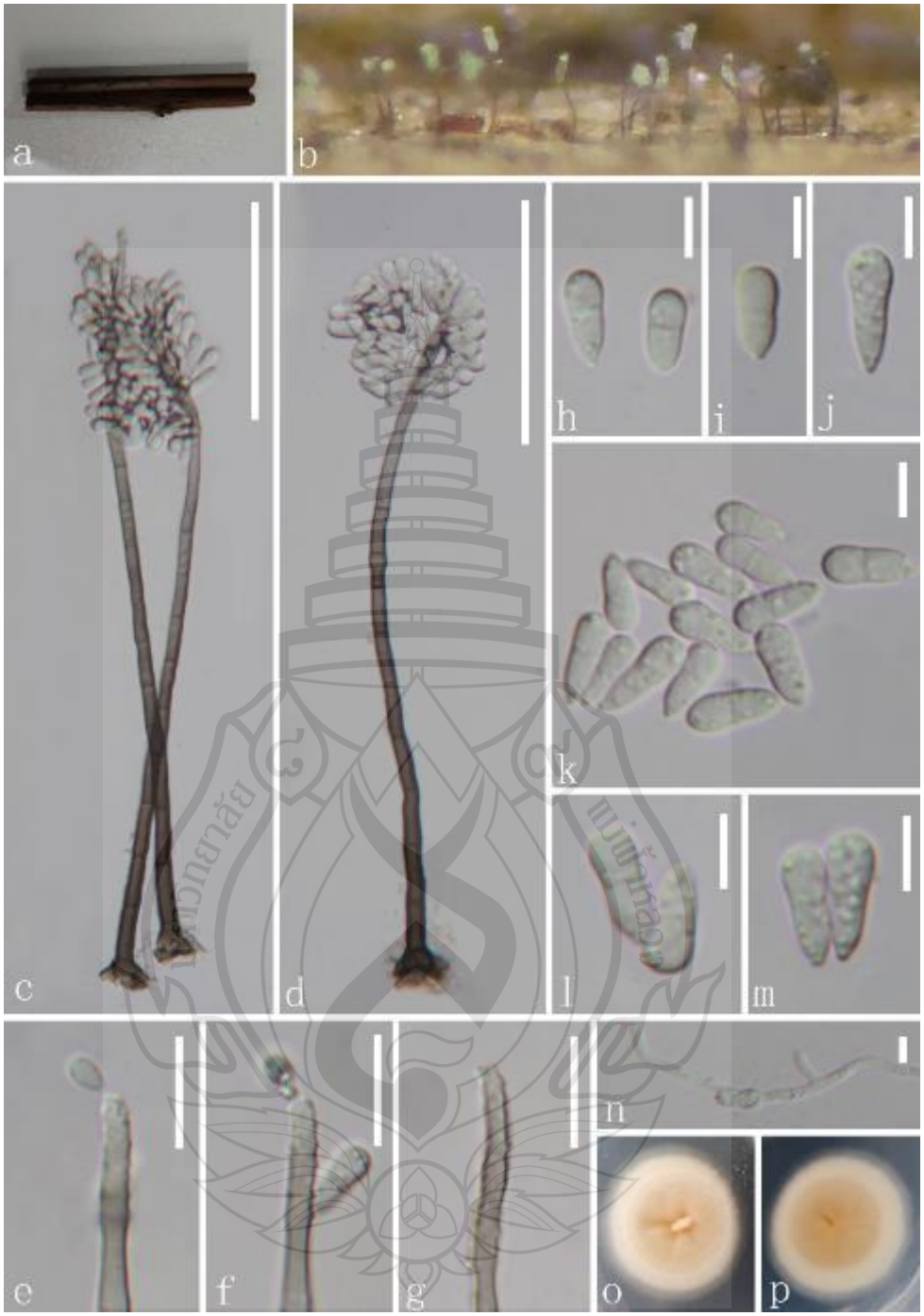
Material examined: CHINA, Guizhou Province, Guiyang city, Guizhou Medicinal Botanical Garden, on dead rachis of *Alsophila podophylla* (Cyatheaceae), 23 December 2021, Jing-Yi Zhang, J128 (HKAS 129732, holotype), ex-type living culture KUNCC 23–13922.

Notes: Morphologically, *Nothodactylaria polyblastis* resembles *N. fusiformis* in having brown to subhyaline, septate conidiophores without a swelling at the apex. However, *Nothodactylaria polyblastis* has ovoid and smaller conidia [6.2–8 (–10.33) × 2.8–3.6 μm vs. 16.5–23 × 2–3 μm], while *N. fusiformis* produces fusiform conidia (Table 3.7). Phylogenetically, *N. polyblastis* formed a distinct phylogenetic clade basal to *Nothodactylaria* with 100% ML/1.00 PP high support), which confirmed that *N. polyblastis* is a new species.



Note a, b Colonies on host substrate. c, d Conidiophores with conidiogenous cells. e–g Conidiogenous cells. h–m Conidia. n Germinating conidium. o Culture on PDA. Scale bars: c, d = 20 µm, e–g, n = 10 µm, h–m = 5 µm

Figure 3.55 *Nothodactylaria guizhouensis* (HKAS 129830, holotype)



Note a, b Colonies on host substrate. c, d Conidiophores with conidiogenous cells. e–g Conidiogenous cells. h–m Conidia. n Germinating conidium. o, p Colony on PDA from above and below. Scale bars: c, d = 50 µm, e–g = 10 µm, h–n = 5 µm

Figure 3.56 *Nothodactylaria polyblastis* (HKAS 129732, holotype)

Nothodactylaria woodwardiae J.Y. Zhang, Y.Z. Lu & K. D. Hyde, *sp. nov.*

Index Fungorum number: IF 903191; *Facesoffungi number*: FoF 17041; Figure 3.57 and Figure 3.58

Etymology: The species epithet "*woodwardiae*" refers to the host *Woodwardia japonica*.

Holotype: HKAS 129738

Saprobic on dead petioles of *Woodwardia japonica* in terrestrial habitats. **Sexual morph:** undetermined. **Asexual morph:** hyphomycetous. *Colonies* on natural substrate superficial, effuse, single, dark brown, with yellow-green masses of conidia at the apex of conidiophores. *Mycelium* mostly immersed, composed of pale brown, septate hyphae. *Conidiophores* 147–207.5(–263.5) × 3.8–5.5 μm ($\bar{x}$ = 174.2 × 4.5 μm, n = 20), macronematous, mononematous, solitary, erect, straight, smooth, most unbranched, rarely branch, cylindrical, with a big swelling at the apex. *Conidiogenous cells* (8.2–)21.5–41 × 2.35–4 μm ($\bar{x}$ = 32.7 × 3.5 μm, n=20), integrated, polyblastic, terminal, pare brown to subhyaline towards apex, sympodial proliferated at swelling. *Conidia* 9.5–14 × 2.76–3.9 μm ($\bar{x}$ = 11.5 × 3.2 μm, n =30), obovoid to broad, fusiform, tapering and rounded at the apex, narrow and slightly truncate at the base, 0–1-septate,not constricted at the septum when young, 2–3-septate with slight constriction when mature, straight or slightly curved, brown at the base, becoming paler to subhyaline towards the apex, thick-walled, guttulate occasionally, smooth-walled, hyaline

Culture characteristics: Conidia germinating on PDA within 13 h and germ tubes produced from a point of the ends of conidia. Colonies growing on PDA in natural light, reaching 19 mm diameter in 14 days at 25°C, circular, flat, wrinkle at the surface, cream yellow from above, while yellowish in reverse with yellowish-white edge, not producing pigmentation in culture.

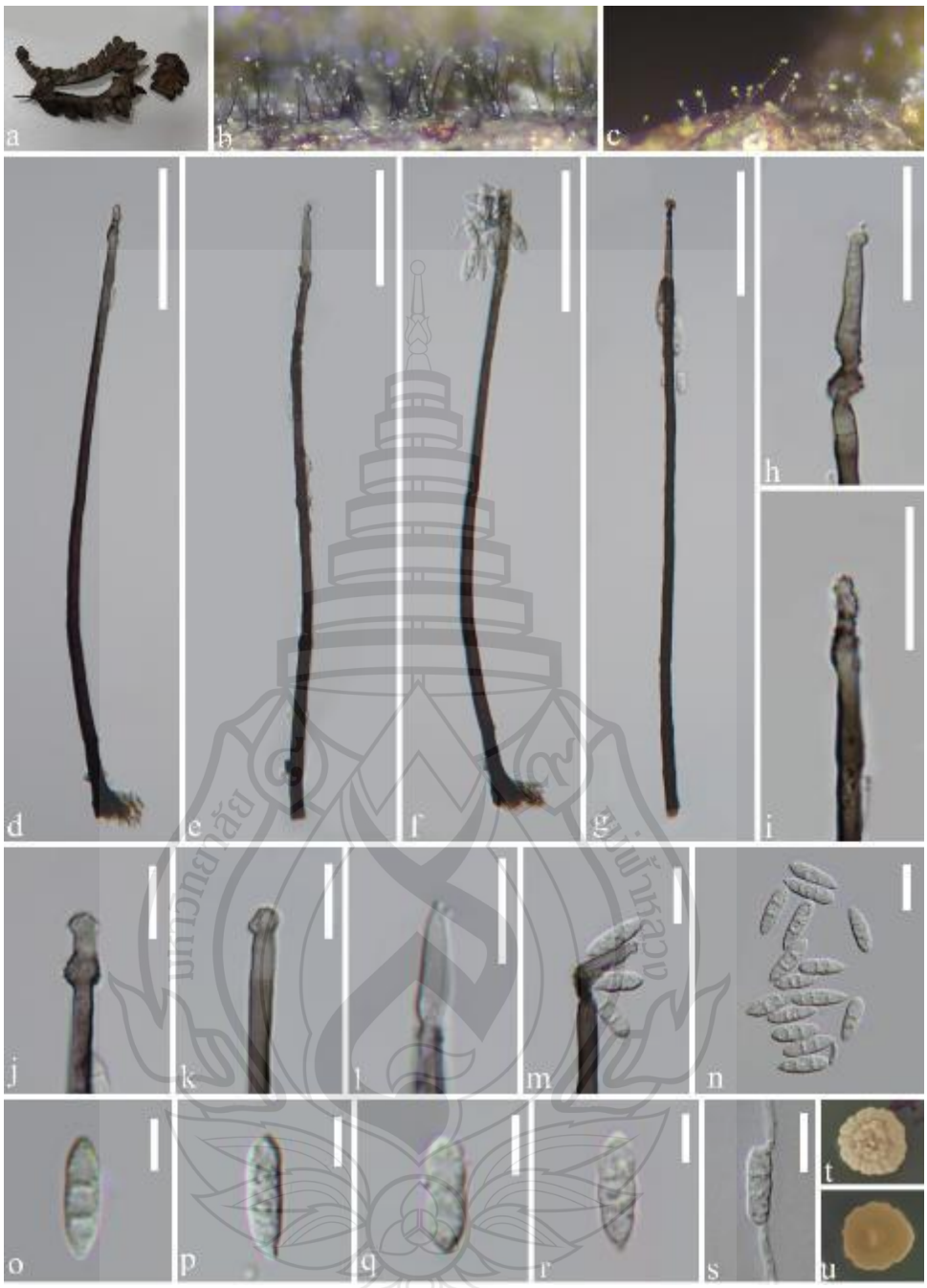
Material examined: CHINA, Guizhou Province, Guiyang City, Guizhou Medicinal Botanical Garden, on dead petioles of *Woodwardia japonica*, 25 December 2021, Jing-Yi Zhang, J140 (HKAS 129738, **holotype**; GZAAS 23-0686, **isotype**),

ex-type living culture KUNCC 23–13927; *ibid*., Tongren City, collected from *Woodwardia japonica* (Blechnaceae), 21 May 2022, J.Y. Zhang F50 (HKAS 129709), living culture KUNCC 23–13886; Guizhou, Sandu Shui Autonomous County, on dead leaves of *Woodwardia japonica* (Blechnaceae), 13 August 2021, J.Y. Zhang, J56-2 (HKAS 129802), living culture KUNCC 23–14045; CHINA, Guizhou Province, Guiyang City, Aha Lake National Wetland Park, on dead petiole of *Woodwardia japonica* (Blechnaceae), 9 January 2022, J.Y. Zhang, J220 (GZAAS 23–0822), living culture KUNCC 23–13954; CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, on dead fronds of *Blechnopsis orientalis* (Blechnaceae) in a forest, 27 March 2022, J.Y. Zhang, J331 (GZAAS 23–0714), living culture KUNCC 23–14006.

Notes: *Nothodactylaria woodwardiae* sp. nov. was collected from ferns in Guizhou province, southwest China. Morphologically, *N. woodwardiaee* formed an asexual morph on the natural substrate and is similar to *N. guizhouensis* in having macronematous, erect conidiophores with a swelling at the apex, and polyblastic, terminal conidiogenous cells. However, it differs from *N. guizhouensis* by its darker conidiophores, longer conidiogenous cells and larger conidia (Table 3.7). Phylogenetic analysis clearly showed that our five new isolates of *N. woodwardiae* formed a phylogenetically distinct clade, sister to *N. fusiformis*, confirming that they are species.

Note a, b Colonies on host substrate. c–f Conidiophores, conidiogenous cells with conidia. g–k Conidiogenous cells. l–q conidia. r, s Colonies on PDA from above and below. Scale bars: c–f = 50 µm, h–k = 20 µm, g, l = 10 µm, m–q = 5 µm

Figure 3.57 *Nothodactylaria woodwardiae* (HKAS 129738, holotype)



Note a–c Colonies on host substrate. d–g Conidiophores with conidiogenous cells. h–m Conidiogenous cells. n–r Conidia. s Germinating conidium. t, u C Colony on PDA from above and below. Scale bars: d–g = 50 µm, h–i =20 µm, j–n, s = 10 µm, o–r = 5 µm

Figure 3.58 *Nothodactylaria woodwardiae* (HKAS 129802, paratype)

Oxydothidaceae S. Konta & K.D. Hyde, Mycosphere 7(9): 1431 (2016)

Oxydothis Penz. & Sacc., Malpighia 11(11-12): 505 (1897)

Index Fungorum number: IF3661; *Facesoffungi number*: FoF 05091; two species including an unidentified species associated with pteridophytes (including one species newly described in this study); Figure 3.59

Type species: *Oxydothis grisea* Penz. & Sacc.

Notes: *Oxydothis* was introduced by Penzig and Saccardo (1897) to accommodate three species *O. grisea* (as the type species), *O. maculosa* and *O. nigricans*. The phylogenetic placement of *Oxydothis* remained uncertain for a long time (Barr, 1990; Hyde, 1993; Kang et al., 1998; Wang & Hyde, 1999; Wong & Hyde, 2001; Shenoy et al., 2005) until Konta et al. (2016) placed the genus in Oxydothidaceae, which is phylogenetically closely related to Vialaeaceae and Iodosphaeriaceae. *Oxydothis* is characterized by two types of ascomata, pedicellate, unitunicate asci, often with a J^+ apical ring, subapical ring, fusiform, hyaline ascospores with spine-like or rounded ends. (Fröhlich & Hyde, 1994, 2000; Zhang et al., 2014; Konta et al., 2016; Hyde et al., 2020b). Species of *Oxydothis* have been reported as endophytes, pathogens, and saprobes commonly found in monocotyledons, such as Arecaceae (palms), Liliaceae, Pandanaceae and Poaceae (bamboo) (Hyde, 1994; Wang & Hyde, 1999; Fröhlich & Hyde, 2000; Wong & Hyde, 2001; Shenoy et al., 2005; Hidayat et al., 2006; Konta et al., 2016; Hyde et al., 2020b). It is interesting to note that an unidentified species in *Oxydothis* was recorded on *Diplopterygium glaucum* (≡ *Hicriopteris glauca*) in southern Japan (Hosoya & Tanaka, 2007). In this study, we introduce a new species, *Oxydothis woodwardiae*, isolated from *Woodwardia japonica* (Blechnaceae) in China.

Oxydothis woodwardiae J.Y. Zhang, Y.Z. Lu & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF903192; Facesoffungi number: FoF17042; Figure 3.60

Etymology: The species epithet "*woodwardiae*" refers to the host of holotype.

Holotype: HKAS 129801

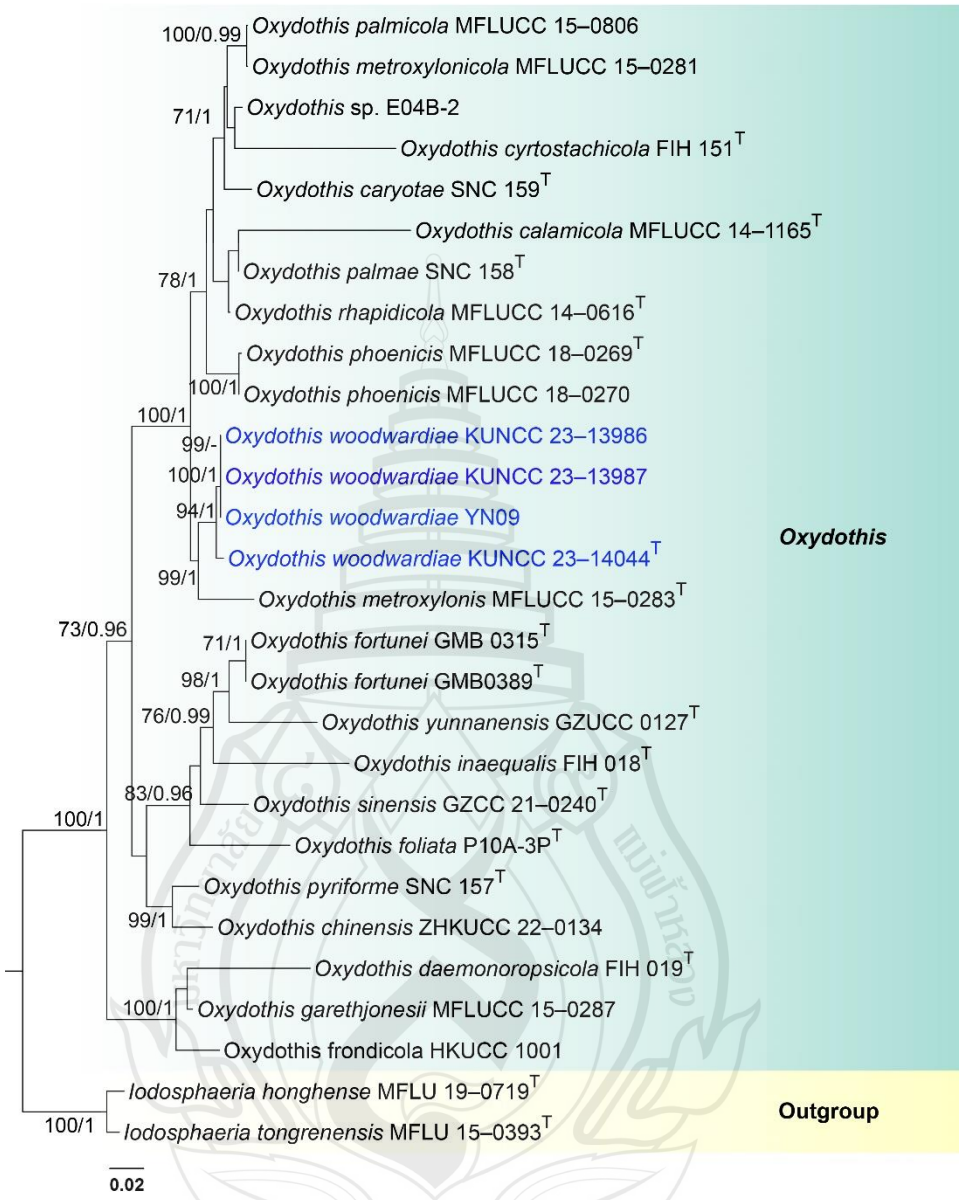
Saprobic on petiole of *Woodwardia japonica* (Blechnaceae). **Asexual morph:** Undetermined. **Sexual morph:** Ascomycetes. *Ascostromata* solitary or aggregated in groups, immersed, forming slightly raised as blistering areas on the host surface, long axis horizontal to that of the host, brown. *Locules* 112–223 µm diam. ($\bar{x}$ = 176 µm), 32–72 µm high ($\bar{x}$ = 51 µm), immersed in stromata, comprising slightly raised blistering areas through the host tissue, axis oblique to the host surface, with central papilla. *Peridium* 4–8.5 µm wide ($\bar{x}$ = 6 µm), thin-walled, outer cells mixing with the host epidermal cells, composed 1–3 layers of pale brown to brown cells of *textura angularis*, 23–42 µm wide ($\bar{x}$ = 30 µm, n = 30) between the two locules of peridium composed of pale brown cells of *textura prismatica*. *Hamathecium* 1.9–3.2 µm ($\bar{x}$ = 2.5 × 9.3 µm, n = 30), dense, smooth-walled, septate, no constricted or slightly constricted at the septum, hyaline. *Asci* (165–)180–215 × 8.5–10.5 µm ($\bar{x}$ = 193.5 × 9.3 µm, n = 30), 8-spored, fasciculate, unitunicate, cylindrical-clavate, pedicellate, with a J^+, wedge- shaped, subapical ring, hyaline. *Ascospores* 60.5–73 × 4.3–5.5 µm ($\bar{x}$ = 68 × 5 µm, n = 30), 2–3-seriate, rarely straight, filiform to fusiform, tapering gradually from the center to the ends, centrally 1-septate, not constricted at the septum, with blunt to pointed ends, hyaline, several guttules in each cell, with large guttules when immature, smooth-walled.

Culture characteristics: Ascospores germinating on WA within 18 h. and germ tube produced from a point of ascospores. Colonies on PDA in natural light, slow growing, reaching 20 mm diameter in 15 days at 25°C, irregular or subrotund in shape with lobate edge, dry, flat, with a knobby protuberance in the center, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiannan Buyi and Miao Autonomous Prefecture, Sandu Shui Autonomous County, on dead fronds of *Woodwardia unigemmata* (Blechnaceae), 13 August 2021, J.Y. Zhang, J56 (HKAS 129801, holotype; GZAAS 23–0728, isotype), ex-type living culture KUNCC 23–14044; China, Qianxinan Buyi and Miao Autonomous Prefecture, Zhenfeng County,

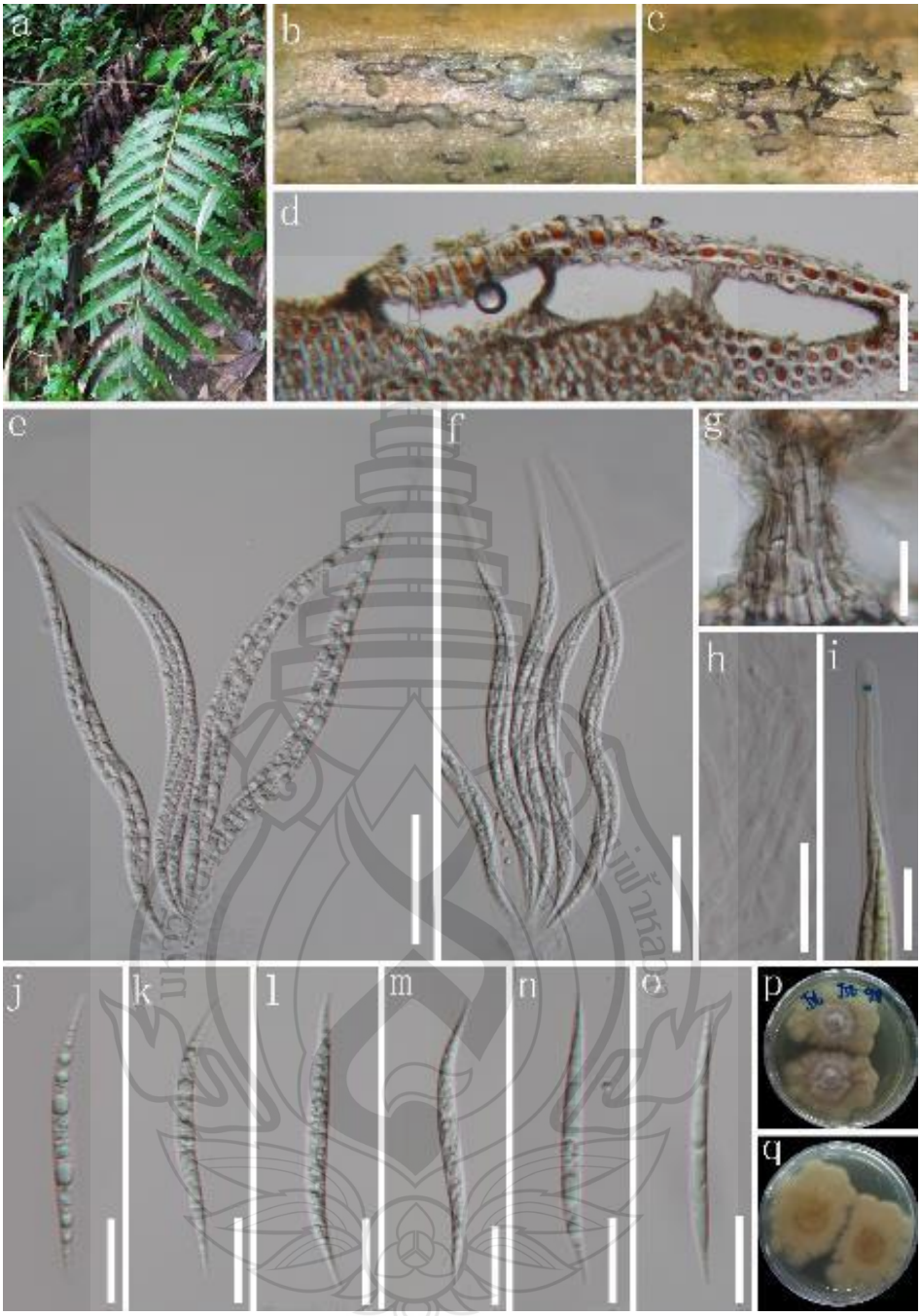
Huanlian Township, Fengyouwan Village, on dead fronds of *Woodwardia unigemmata* (Blechnaceae), 17 March 2022, J.Y. Zhang, J282 (HKAS 129767), living culture KUNCC 23–13986; *ibid*., J283 (HKAS GZAAS 23–0705), living culture KUNCC 23–13987; China, Yunnan Province, Kunming City, Kunming Institute of Botany, 04 April 2022, R.J. Xu, YN09.

Notes: Morphologically, our new collections of *Oxydothis woodwardiae* resemble *O. metroxyli* in having ascostromata with long axis horizontal to that of the host, fasciculate, unitunicate asci with a J^+ and filiform to fusiform ascospores (Konta et al., 2016). However, *O. woodwardiae* differs from *O. metroxyli* by its lenticular ascomata, and larger ascospores (60.5–73 × 4.3–5.5 µm vs. 47–57 × 4–6 µm). Phylogenetically, three strains representing *O. woodwardiae* sp. nov. formed a distinct clade sister to *O. metroxyli* within *Oxydothis*. Additionally, the sequences similarities of the LSU and ITS gene regions between *O. woodwardiae* (KUNCC 23–14044) and *O. metroxyli* (MFLUCC 15–0283) are 98 % (879/896 bp, including 2 gaps) and 87% (526/602 bp, including 15 gaps), respectively. Therefore, we introduce *O. woodwardiae* new to science based on its morphology and phylogeny.



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS and SSU sequence data. Bootstrap support values for ML equal to or greater than 70% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP. Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.59 Phylogenetic tree of *Oxydothis*



Note a The host. b, c Ascomata on substrate. d Section through an ascoma. e, f Asci. g Peridium. h Paraphyses. i An apical ring. j–o Ascospores. p, q Colonies on PDA from above and below. Scale bars: d = 100 µm, e, f = 50 µm, g–o = 20 µm

Figure 3.60 *Oxydothis woodwardiae* (HAKS 129801, holotype)

Chaetosphaeriales Huhndorf, A.N. Mill. & F.A. Fernández, Mycologia 96(2): 378 (2004)

Chaetosphaeriaceae Réblová, M.E. Barr & Samuels, Sydowia 51(1): 56 (1999)

Codinaeella Réblová & Hern.-Restr., Journal of Fungi 7(12, no. 1097): 45 (2021)

Index Fungorum number: IF 842000; *Facesoffungi number*: FoF17043; 2 species associated with pteridophytes; Figure 3.61

Type species: *Codinaeella minuta* (Tubaki) Réblová & Hern.-Restr.

≡ *Menispora minuta* Tubaki

Notes: *Codinaeella* was established in Chaetosphaeriaceae (Chaetosphaeriales, Sordariomycetes, Ascomycota) by Réblová et al. (2021a) for eight codinaea-like fungi, typified by *C. minuta*. *Codinaeella* is characterized by lanose colonies, macronematous, mononematous, straight or flexuous, septate, unbranched conidiophores, integrated, terminal or several lateral phialides, mono-and poly-phialidic pigmented conidiogenous cells, often with funnel-shaped collarettes, and falcate, aseptate, hyaline conidia, often accumulating in slimy fascicles (Réblová et al., 2021a; Wu & Diao, 2022). Currently, 17 species have been accepted in *Codinaeella* (Réblová et al., 2021a; Wu & Diao, 2022), all verified with molecular data (Zhang et al., 2022; Wu & Diao, 2022; Réblová et al., 2021a). Members of *Codinaeella* are saprobes with a worldwide distribution, associating with dead materials of various plants, sometimes occurring in soil (Réblová et al., 2021a; Wu & Diao, 2022). Herein, we described *C. plagiogyriae* and a new host record of *C. lutea*, isolated from ferns in terrestrial habitat. This is the first finding of *Codinaeella* species associated with ferns.

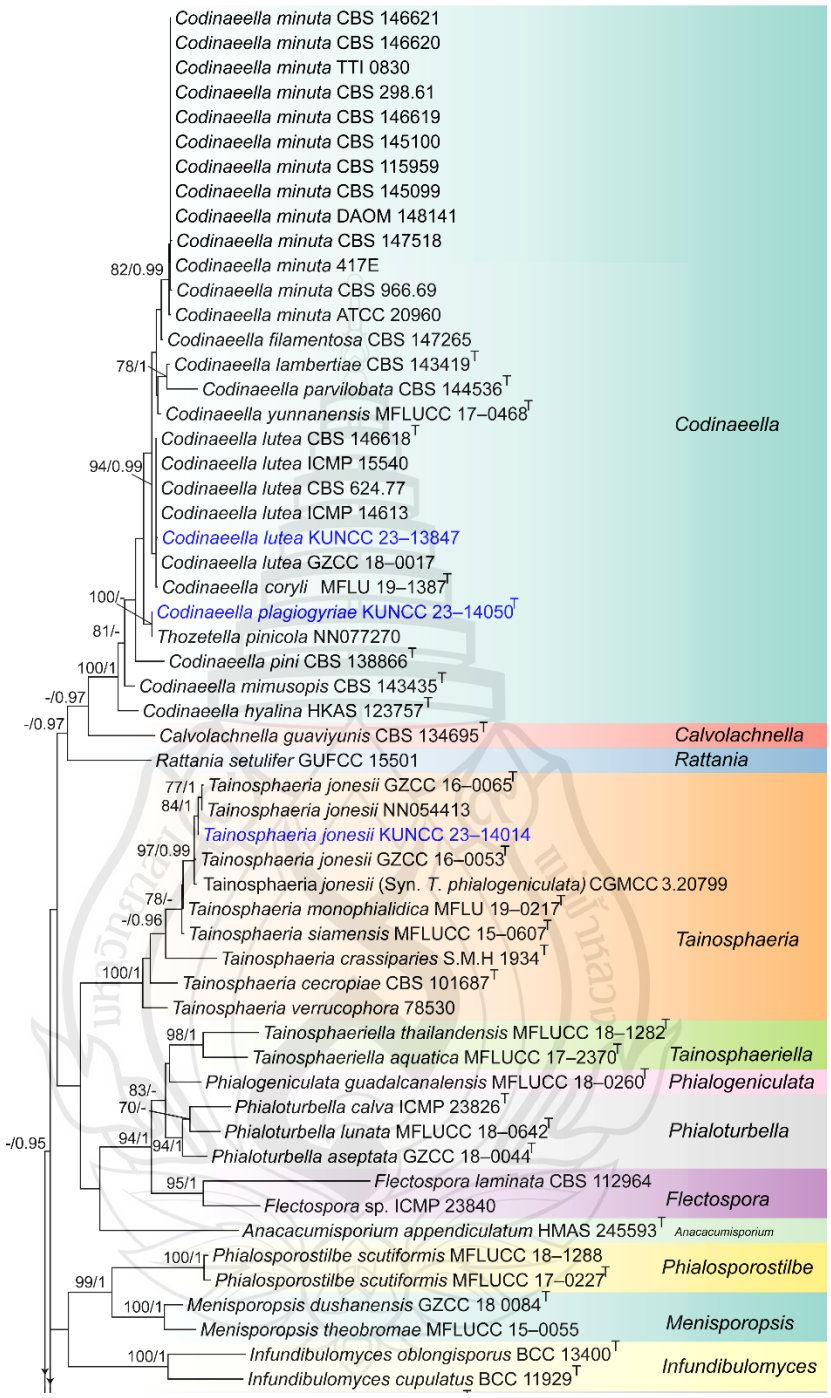
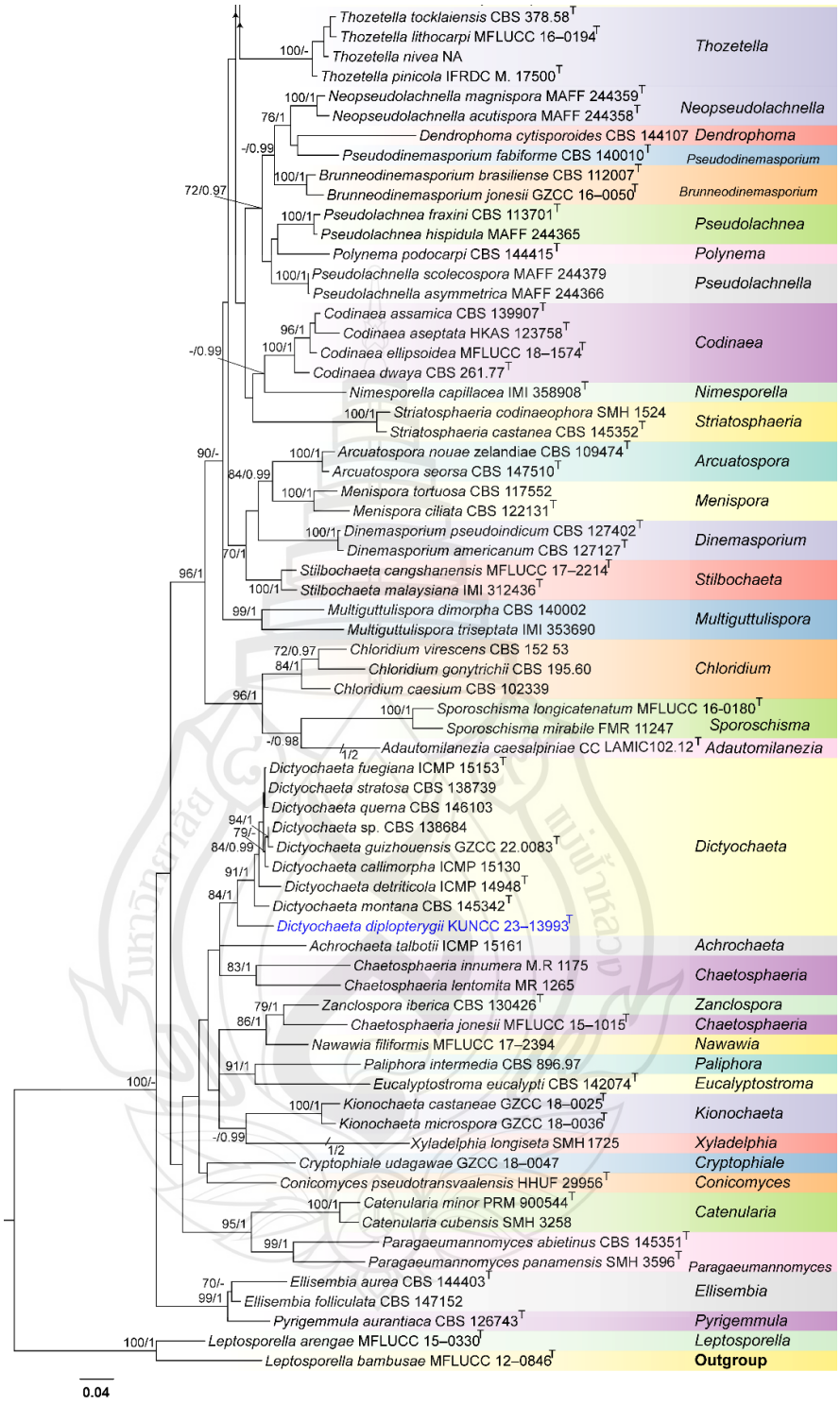


Figure 3.61 Phylogenetic tree of Chaetosphaeriaceae



Note Phylogram generated from maximum likelihood analysis based on combined LSU and ITS sequence data. The tree was rooted to *Leptosporella arengae* (MFLUCC 15–0330) and *L. bambusae* (MFLUCC 12–0846).

Figure 3.61 (continued)

Codinaeella lutea Réblová & Hern.-Restr., Journal of Fungi 7(12, no. 1097): 51 (2021)

Index Fungorum number: IF842204; *Facesoffungi number*: FoF 17044; Figure 3.62

Holotype: PRA 20986

Saprobic on dead frond stalks and leaves of an unidentified fern in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, pale brown, with white, shiny masses on the apex of conidiophores. *Mycelium* mostly immersed, composed of septate, brown hyphae. *Conidiophores* 30–73.5 × 2.5–4.3µm ($\bar{x}$ = 48 × 3.5 µm, n = 15), macronematous, mononematous, erect, solitary, straight, cylindrical, unbranched, extending percurrently occasionally, brown or light brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 8.5–31 × 2.8–4.3 µm ($\bar{x}$ = 16.4 × 3.6 µm, n = 10), monophialidic, integrated, terminal, subcylindrical, with funnel-shaped collarettes, pale brown to subhyaline towards the apex. *Conidia* 13.5–17.5 × 2.3–3.5 µm ($\bar{x}$ = 16 × 2.8 µm, n = 25), amerospores, falcate, tapering towards both ends, smooth, guttulate, hyaline, with hair-like and (3.5–)6–8 µm-long appendages at both ends.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from the end of conidium. Colonies growing on PDA in natural light, reaching 223 mm diameter in 14 days at 25°C, circular, flat with entire margin, dry, velvety, grey or brown from above; dark brown to pale yellow in reverse from center to margin, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Baiyun District, Changpolin Forest Park, on dead frond stalks of an unidentified fern, 26 June 2022, J.Y. Zhang, A7 (GZAAS 23–0658), living culture KUNCC 23–13847.

Known hosts: An unidentified fern (This study), *Quercus ilex*, *Q. robur*, *Quercus* sp., and others unknown host (Réblová et al., 2021a)

Distribution: Australasia, China, Europe, Czech Republic, New Zealand and the Netherlands (Réblová et al., 2021a; this study)

Notes: *Codinaeella lutea* was introduced as a saprobe on various plant substrates by Réblová et al. (2021a), but no records found on ferns or fern-allies. The morphological characteristic of our new collection closely matches those of previous specimens of *C. lutea*, with the exception that polyphialidic conidiogenous cells with multi-lateral openings were not observed in our new collection. Furthermore, phylogenetic analysis supported their conspecific nature. Thus, we introduced our new collection as *C. lutea* based on molecular data and aided by morphology. This marks the first instance of *Codinaeella* species being associated with ferns.

Codinaeella plagiogyriae J.Y. Zhang, Y.Z. Lu & K. D. Hyde, *sp. nov.*

Index Fungorum number: IF 903193; *Facesoffungi number*: FoF17045; Figure 3.63

Etymology: The species epithet "*plagiogyriae*" refers to the host genus *Plagiogyria*.

Holotype: HKAS 129804

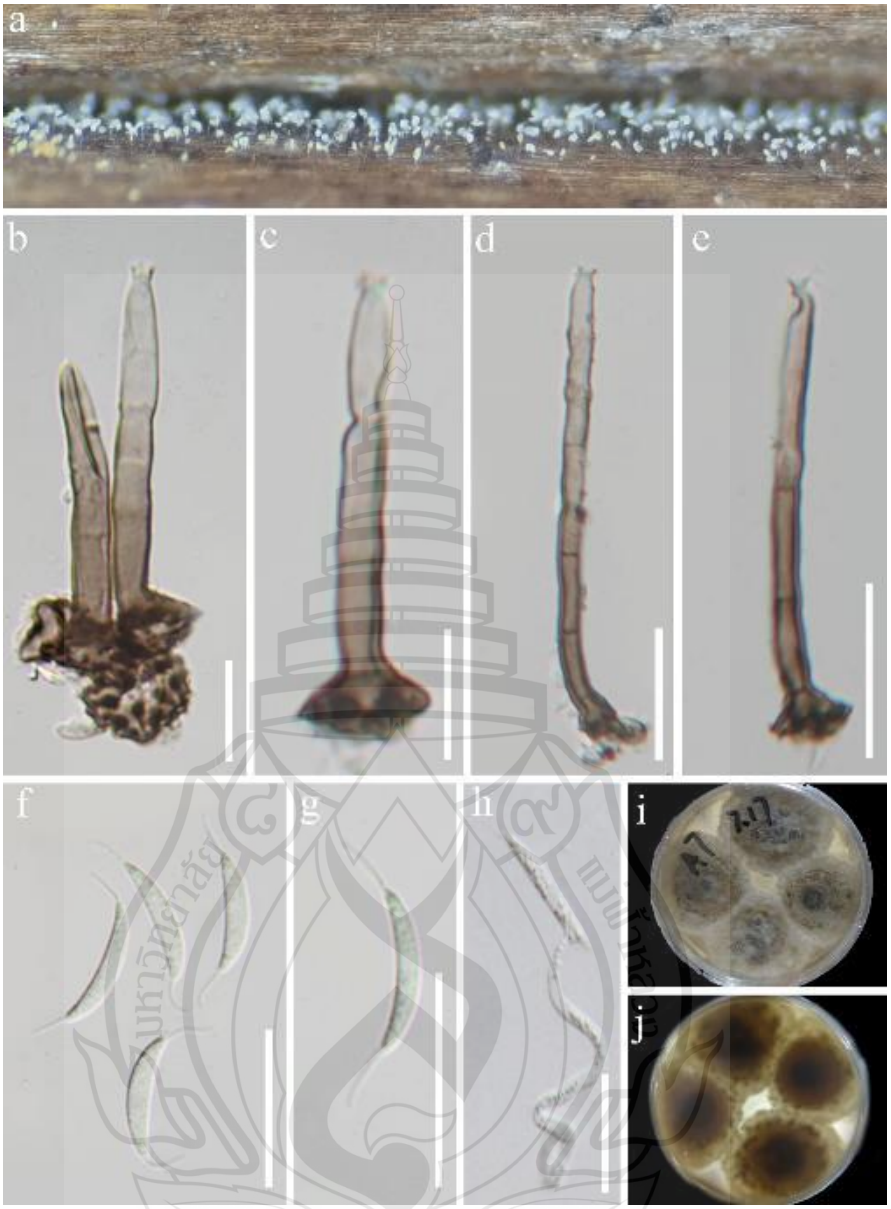
Saprobic on dead fronds and stalks of *Plagiogyria euphlebia* (Plagiogyriaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, brown, with yellow masses on the apex of conidiophores. *Mycelium* mostly immersed, composed of septate, brown hyphae. Setae absent. *Conidiophores* (25–)46–87.5 × 2.7–4.8 µm ($\bar{x}$ = 62.5 × 3.4 µm, n = 15), macronematous, mononematous, erect, solitary, straight or slightly flexuous, cylindrical, unbranched, extending percurrently and sympodially, brown or light brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 20–37 × 2.8–3.8 µm ($\bar{x}$ = 27.5 × 3.4 µm, n = 20), mono- or polyphialidic with discrete, integrated, terminal or lateral phialides openings formed by successive sympodial elongation, with subcylindrical to funnel-shaped collarettes with pale yellow pigment attached always, pale brown to subhyaline towards the apex. *Conidia* 16–21 × 2.6–3.8 µm ($\bar{x}$ = 19 × 3.1 µm, n = 35), aseptate, falcate, tapering

towards both ends, smooth, guttulate, hyaline, with hair-like and 7.5–10 µm long appendages at both ends.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from conidia. Colonies growing on PDA in natural light, reaching 17 mm diameter in 20 days at 25℃, circular, flat with entire margin, dry, velvety, white from above; brown to pale yellow in reverse from center to margin, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiannan Buyi and Miao Autonomous Prefecture, Sandu Shui Autonomous County, egg-laying cliff, on dead fronds and frond stalks of *Plagiogyria euphlebia* (Plagiogyriaceae), 13 August 2021, J.Y. Zhang, J61 (HKAS 129804, holotype; GZAAS 23–0729, isotype), ex-type living culture KUNCC 23–14050.

Notes: Following BLASTn searches, the closest match of LSU and ITS to our new isolate (KUNCC 23–14050) are *Codinaeella minuta* ATCC 20960 (OL654146, 99.55% similarity) and *Thozetella pinicola* isolate NN077270 (OL628295, 100% similarity), respectively. In the present phylogenetic analysis, our new isolate (KUNCC 23–14050) clustered together with *Thozetella pinicola* (NN077270). *Thozetella pinicola* was introduced by Jeewon et al. (2009), isolated from leaf litter of *Pinus elliottii* Engelm. in Hong Kong. However, phylogenetic tree in this study showed that *T. pinicola* (NN077270) and the type strain of *T. pinicola* are distinct species. We could not compare the morphological characteristics of both strains as the morphology of *Thozetella pinicola* (NN077270) has not been reported. We therefore considered that the strain of *T. pinicola* (NN077270) may have been misidentified and needs to be reevaluated. The morphological characters of our new collection (HKAS 129804) are similar to *Codinaeella lamberiae*, *C. mimusopis*, *C. minuta* and *C. pini* (Reblova et al., 2021a), but are clearly distinct from the phylogenetic analysis.



Note a Colonies on substrate. b–e Conidiophores with conidiogenous cells. f, g Conidia. h Germinated conidium. i, j Colonies on PDA from above and below. Scale bars: b, c = 10 μm, d–h = 20 μm

Figure 3.62 *Codinaeella lutea* (GZAAS 23-0658)

Note a The host substrate. b, c Colonies on the host surface. d–h Conidiophore and conidiogenous cells. i, j Conidiogenous cells. k–n Conidia. o Germinated conidium. p, q Colony on PDA from above and below. Scale bars: d–h = 20 µm, i–o = 10 µm

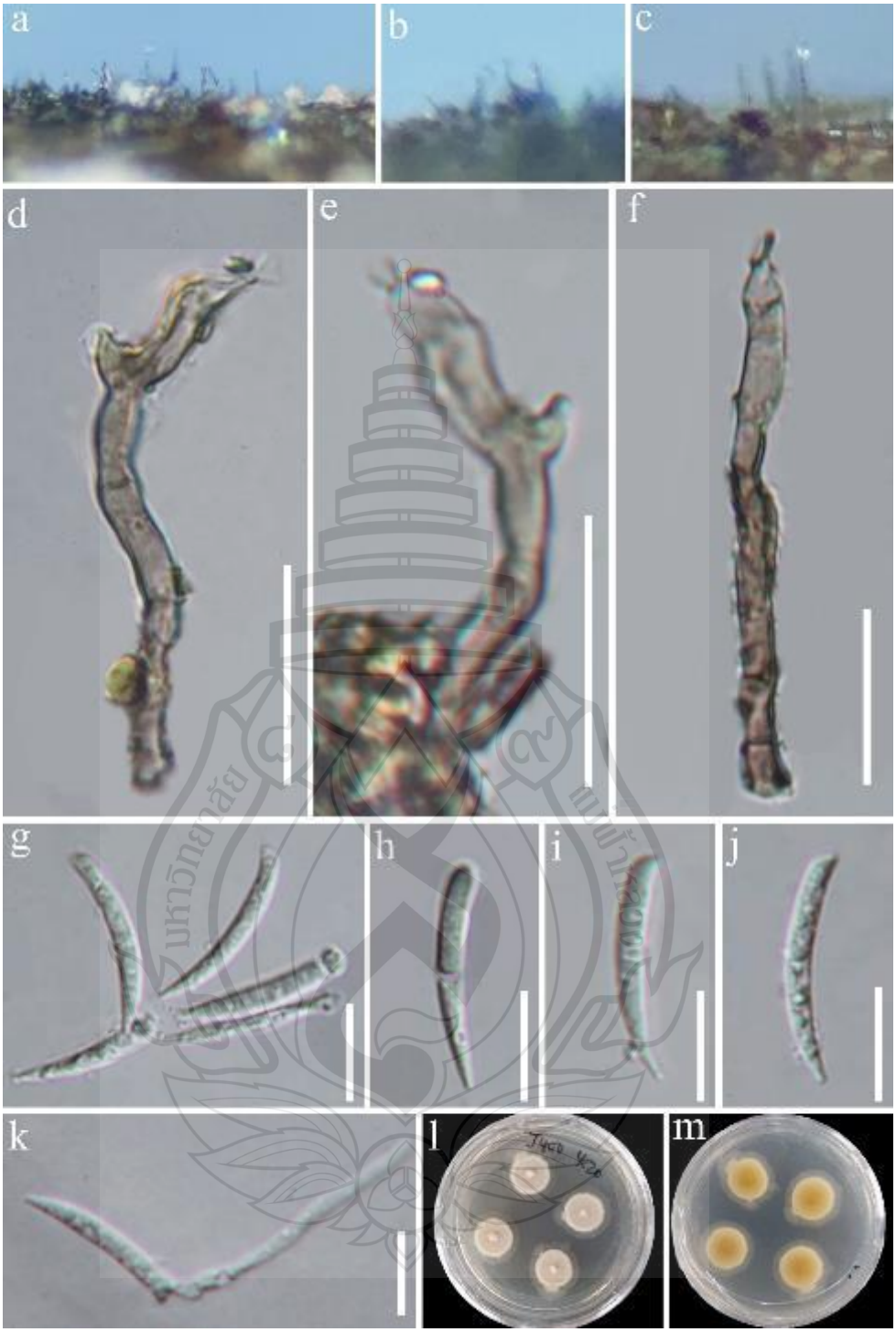
Figure 3.63 *Codinaeella plagiogyriae* (HKAS 129804, holotype)

Dictyochaeta Speg., Physis, Rev. Soc. Arg. Cienc. Nat. 7: 18 (1923)

Index Fungorum number: IF7996; *Facesoffungi* number: FoF 13058; one species associated with pteridophytes.

Type species: *Dictyochaeta fuegiana* Speg.

Notes: *Dictyochaeta* was introduced by Spegazzini (1923) with *D. fuegiana* as the type species. The broad definition of *Dictyochaeta* has long been confused with *Codinaea* and later was emended to monophyletic genera based on molecular data and narrow morphological characteristics (Réblová et al., 2021a, 2021c). The character of conidia with setulae and no setulae was supported to be an identification feature (Réblová & Gams, 2000; Lin et al., 2019; Réblová et al., 2020, 2021a, 2021c, 2021d). The sexual morph of *Dictyochaeta* is characterized by perithecial ascomata with papillate, unitunicate, 8-spored asci and septate ascospores (Booth, 1957; Hughes & Kendrick, 1968; Réblová et al., 2021c). The asexual morph has unbranched setae, macronematous, mononematous, unbranched conidiophores, which are shorter than setae, phialidic conidiogenous cells with an apical opening or one to several lateral openings formed by successive sympodial elongation, and asymmetrical, falcate, hyaline conidia without setulae (Réblová, 2004, 2021a; Wu & Diao, 2022; Zhang et al., 2022). A key to *Dictyochaeta* and related genera with asetulate conidia was provided by Wu and Diao (2022). Réblová et al. (2021c) also provided a key to accepted species in *Dictyochaeta*. Recently, Zhang et al. (2022) newly added a species, *D. guizhouensis* from Guizhou Province, China. *Dictyochaeta* species have been reported as saprobes found on dead plant materials in temperate and subtropical regions. However, *Dictyochaeta* species have never been found on pteridophytes. In this study, a new species (*D. diplopterygii*) found on fern in Guizhou Province, China, is introduced based on the evidence of morphology and phylogeny.



Note a–c Colonies on the substrate. d–f Conidiophores with conidiogenous cells. g–j Conidia. k Germinated conidium. l, m Colonies on PDA from above and below. Scale bars: d–f = 20 µm, g–k = 10 µm

Figure 3.64 *Dictyochaeta diplopterygii* (HKAS 129796, holotype)

Dictyochaeta diplopterygii J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF804763; *Facesoffungi number*: FoF 17046; Figure 3.64

Etymology: The species epithet "*diplopterygii*" refers to the host genus *Diplopterygium*.

Holotype: HKAS 129796

Saprobic dead frond stalks of *Diplopterygium chinense* (Gleicheniaceae) in a terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, hairy, brown. *Mycelium* mostly immersed, composed of septate, hyaline to pale brown hyphae. *Conidiophores* 39–63 × 3.7–5 μm ($\bar{x}$ = 54 × 4.3 μm, n = 10) near the base, macronematous, mononematous, erect, single, slightly flexuous, cylindrical, unbranched or branched, brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 18–24.5 × 3.7–4.5 μm ($\bar{x}$ = 20.8 × 4.2 μm, n = 15), monophialidic, integrated, terminal, subcylindrical, with an inconspicuous collarette, rough-wall, brown at the base and becoming subhyaline to hyaline towards the apex. *Conidia* 17–21.5 × 2.1–3 μm ($\bar{x}$ = 19.5 × 2.5 μm, n =25), amerospores, acrogenous, asymmetrical, falcate, rounded at the apex, tapering toward the sharp base, non-septate, asetulate, surrounding by a thin, inconspicuous sheath, smooth-walled, hyaline.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from conidia. Colonies growing on PDA in natural light, reaching 15 mm diameter in 20 days at 25℃, circular, flat with a white protuberance in the center, entire margin with thin, emissive mycelia, pale brown to white towards to edge; yellow to white from center to edge in reverse, not producing pigmentation.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead frond stalks of *Diplopterygium chinense* (Gleicheniaceae), 27 March 2022, J.Y. Zhang, J400 (HKAS 129796, **holotype**), ex-type living culture KUNCC 23–14032.

Notes: In a BLASTn search in GenBank, the closest matches of our new isolate (KUNCC 23–13993) of ITS and LSU sequence data were *Dictyochaeta stratosa* FMR 11228 (MT454506, 98.32% similarity) and *D. montana* CBS 145342 (NR 172307, 92.95% similarity). Morphologically, *Dictyochaeta diplopterygii* fits well with the narrow genetic concept of conidia without setulae and is most similar to *D. guizhouensis* in the shape of conidia (Zhang et al., 2022). However, our collection has notedly shorter conidiophores (39–63 μm vs.133–240 μm) and larger conidia (17–21.5 × 2.1–3 μm vs. 13–16 × 1.5–2.2 μm). Phylogenetically, our new isolate formed a separate clade basal to other *Dictyochaeta* species with high support. Therefore, we introduce *D. diplopterygii* as a new species based on its distinct morphology and phylogenetic evidence.

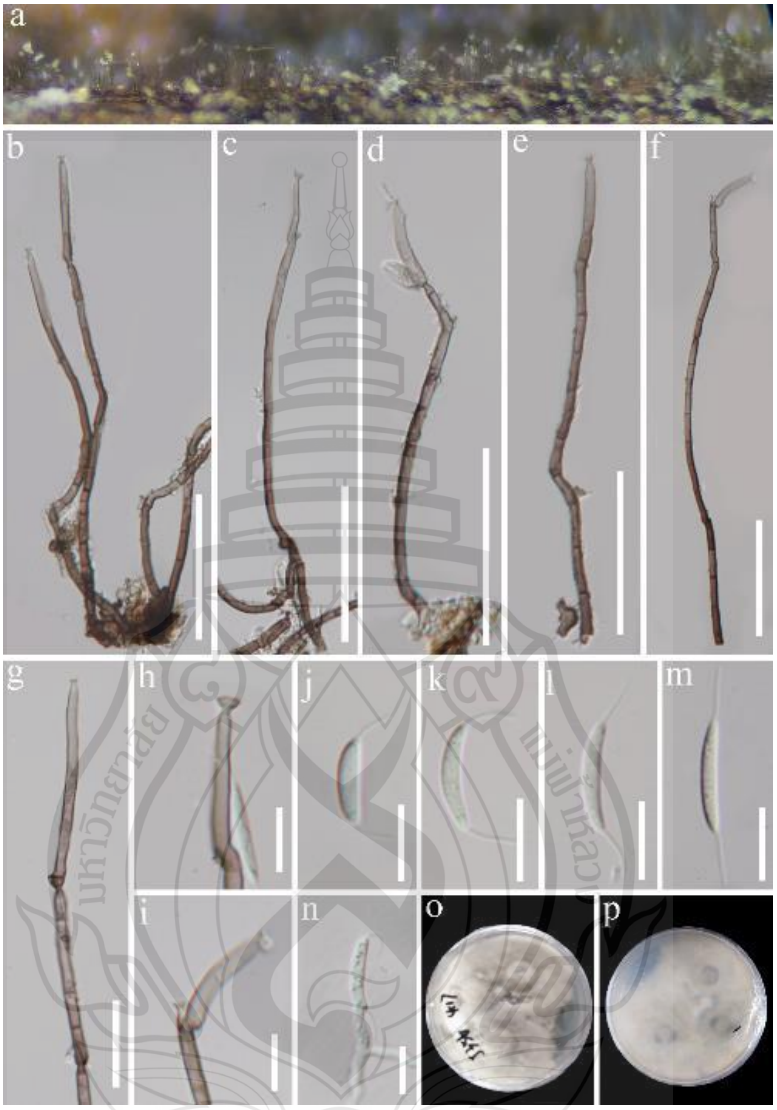
Tainosphaeria F.A. Fernández & Huhndorf, Fungal Diversity 18: 44 (2005)

Index Fungorum number: IF28947; *Facesoffungi* number: FoF 12975; one species associated with pteridophytes.

Type species: *Tainosphaeria crassiparies* F.A. Fernández & Huhndorf

Notes: *Tainosphaeria* was introduced by Fernández and Huhndorf (2005) and typified by *T. crassiparies* found on *Hymenaea pod* from Puerto Rico. *Tainosphaeria* was previously shown to be polyphyletic (Lin et al., 2019; Luo et al., 2019; Li et al., 2021). However, Réblová et al. (2021b) re-evaluated the generic concept and resolved this genus into three monophyletic genera based on molecular date and distinct morphology. Species of *Tainosphaeria* are characterized by subglobose to ovoid, perithecial ascomata, unitunicate asci with a J^-, apical ring, narrow-fusiform, septate, hyaline ascospores, and codinaea-like anamorphs with macronematous, mononematous, pigmented, unbranched conidiophores, usually monophialidic conidiogenous cells and falcate, aseptate, setulate, hyaline conidia (Fernández & Huhndorf, 2005; Lu et al., 2016; Lin et al., 2019; Réblová et al., 2021a, 2021b; Wu & Diao, 2022). Wu and Diao (2022) provided a key to 13 accepted species of *Tainosphaeria*, which are reported as saprobic on decaying or submerged wood with a worldwide distribution (Fernández & Huhndorf, 2005; Liu et al., 2016; Lu et al., 2016; Wu & Diao, 2022). One new host record of

T. jonesii was collected from ferns in terrestrial habitat, marking the first link to ferns for *Tainosphaeria* species.



Note a Colonies on substrate. b–f Conidiophores. f–i Conidiogenous cells. j–m Conidia. n Germinated conidium. o, p Colonies on PDA from above and below. Scale bars: b–f = 50 µm, g = 20 µm, h–n = 10 µm

Figure 3.65 *Tainosphaeria jonesii* (HKAS 129782)

Tainosphaeria jonesii Y.Z. Lu, J.K. Liu & K.D. Hyde, Mycosphere 7 (9): 1328 (2016)

= *Tainosphaeria phialogeniculata* W.P. Wu & Y.Z. Diao, Fungal Diversity 116: 1–546 (2022)

Index Fungorum number: IF552517; *Facesoffungi number*: FoF02639; Figure 3.65

Holotype: GZAAS 16–0065

Saprobic on dead frond stalks of *Blechnopsis orientalis* (Blechnaceae) in terrestrial a habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, hairy, brown. *Mycelium* mostly immersed, composed of septate, hyphae. *Setae* absent. *Conidiophores* 105–174(–206.5) × 2.3–3.8 µm ($\bar{x}$ = 135.8 × 2.9 µm, n = 15), macronematous, mononematous, erect, single, or in groups of 2–3 from knots of hyphal cells, slightly flexuous, cylindrical, extending percurrently, cylindrical, brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cell* 10.5–35(–46.5) × 1.8–4 µm ($\bar{x}$ = 23.5 × 2.7 µm, n = 20), monophialidic and polyphialidic, terminal or intercalary, integrated, subcylindrical, slightly swollen, with a unconspicuous collarette, rough-wall, brown at the base and becoming subhyaline to hyaline towards the apex, extending sympodially. *Conidia* 12.5–16.5 × 1.8–2.7 µm ($\bar{x}$ = 14.5 × 2.3 µm, n = 30), aseptate, acrogenous, falcate, tapering towards both ends, smooth, hyaline, with hair-like and 7–8 µm long appendages at both ends.

Culture characteristics: Conidia germinating on WA within 16 h and germ tube produced from conidia. Colonies growing on PDA in natural light, reaching 53 mm diameter after 20 days at 25℃, irregular, umbonate with undulate margin, dry, velvety, ashen, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead frond stalks of *Blechnopsis orientalis* (Blechnaceae), 27 March 2022, J.Y. Zhang, J356 (HKAS 129782), living culture KUNCC 23–14014.

Known hosts: Bamboo and dead plant substrates including *Acer* sp., *Acacia* sp., bamboo, *Eucalyptus* sp., mango and palm (Lu et al., 2016; Wu & Diao, 2022), *Blechnopsis orientalis* (Blechnaceae) (This study).

Distribution: China (Lu et al., 2016; Wu & Diao, 2022; this study).

Notes: In the LSU-ITS phylogenetic tree, our isolate grouped together with *Tainosphaeria jonesii* strains (GZCC 16–0065, GZCC 16–0053 and NN054413) and *T. phialogeniculata* (CGMCC 3.20799 = NN 76036) with good support. The morphology of our isolate is like *T. jonesii* and *T. phialogeniculata* in having phialidic conidiogenous cells and conidial characteristics. However, our new collection has longer [105–174(–206.5) vs. 44–98(–113)] µm, solitary conidiophores or 2–3 in groups, with occasionally extending percurrently, and mono- to polyphialidic, terminal or intercalary conidiogenous cells with sympodial proliferation, while the holotype of *T. jonesii* has simple conidiophores and terminal conidiogenesis with percurrent proliferation (Lu et al., 2016). The feature of long conidiophores (up to 240 µm) while extending sympodially and percurrently were observed in other specimens of *T. jonesii* (Wu & Diao, 2022), as well as terminal to intercalary conidiogenous cells, based on several collections of *T. jonesii* with high similarity (>99%) of ITS sequences. Moreover, comparisons of ITS and LSU showed 99% (472/474 bp, with 1 gap) and 100% (805/805 bp) similarity. Therefore, we identified our new collection as *T. jonesii*, which is new to ferns.

Tainosphaeria phialogeniculata was introduced by Wu and Diao (2022) and is characterized by macronematous, solitary conidiophores or 2–3 in groups, and terminal, monophialidic and polyphialidic conidiogenous cells extending sympodially. Our collection also resembles *T. phialogeniculata*, and the distinctive feature between these

two species is the longer conidiophores in our new collection [105–174(–206.5) vs. 30–55 µm] (Wu and Diao 2022). Furthermore, a comparison of ITS sequence revealed 99% (451/455 bp) similarity. LSU sequence data is not available for *T. phialogeniculata*. In addition, there arefew differences between *T. jonesii* and *T. phialogeniculata* (Lu et al., 2016, Wu & Diao, 2022), with a high level of ITS similarity [(99%, 452/455 bp)]. Consequently, we consider that our new collection, *T. phialogeniculata* and *T. jonesii* are conspecific. Therefore, we synonymized *T. phialogeniculata* under *T. jonesii* based on nomenclatural priority.

Glomerellales Chadef. ex Réblová, W. Gams & Seifert, Stud. Mycol. 68: 170 (2011)

Australiascaceae Réblová & W. Gams, in Réblová, Gams & Seifert, Stud. Mycol. 68: 171 (2011)

Monilochaetes Halst. ex Harter, J. Agric. Res., Washington 5: 791 (1916)

Index Fungorum number: IF8969; *Facesoffungi number*: FoF 07924; five species associated with pteridophytes (including two species newly reported in this study); Figure 3.66

Type species: *Monilochaetes infuscans* Halst. ex Harter

Notes: *Monilochaetes* Halst. ex-Harter was introduced by Harter (1916), with *M. infuscans* as the type species. The sexual morph of *Monilochaetes* is represented by *Monilochaetes camelliae* and *M. laeensis*, which exhibit superficial, dark brown, obpyriform, dark brown ascomata with periphysate ostioles, unitunicate, cylindrical-clavate, short-pedicellate asci and sub-ellipsoidal and 0–3-septate, hyaline ascospores (Sivanesan & Alcorn, 2002; Réblová et al., 2011a). *Monilochaetes* has dimorphic hyphomycetes with macro- to micro- type asexual forms, characterized by macronematous, mononematous conidiophores, monophialidic, terminal conidiogenous cells conidiogenous cells with a shallow collarette and aseptate or rarely septate, cylindrical to ellipsoid, hyaline conidia (Réblová et al., 2011a, 2011b; Zhou et al., 2017). Currently, 11 species have been included in *Monilochates*, with nine species

confirmed with molecular data (Réblová et al., 2011a; Zhou et al., 2017; Zhang et al., 2021; Yang et al., 2023). Two species, *M. basicurvata* and *M. regenerans*, were accepted in *Monilochaetes* based on morphology alone (Bhat & Kendrick, 1993; Matsushima, 1995; Réblová et al., 2011a). *Monilochaetes* species have a cosmopolitan distribution and are found as endophytes, pathogens, and saprobes from various hosts (Rong & Gams, 2000; Réblová et al., 2011a; Zhou et al., 2017; Zhang et al., 2021). *Monilochaetes laeensis* was the first species of *Monilochaetes* found on ferns (tree ferns) in Australia and the UK (Kirk, 1986; Réblová et al., 2011a). Zhang et al. (2021) described the second *Monilochaetes* species associated with a tree fern (*Alsophila costularis*) in Thailand. The third *Monilochaetes* species related to ferns was introduced by Yang et al. (2023), isolated from *Alsophila spinulosa* in a freshwater habitat, marking the first report of the genus from a freshwater habitat. It is interesting to note that the seedless hosts of *Monilochaetes* species are all found on tree ferns (Cyatheaceae), revealing the preference of saprobic fungi for tree ferns. In this study, seven taxa representing two new species (*M. guizhouensis* and *M. pronephrii*) and one new habitat record of *M. alsophilae* were newly isolated from ferns in terrestrial habitats.

Monilochaetes alsophilae J. Yang, Jian K. Liu & K.D. Hyde, Fungal Diversity 119: 146 (2023)

Index Fungorum number: IF559708; *Facesoffungi number*: FoF12821; Figure 3.67

Holotype: HKAS 112601

Saprobic dead frond stalks of *Alsophila spinulosa* (Cyatheaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, hairy, dark brown, with white masses on the apex of conidiophores. *Mycelium* partly immersed, partly superficial, composed of septate, light brown hyphae. *Conidiophores* 468–1204 μm long ($\bar{x}$ = 836 μm, n = 12), 9–16 μm wide ($\bar{x}$ = 12.7 μm, n = 12) near the base, macronematous, mononematous, erect, solitary, straight or slightly flexuous, extending percurrently,

cylindrical, thick-walled, black at the base, becoming paler brown towards the apex. *Conidiogenous cells* 20.5–71.5 × 7.5–12 µm ($\bar{x}$ = 53.5 × 9.5 µm, n = 20), enteroblastic, monophialidic, terminal, subcylindrical, swollen, with a shallow collarette, rough-wall, producing conidia successively, pale brown to light brown. *Conidia* 26–32 × 11–17 µm ($\bar{x}$ = 29 × 15 µm, n = 20), aseptate, aseptate, oblong, ellipsoidal, thick-walled, smooth-walled, guttulate, hyaline.

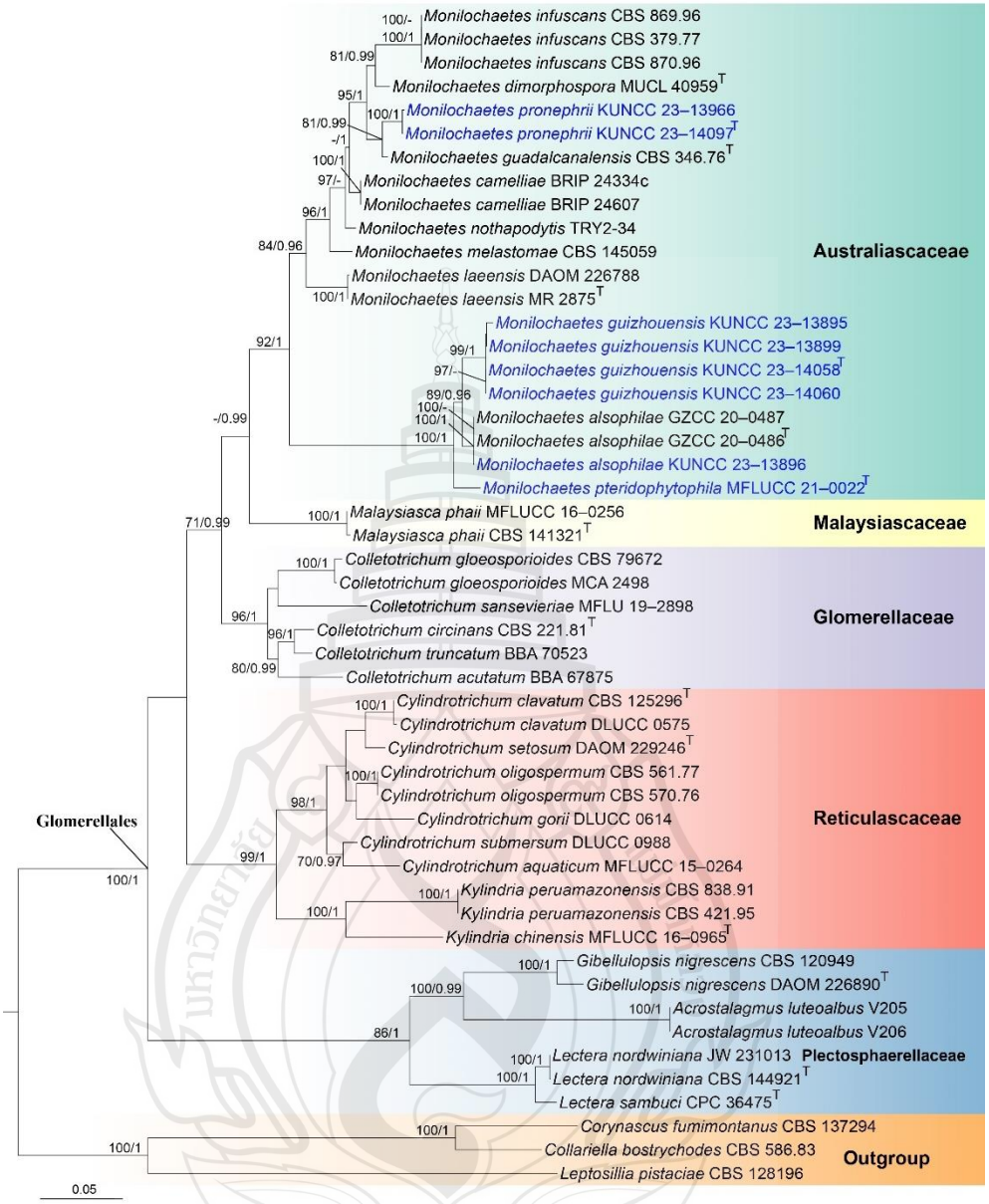
Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from conidia. Colonies growing on PDA, reaching 20 mm diameter in 10 days at 25°C, circular, flat with entire margin, dry, velvety, white, atroviren to oyster in reverse from the centre to margin of the colony, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Chishui City, Hushi Town, on dead frond stalks of *Alsophila spinulosa* (Cyatheaceae), 23 June 2022, J.Y. Zhang, F87 (HKAS 129697), living culture KUNCC 23–13896.

Known hosts: *Alsophila spinulosa* (Cyatheaceae) (Yang et al., 2023; this study).

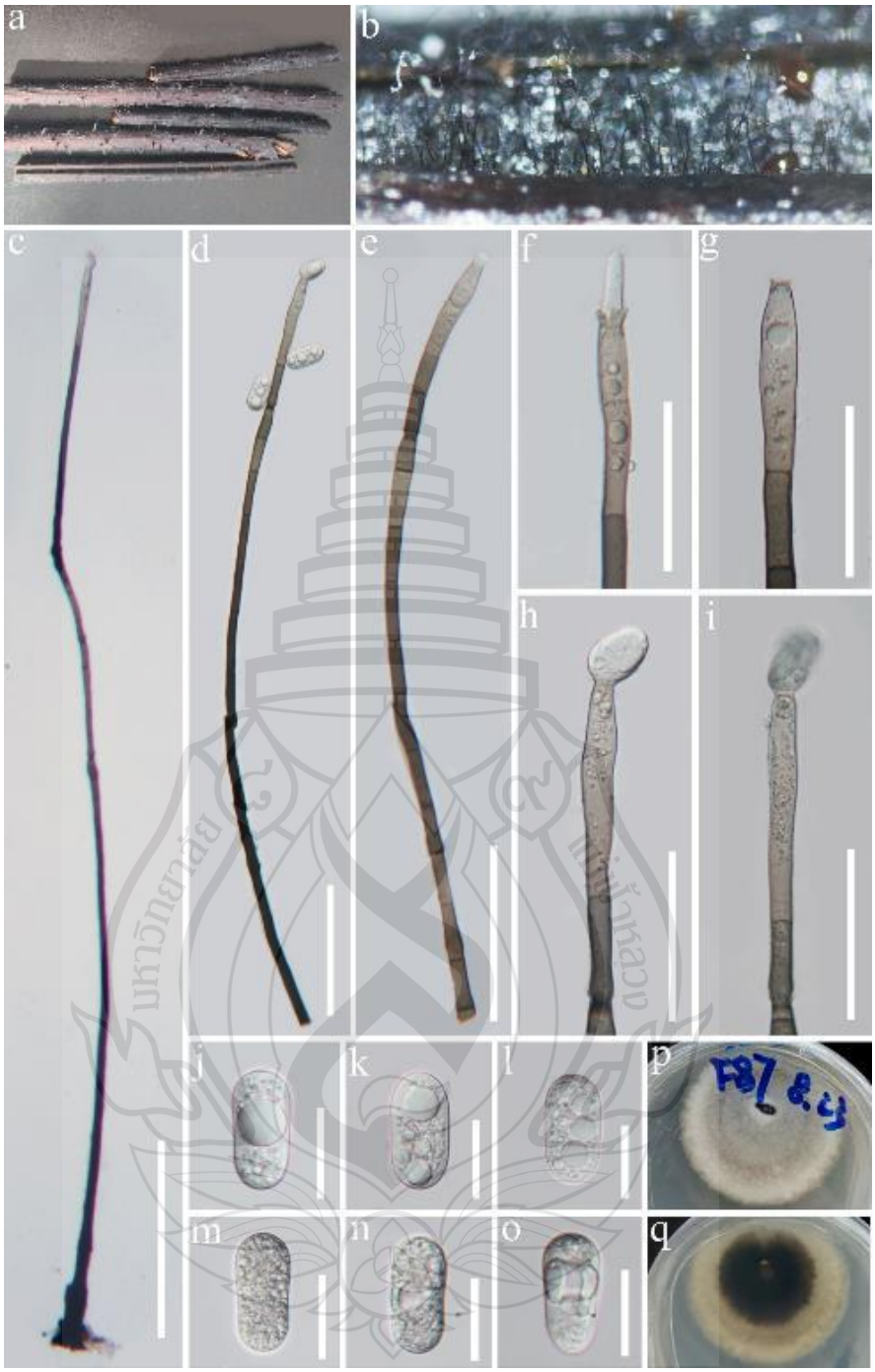
Distribution: China (Yang et al. 2023, this study).

Notes: *Monilochaetes alsophilae* was isolated from *Alsophila spinulosa* (Yang et al., 2023), which is same host as our new collection (HKAS 129697). In the LSU-ITS-SSU-*rpb2* phylogenetic tree, our isolate grouped together with *M. alsophilae* with 100% ML support vales. The morphology of our isolates resembles the holotype of *M. alsophilae* in having macronematous, mononematous conidiophores, enteroblastic, monophialidic conidiogenous cells and aseptate, oblong conidia (Yang et al., 2023). There is a slight difference in the conidiophores and conidial sizes. Our new collection has longer and narrower conidiophores (468–1204 × 9–16 µm vs. 500–800 × 13–28 µm), larger conidia (26–32 × 11–17 µm vs. 23–27 × 11–15 µm). Furthermore, a comparison of nucleotide base pairs of ITS and LSU between our isolate (KUNCC 23-13896) and type strain of *M. alsophilae* (GZCC 20-0486) shows fewdifferences. Therefore, we identified our new collection as *M. alsophilae*, which is new to terrestrial habitat.



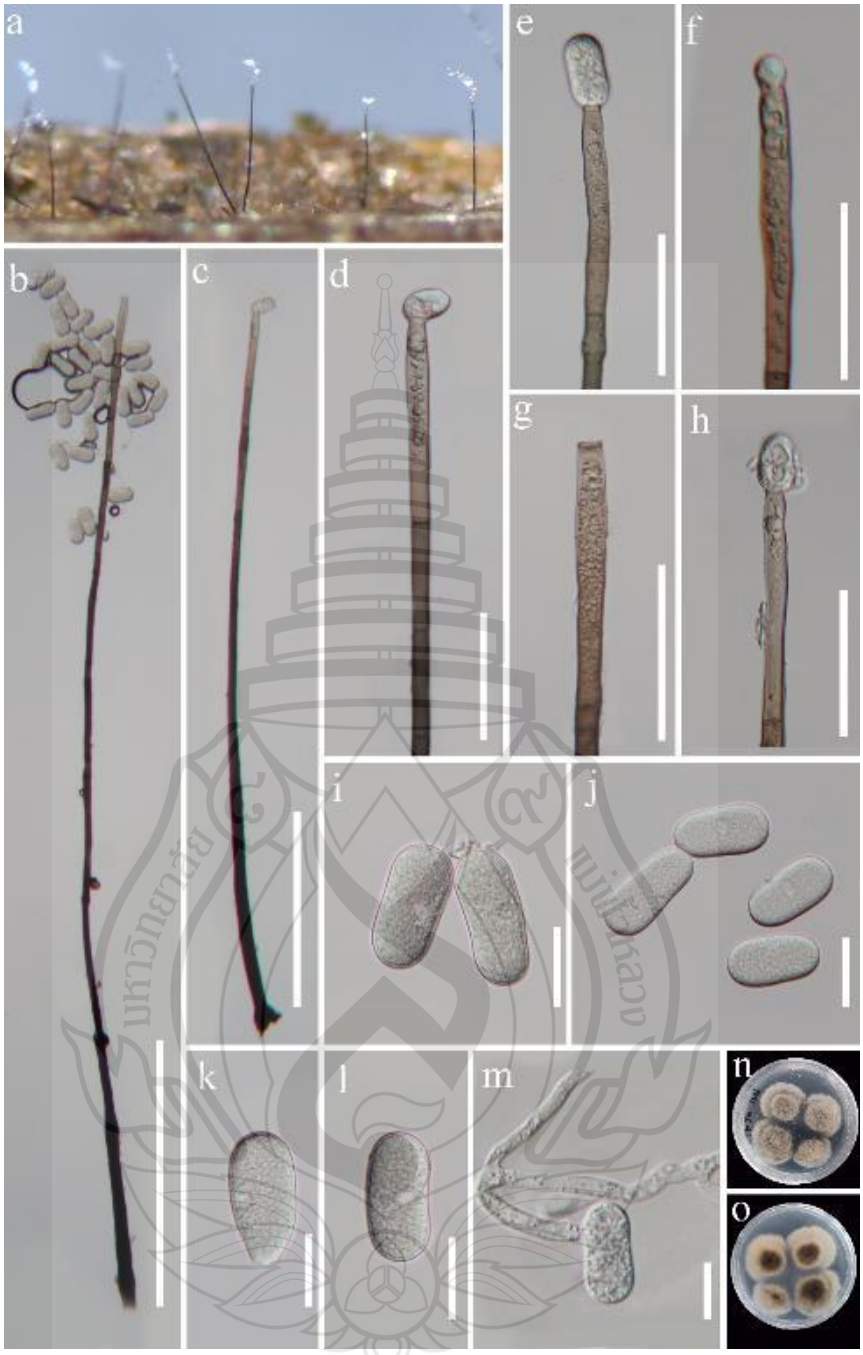
Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, *rpb2* and SSU sequence data. The tree was rooted to *Collariella bostrychodes* (CBS 586.83), *Corynascus fumimontanus* (CBS 137294) and *Leptosillia pistaciae* (CBS 128196) were used as outgroup taxa. Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.66 Phylogenetic tree of *Monilochaetes*



Note a, b Colonies on the host. c–e Conidiophores. f–i Conidiogenous cells. j–o Conidia. p, q Colony on PDA from above and below. Scale bars: c = 200 µm, d, e = 100 µm, f–i = 50 µm, j–o = 20 µm

Figure 3.67 *Monilochaetes alsophilae* (HKAS 129697)



Note a Colonies on substrate. b, c Conidiophores with attached conidia. d–f Conidiogenous cells. i–l Conidia. m Germinated conidium. n, o Colonies on PDA from above and below. Scale bars: b = 300 µm, c = 200 µm, d–h = 50 µm, i–m = 20 µm

Figure 3.68 *Monilochaetes guizhouensis* (HKAS 129810, holotype)

Monilochaetes guizhouensis J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903195; *Facesoffungi number*: FoF17047; Figure 3.68

Etymology: The species epithet "*guizhouensis*" refers to the location, where the fungus collected.

Holotype: HKAS 129810

Saprobic on dead frond stalks of *Alsophila metteniana* (Cyatheaceae) in terrestrial habitats. Sexual morph: Undetermined. Asexual morph: *Hyphomycetous*. *Colonies* on natural substrate superficial, effuse, gregarious, hairy, dark brown, with white masses on the apex of conidiophores. *Mycelium* mostly immersed, composed of septate, light brown hyphae. *Conidiophores* 451–894 × 8–16 μm ($\bar{x}$ = 675 × 11.5 μm, n = 18) near the base, macronematous, mononematous, erect, solitary, straight or slightly flexuous, sometimes with knots, cylindrical, thick-walled, black at the base, becoming paler brown towards the apex. *Conidiogenous cells* (40–)60–92 × 6–8.8 μm ($\bar{x}$ = 75 × 7.7 μm, n = 20), enteroblastic, monophialidic, terminal, subcylindrical, with apical taper to truncate apex, swollen, with a shallow collarette, rough-walled, pale brown to light brown. *Conidia* 27–34 × 15–18.5 μm ($\bar{x}$ = 30.5 × 16.8 μm, n = 30), aseptate, oblong to obovoid or ellipsoidal, thick-walled, smooth-walled, hyaline.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from conidia. Colonies growing on PDA in natural light, reaching 18 mm diameter in 14 days at 25℃, circular, flat with entire margin, dry, velvety, grey in above; brown to white in reverse from the center to margin of the colony, not producing pigmentation in culture.

Material examined: Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Alsophila metteniana* (Cyatheaceae), 13 December 2021, J.Y. Zhang, J70 (HKAS 129810, holotype; GZAAS 23–0732, isotype), ex-type living culture KUNCC 23–14058; *ibid*., J72 (HKAS 129812),e living culture KUNCC 23–14060; CHINA, Guizhou Province,

Zunyi city, Chishui County, Hushi Town, Chishui Alsophila Natural Reserve, on dead frond stalks of *Alsophila spinulosa* (Cyatheaceae), 23 June 2022, J.Y. Zhang, F86 (HKAS 129716), living culture KUNCC 23–13895; *ibld*., F88-3 (HKAS 129717), living culture KUNCC 23–13899.

Notes: Morphologically, *Monilochaetes guizhouensis* is similar to *M*. *alsophilae* in the shapes of conidiophores, conidiogenous cells and conidia (Yang et al., 2023), but clearly distinguished by the sizes, which are longer conidiogenous cells (60–92 μm vs. 36–62 μm), and notably larger conidia (27–34 × 15–18.5 μm vs. 23–27 × 11–15 μm) without guttules. The phylogenies confirm that our new isolate *M*. *guizhouensis* shared a sister relationship with *M*. *alsophilae* with good support. Furthermore, a comparison of nucleotide base pairs of ITS and *rpb2* between our isolate (KUNCC 23–14058) and *M*. *alsophilae* showed 8/420 bp (2%) and 47/984 bp (5%) differences, confirming they are distinct species (Jeewon and Hyde 2016).

Note a Colonies on subatrate. b, d Conidiophores. e, f Conidiogenous cells. g–k Conidia. l Germinated conidia. m, n Colonies on PDA from above and below. Scale bars: b–d = 100 μm, e, f = 20 μm, g–l = 10 μm

Figure 3.69 *Monilochaetes pronephrii* (HKAS 129755, holotype)

Monilochaetes pronephrii J.Y. Zhang, Y.Z. Lu & K.D. Hyde, ***sp. nov.***

Index Forum number: IF 903196; Facesoffungi number: FoF 17048; Figure 3.69

Etymology: The species epithet "*pronephrii*" refers to the host genus *Pronephrium*.

Holotype: HKAS 129755

Saprobic on dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, hairy, dark brown, with a white and glittery line on the apex of conidiophores. *Mycelium* mostly immersed, composed of septate, brown hyphae. *Conidiophores* 278–546 × 9–20 µm ($\bar{x}$ = 412.5 × 12 µm, n = 15) near the base, macronematous, mononematous, erect, solitary, single, or in groups of 2–3 from knots of hyphal cells, straight or slightly flexuous, cylindrical, thick-walled, dark brown at the base, becoming paler to subhyaline towards the apex. *Conidiogenous cells* 27–50.5 × 7.3–9.3 µm ($\bar{x}$ = 41.5 × 8 µm, n = 15), enteroblastic, monophialidic, terminal, subcylindrical, slightly swollen, with a unconspicuous collarette, rough-wall, brown at the base and becoming subhyaline to hyaline towards the apex. *Conidia* 21–24.5 × 10.5–14 µm ($\bar{x}$ = 22.5 × 12.5 µm, n = 25), aseptate, obovoid, rounded at the apex, narrow and truncate at base, thick-walled, rough-walled, guttulate, hyaline.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from conidia. Colonies growing on PDA, reaching 13 mm diameter in 14 days at 25°C, irregular, flat with wavy margin, dry, velvety, ashen in above, olive green to yellowish white in reverse towards margin of the colony, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Anlong County, Xianheping National Forest Park, on dead fronds of *Pronephrium penangianum* (Thelypteridaceae), 16 March 2022, J.Y. Zhang,

Y314 (HKAS 129755, **holotype**; GZAAS 23–0749, **isotype**), ex-type living culture KUNCC 23–14097; *ibid*., J250-1 (GZAAS 23–0698), living culture KUNCC 23–13966.

Notes: Two strains representing *Monilochaetes pronephrii* formed a phylogenetically distinct clade, which shares sister relationship with *M. guadalcanalensis*. However, *M. pronephrii* has unique morphological differences from *M. guadalcanalensis* (Rong & Gams, 2000) by its larger conidiophores (278–546 × 9–20 μm vs. 150–220(–400) × 4–7 μm) and conidia (21–24.5 × 10.5–14 μm vs. 18–21 × 6–9 μm). Furthermore, a nucleotide comparison of LSU and ITS revealed that *M. pronephrii* (KUNCC23–14097) is different from *M. guadalcanalensis* (CBS 346.76) by 4/836 bp (0.48%, without gap) and 15/493 bp (3%, including 5 gaps). Additionally, *M. pronephrii* sp. nov. is well distinguished from other species of the genus by having obovoid conidia that are narrow and truncate at the base.

Monilochaetes pteridophytophila J.Y. Zhang & Y.Z. Lu, *sp. nov*.; Figure 3.70

Index Fungorum number: IF 558296, *Facesoffungi number*: FoF 09708

Etymology: The epithet "pteridophytophila" refers to the host of pteridophyte.

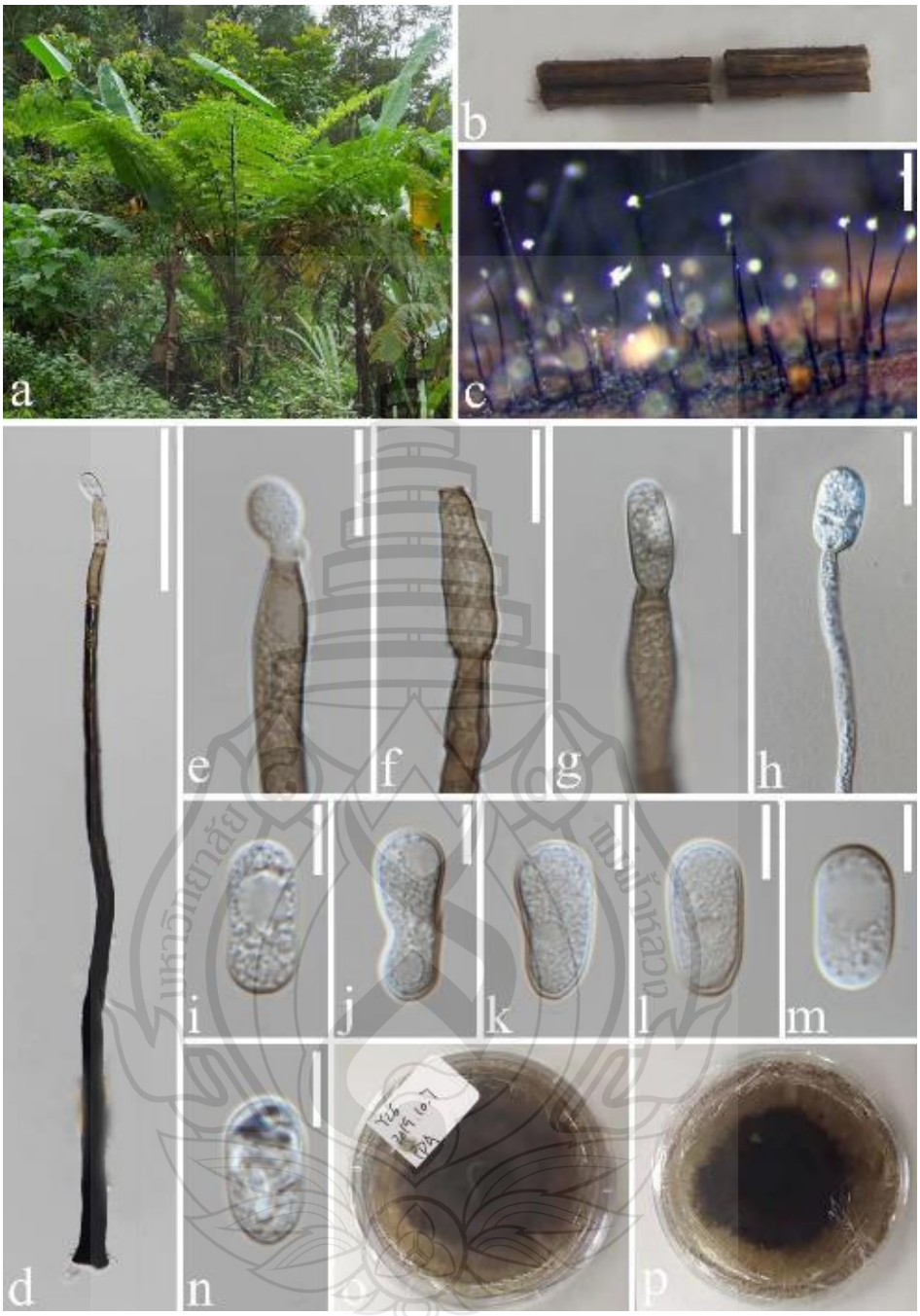
Holotype: MFLU 21-0023

Saprobic on dead scale of tree fern. **Sexual morph**: Undetermined. **Asexual morph**: hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, white. *Conidiophores* (268–)360–565 μm high ($\bar{x}$ = 465 μm, n = 15), 9–14.5 μm wide ($\bar{x}$ = 12 μm, n = 15) near the base, macronematous, unbranched, solitary, erect, straight or slightly flexuous monophialidic, subcylindrical, thick-walled, 1–4-septate, dark brown to black, darker near the base, becoming paler brown towards the apex. *Conidiogenous cells* 25–54 μm × 9–14.5 μm ($\bar{x}$ = 38 × 9.5 μm, n = 20), enteroblastic, monophialidic, apical, terminal, swollen, with a shallow collarette, subcylindrical with apical taper to truncate apex, pale brown, rough. *Conidia* 20–24 × 10–12 μm ($\bar{x}$ = 22 × 11.7 μm, n = 30), ellipsoidal to cylindrical-ellipsoidal, occasionally with a median or submedian constriction, thick-walled, hyaline, aseptate, smooth to rough walled.

Culture characteristics: Conidia germinating on PDA within 12 hrs at 25°C. The hyaline germ tube germinated from the base of conidia. Colonies growing on PDA at 25°C, circular, flat surface, planar, thin, dark brown, reaching 2 cm diam. in 7 days, marginal hyphae emission, edge entire, dark brown to pale brown in reverse from the center to margin of the colony.

Material examined: THAILAND, Tak Province, Umphang District, Mo Kro Subdistrict, (16°12'11"N 98°52'5"E), on dead scale of *Alsophila costularis* Baker (Cyatheaceae) in a disturbed forest nearby the roadside, 21 August 2019, J.Y. Zhang, Y26 (MFLU 21-0023, holotype; GZAAS 21-0015, isotype); ex-type living culture, MFLUCC 21-0022.

Notes: *Monilochaetes pteridophytophila* formed a distinct clade, which clustered with other *Monilochaetes* species. In a BLASTn search of NCBI GenBank, the closest match of the LSU, ITS, SSU and RPB2 sequence for *M. pteridophytophila* is 98.21% similarity to *M. melastomae* (NG_068601), 84.5% similarity to *M. melastomae* (NR_161124), 99.4% similarity to *M. laeensis* (GU180610), and 80.64% similarity to *M. infuscans* (GU180658), respectively. *Monilochaetes pteridophytophila* is most similar to *M. regenerans* in the shape of conidiophores, conidiogenous cells and conidia (Bhat and Kendrick 1993). However, *M. pteridophytophila* can be distinguished from *M. regenerans* by its darker and larger conidiophores [(268–)360–565 μm high vs. 300 μm high], smaller conidiogenous cells (25–54 μm vs. 70–100 μm) and conidia (20–24 × 10–12 μm vs. 25–38 × 12–16 μm). Therefore, we introduce *M. pteridophytophila* as a novel species based on both phylogenetic evidence and morphological characteristics.



Note a Tree fern in the field. b Dead scale of tree ferns. c Colony on dead scale of tree fern. d Conidiophore. e–g Conidiogenous cells with attached conidia. h Germinating conidium. i–n Conidia. o, p Colony on PDA from above and below. Scale bars: c = 200 µm, d = 100 µm, e–h = 20 µm, i–n = 10 µm

Figure 3.70 *Monilochaetes pteridophytophila* (MFLU 21-0023, holotype)

Hypocreales Lindau, in Engler & Prantl, Nat. Pflanzenfam., Teil. I (Leipzig) 1(1): 343 (1897)

Stachybotryaceae L. Lombard & Crous, Persoonia 32: 283 (2014)

Achroiostachys L. Lombard & Crous, Persoonia 36: 172 (2016)

Index Fungorum number: IF815916; *Facesoffungi number*: FoF 05529; one species associated with pteridophytes.

Type species: *Achroiostachys humicola* L. Lombard & Crous

Notes: The stachybotrys-like genus *Achroiostachys* was introduced by Lombard et al. (2016b) under the family Stachybotryaceae for six species that formed a highly-supported clade distantly related to the *Stachybotrys sensu stricto* clade. The seventh species, *A. bambusicola*, was introduced by Rashmi (2021) based solely on morphological comparison, and provided a morphological synopsis for the accepted *Achroiostachys* species. *Achroiostachys* species only have asexual morphs, with hyaline, mostly smooth, thin-walled conidiophores; phialidic conidiogenous cells with a somewhat protruding apical opening and hyaline, aseptate, ellipsoidal to limoniform conidia (Lombard et al., 2016b; Rashmi, 2021). Members of *Achroiostachys* have a wide distribution and are found on dead plant substrates and soils in the tropical and temperate regions around the world (Lombard et al., 2016b; Rashmi, 2021). However, *Achroiostachys* species have never been found on pteridophytes. In this study (Figure 3.71), a new species (*A. equiseti*) is introduced, representing the first association of *Achroiostachys* species with pteridophytes.

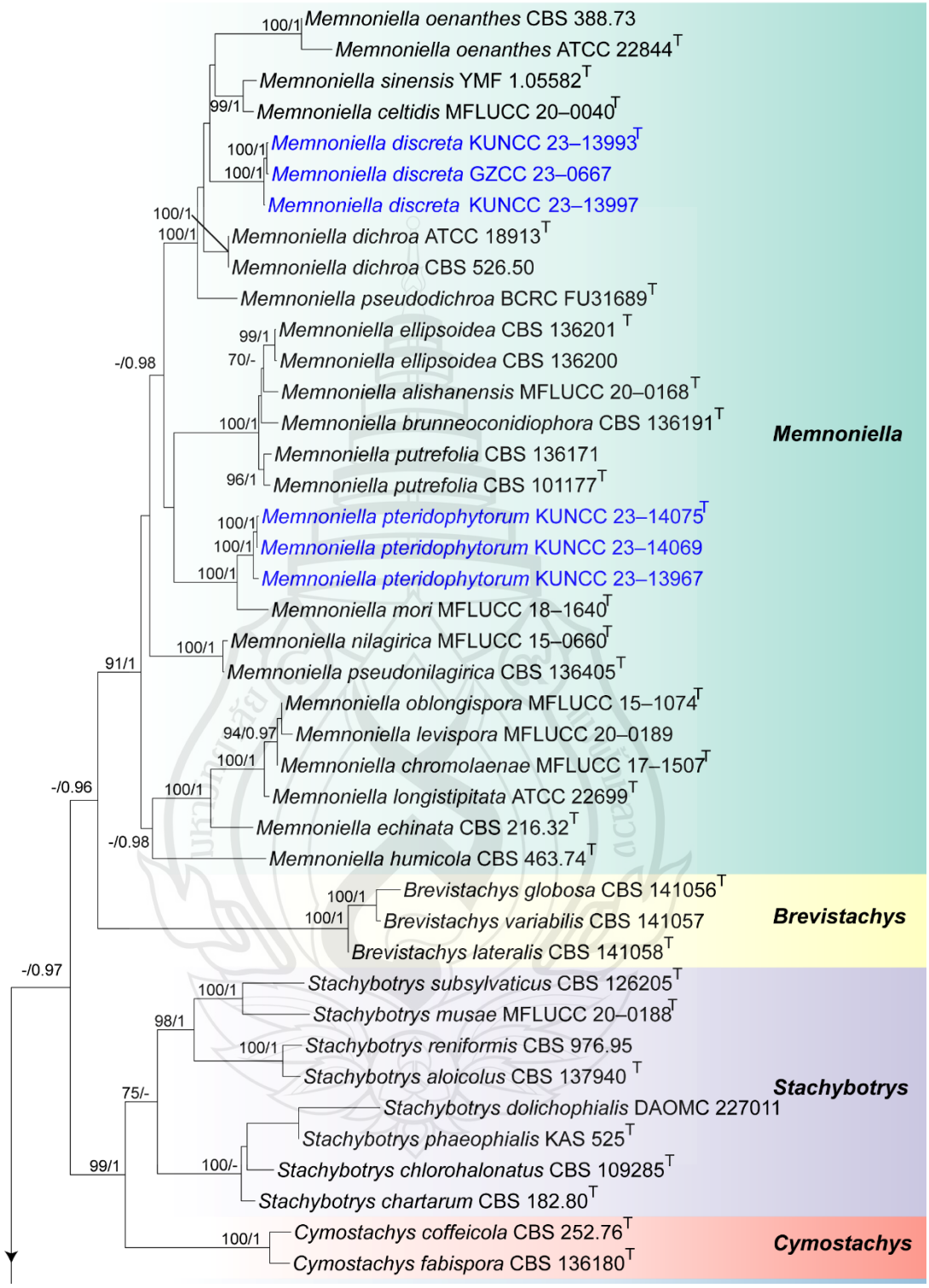
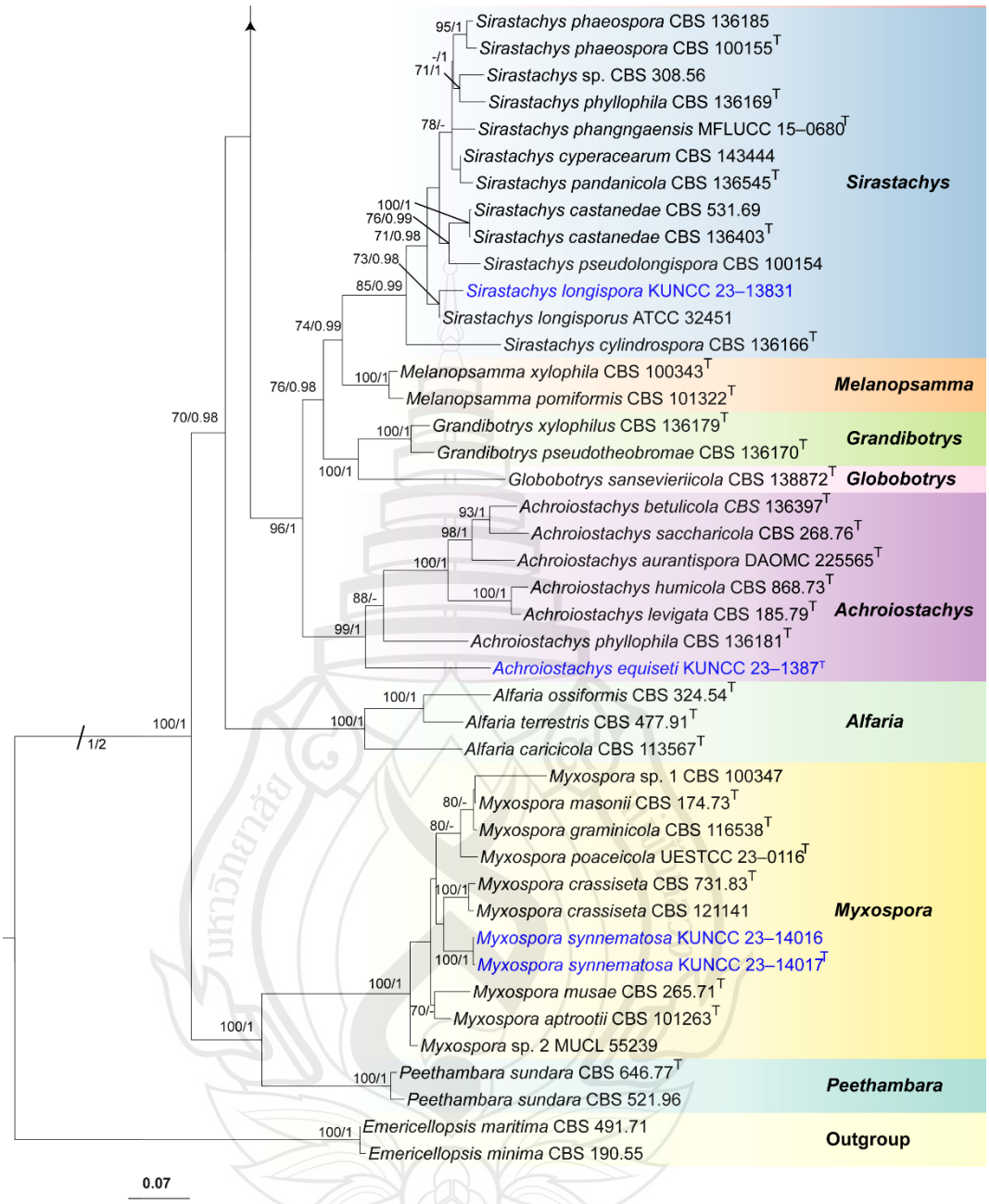


Figure 3.71 Phylogenetic tree of stachybotryaceae



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *Cal*, *rpb2* and *tef1-α* and *Tub2* sequence data. The tree was rooted to *Emericellopsis minima* (CBS 190.55) and *E. maritima* (CBS 491.71). Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.71 (continued)

Achroiostachys equiseti J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 903197; *Facesoffungi number*: FoF 17049; Figure 3.72

Etymology: The species epithet "*equiseti*" refers to the host genus.

Holotype: HKAS 129703

Saprobic on dead petiole of *Equisetum* sp. in terrestrial habitats. Sexual morph: Undetermined. Asexual morph: Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, hyaline, with sub-hyaline to pale yellow drop-shaped at the top of conidiophores, glistening. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophores* (80–)106.5–164 × (3–)3.5–6 µm ($\bar{x}$ = 149 × 5 µm, n = 15) near the base, macronematous, mononematous, erect, solitary, often with small guttules attached the surface, straight or slightly flexuous, cylindrical, unbranched or branched, usually septate at the base part, hyaline, sometime pale brown or brown at the base and hyaline towards the apex. *Conidiogenous cells* 9–14.5 × 3.5–6.5 µm ($\bar{x}$ = 12.5 × 4.5 µm, n = 15), monophialidic, discrete, in groups of 5–8 at the apex of each conidiophore, terminal, obovoid, with peripheral ones somewhat curved, smooth, hyaline, or pale yellow at the apex. *Conidia* 11–15.5 × 5–7.5 µm ($\bar{x}$ = 13 × 6.2 µm, n = 30), amerospores, simple, often aggregated as large glistening heads at conidiophores, obovoid to elliptical to fusiformis, straight, guttulate, smooth-walled, hyaline.

Culture characteristics: Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from conidia. Colonies growing on PDA under natural light, reaching 33 mm diameter in 20 days at 26°C, circular, flat with entire margin, thin, with mostly vegetative mycelium and thinnish aerial hyphae, white, producing pale yellow pigmentation in culture.

Material examined: CHINA, Guizhou Province, Tongren City, Jiangkou County, Taiping Town, Banaogou Group, on dead petiole of *Equisetum* sp. (Equisetaceae) a distributed forest, 21 May 2022, J.Y. Zhang, F16-1 (HKAS 129703, holotype; GZAAS 23–0672, isotype), ex-type living culture KUNCC 23–13872.

Notes: The morphological characteristics of *Achroiostachys equiseti* align well with the generic concept of *Achroiostachys* in having macronematous conidiophores, phialidic, elongate ampulliform to ventricose to subcylindrical conidiogenous cells and aseptate, ellipsoidal, guttulate, hyaline conidia (Lombard et al., 2016b; Rashmi, 2021). However, *A. equiseti* has a unique morphology that distinguishes it from other *Achroiostachys* species by having the longest conidiophores, which are hyaline or hyaline to brown towards the apex and brown at the ends, along with the largest, obovoid to elliptical conidi. Phylogenetically, *A. equiseti* formed a distinct clade basal to other *Achroiostachys* species with high support, providing strong evidence to support *A. equiseti* as a novel species.

Note a, b Colonies on the host. c–h Conidiophores. i–k Conidiogenous cells. l–p Conidia. q Germinated conidium. r, s Colonies on PDA from above and below. Scale bars: c–h = 50 µm, i–k, p, q = 20 µm, l–o = 10 µm

Figure 3.72 *Achroiostachys equiseti* (HKAS 129703, holotype)

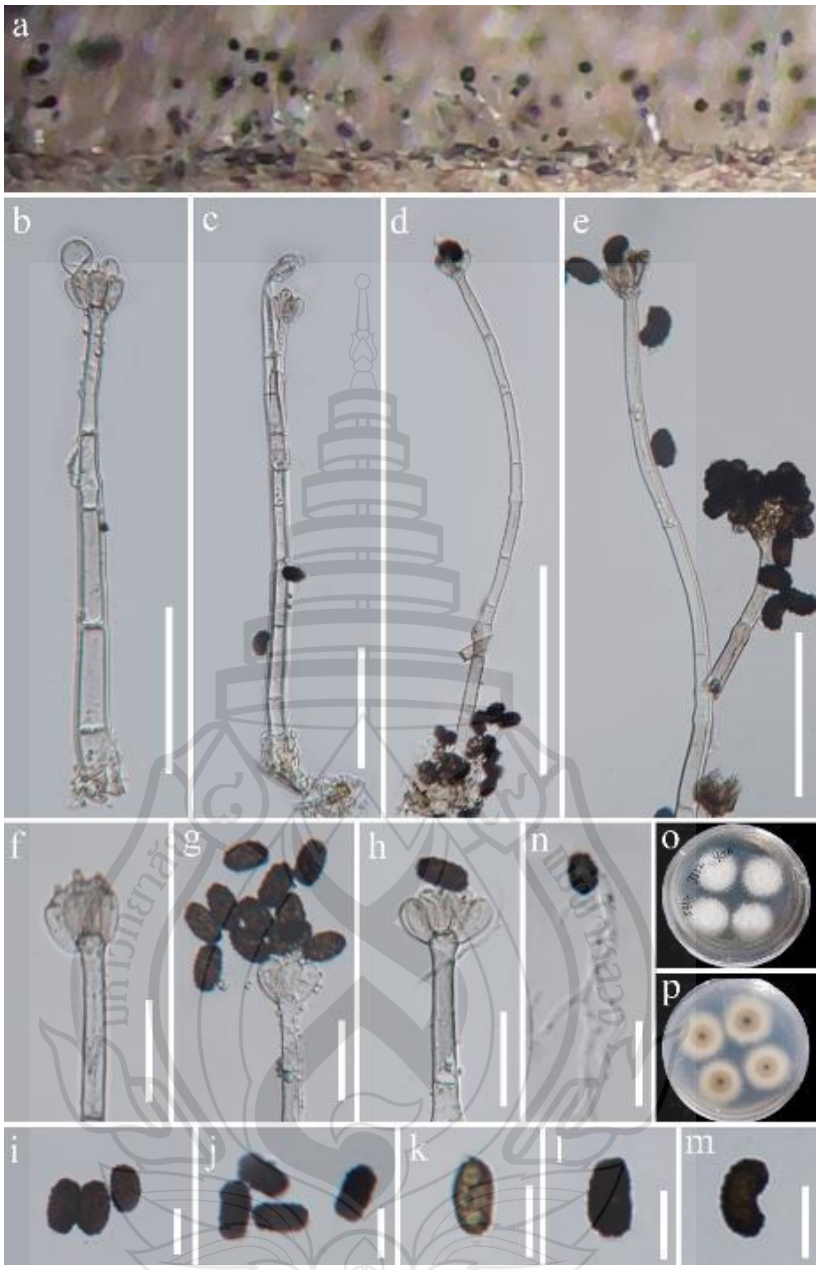
Memnoniella Höhn., Centbl. Bakt. ParasitKde, Abt. II 60: 16 (1923)

= *Spinomyces* Saito, J. Ferment. Technol. 17: 2. 1939 (non Spinomyces Bat. & Peres)

Index Fungorum number: IF 8900; *Facesoffungi number*: FoF 05558; three species associated with pteridophytes (including two species newly reported in this study)

Type species: *Memnoniella echinata* (Rivolta) Galloway

Notes: *Memnoniella* was introduced by von Höhnel (1924) based on *M. aterrima*. *Memnoniella* was previously considered synonymous with *Stachybotrys* (Smith, 1962; Wang et al., 2015), but Lombard et al. (2016b) resurrected it to genus level within Stachybotryaceae (Hypocreales, Sordariomycetes, Ascomycota) based on its distinct phylogenetic placement and designated *M. echinata* (CBS 216.32) as the epitype species. The genus is only known from its asexual morph, characterized by macronematous, mononematous, unbranched, septate conidiophores, phialidic conidiogenous cells with conspicuous collarettes, and aseptate, ellipsoidal to globose to reniform, smooth to verrucose conidia arranged in dry chains or slimy masses (Wang et al., 2015; Lombard et al., 2016b; Mapook et al., 2020; Tennakoon et al., 2021; Yeh et al., 2023). Sixteen species arelisted in Species Fungorum (Aug. 2024). Most *Memnoniella* species are found as saprobes on various substrates including decaying plant material, air, and soil (Lombard et al., 2016b; Hyde et al., 2020b; Mapook et al., 2020). *Memnoniella dichroa* was the first species in the genus associated with pteridophytes, found on *Cyathea* sp. (Cyatheaceae), *Equisetum hyemale* (Equisetaceae) and *Pteridium aquilinum* (Dennstaedtiaceae) in Cuba, Russia and the United Kingdom (Frankland, 1976; Mel nik et al., 2007; Delgado-Rodríguez et al., 2002). Yeh et al. (2023) introduced the second *Memnoniella* species (*M. pseudodichroa*) occurring on pteridophytes (*Angiopteris lygodiifolia*, Marattiaceae) in Taiwan Province, China. Additionally, this study introduced six new collections, representing two new species of *Memnoniella* (*M. discreta* and *M. pteridophytorum*) obtained from ferns in terrestrial habitats.



Note a Colonies on the substrate. b–d Conidiophores with conidiogenous cells. e–h Conidiogenous cells. i–m Conidia. n Germinated conidium. o, p Colonies on PDA from above and below. Scale bars: b–e = 50 µm, f–h, n = 20 µm, i–m = 10 µm

Figure 3.73 *Memnoniella discreta* (GZAAS 23–0819, holotype)

Memnoniella discreta J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903198; Facesoffungi number: FoF 17050; Figure 3.73

Etymology: The species epithet "*discreta*" refers to its discrete conidiogenous cells.

Holotype: GZAAS 23–0819

Saprobic on dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, gregarious, hyaline, with black mass at the top of conidiophores. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophores* 181–334(–389) × 6.5–11.5 μm ($\bar{x}$ = 236 × 4.5 μm, n = 20) near the base, macronematous, mononematous, erect, solitary, straight or slightly flexuous, cylindrical, unbranched or branched, 5–11-septate, hyaline, pale brown sometime. *Conidiogenous cells* (7.5–)9–11 × 4.5–6.7 μm ($\bar{x}$ = 9.7 × 5.5 μm, n = 15), monophialidic, discrete, in groups of 4–6 at the apex of each conidiophore, terminal, obovoid, with peripheral ones somewhat curved, smooth, hyaline. *Conidia* 10–12.5 × 4.8–7.4 μm ($\bar{x}$ = 11.5 × 6 μm, n = 25), amerospores, simple, often aggregated as large glistening heads in black, reniform to oblong to oval, guttulate when young, verrucous, rough-walled, middle brown to black.

Culture characteristics: Conidia germinating on WA within 13 h and germ tube produced from conidium. Colonies growing on PDA under natural light, reaching 22 mm diameter in 15 days at 26℃, circular with entire margin composed of thin, emissive mycelia, flat, dry, velvety, white; black at the central point, middle brown to pale brown in reverse side from middle ring to margin, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae), 27 March 2022, J.Y. Zhang, J312 (GZAAS 23–0819, **holotype**), ex-type living culture

KUNCC 23-13993; *ibid*., J314, (GZAAS 23–0709),living culture KUNCC 23–13997; CHINA, Guizhou Province, Chishui City, Hushi Town, on dead frond stalks of *Alsophila spinulosa* (Cyatheaceae), 23 June 2022, J.Y. Zhang, F92 (HKAS 129718), living culture GZCC 23–0667.

Notes: *Memnoniella discreta* matches well with generic concept of *Memnoniella* and resembles *M. sinensis* in the shapes of conidiophores and conidiogenous cells, as well as the sizes of conidiogenous cells and conidia (Zheng et al., 2019). However, *M. discreta* differs from *M. sinensis* in having larger conidiophores (181–334(–389) × 6.5–11.5 μm vs. 50–113 × 4.3–6.0 μm) and reniform to oblong to oval conidia, whereas *M. sinensis* has ellipsoidal or ovoid conidia (Zheng et al., 2019). In the phylogenetic analysis, three strains of *Memnoniella discreta* sp. nov. formed a distinct clade basal to the clade including *M. celtidis*, *M. oenanthes* and *M. sinensis*, which support the assertion that *M. discreta* is a new species.

Memnoniella pteridophytorum J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov.*

Facesoffungi number: FoF17051; Figure 3.74

Etymology: The species epithet "*pteridophytorum*" refers to this species being collected from various pteridophytes.

Holotype: HKAS 129824

Saprobic on dead frond stalks of *Angiopteris fokiensis* (Marattiaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, hyaline, with black drop-shaped at the top of conidiophores, glistening. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophores* 170–243 × 8.5–13.5 μm ($\bar{x}$ = 206 × 11 μm, n = 8) near the base, macronematous, mononematous, erect, solitary, straight or slightly flexuous, cylindrical, unbranched or branched, 3–6-septate, hyaline. *Conidiogenous cells* 10–15.5 × 5.8–8.5 μm ($\bar{x}$ = 13 × 7 μm, n = 20), monophialidic, discrete, in groups of 5–9 at the apex of each conidiophore, terminal, obovoid, with peripheral ones somewhat curved, smooth, hyaline, or pale brown. *Conidia* 12.5–15.6

× 5–6.5 µm ($\bar{x}$ = 14 × 5.9 µm, n = 30), amerospores, simple, often aggregated as large glistening heads in black, reniform to oblong, straight to slightly flexible, usually two-guttules at both sides of conidia, smooth to slightly verrucous, yellowish to olive green to dark brown.

Culture characteristics: Conidia germinating on WA within 15 h and germ tube produced from conidium. Colonies growing on PDA under natural light, reaching 23 mm diameter in 20 days at 26°C, circular, flat with entire margin composed of thin mycelia, dry, velvety, white from above; orange to yellow in reserve from center to margin, not producing pigmentation in cultures.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Angiopteris fokiensis* (Marattiaceae), 13 December 2021, J.Y. Zhang, J90 (HKAS 129824, holotype; GZAAS 23–0742, isotype), ex-type living culture KUNCC 23–14075; *ibid*., J81 (GZAAS 23–0820), living culture KUNCC 23–14069; *ibid*., Qianxinan Prefecture, Anlong County, Xianheping Public Forest Park, on dead fronds of *Pronephrium penangianum* (Thelypteridaceae), 16 March 2022, J.Y. Zhang, J252 (HKAS 129757), living culture KUNCC 23–13967.

Notes: The sequences similarities of our new collection using BLAST searches of *Cal*, ITS, *rpb2*, *tef1-α*, and *Tub2* sequence data are *M. pseudonilagirica* CBS 136405 (KU846132, 84.12 %), *M. mori* MFLU 19–2759 (MW114377, 97.13%), *M. sinensis* YMF 1.05582 (MK773575, 88.16%), *M. pseudonilagirica* CBS 136405 (KU846237, 90.77%) and *M. mori* MFLU 19–2759 (MW148283, 96.88%), respectively. The phylogenetic tree showed that our three isolates representing *M. pteridophytorum* formed a phylogenetically distinct clade, which shares a sister relationship with *M. mor*i with high support. However, *M. pteridophytorum* differs from *M. mori* in having occasionally branched, larger conidiophores (170–243 × 8.5–13.5 µm vs. 70–110 × 4–6.5 µm), and longer conidia (12.5–15.6 × 5–6.5µm vs. 10–13 × 5–8 µm) (Tennakoon et al., 2021).

Note a The host substrate. b Colonies on substrate. c–e Conidiophores with conidiogenous cells. f–j Conidia. k–m Conidiogenous cells. n Germinated conidium. o, p Colony on PDA from above and below. Scale bars: c–e = 50 µm, f–h, n = 20 µm, i–m = 10 µm

Figure 3.74 *Memnoniella pteridophytorum* (HKAS 129824, holotype)

Note a The host substrate. b Colonies on the host. c, d Synnematous conidiomata. e The part of the Synnematou conidiomata. f, g Conidiogenous cells. h, i Conidia. j, k Colonies on PDA from above and below. Scale bars: c, d = 200 μm, e–g = 20 μm, h, i = 10 μm

Figure 3.75 *Myxospora synnematosa* (HKAS 129785, holotype)

Myxospora L. Lombard & Crous, Persoonia 36: 202 (2016)

Index Fungorum number: IF816011; *Facesoffungi number*: FoF 05562; one species associated with pteridophytes.

Type species: *Myxospora masonii* (M.C. Tulloch) L. Lombard & Crous

≡ *Myrothecium masonii* M.C. Tulloch

Notes: Based on phylogenetic analysis, *Myxospora* was introduced by Lombard et al. (2016b) for myrothecium-like species that are phylogenetically distinct. *Myxospora* is only known from its asexual morph, characterized by synnematous or sporodochial conidiomata; cylindrical to pyriform, unbranched synnemata consisting of bundles of parallel, longitudinal, compacted hyphae; macronematous conidiophores; phialidic conidiogenous cells with a conspicuous collarettes and periclinal thickenings aseptate, fusiform conidia being an apical hilum lacking a funnel-shaped mucoid appendage (Lombard et al., 2016b; Chen et al., 2023). Currently, six species have been accepted in *Myxospora*, isolated from various plant substrates, including dead twig of unidentified plants, decaying grass leaf, leaf litter, leaves of *Glyceria* sp., *Musa* sp., Poaceae spp. and tar spot lesion on indetermined host, in several countries, including China, England, Japan, Madagascar, USA (Lombard et al., 2016b; Chen et al., 2023). We introduce a new species of *Myxospora* and report a new host of fern for this genus herein.

Myxospora synnematosa J.Y, Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903200; *Facesoffungi number*: FoF17052; Figure 3.75

Etymology: The species epithet "*synnematosa*" reflects to the synnematous conidiomata.

Holotype: HKAS 129785

Saprobic on dead frond stalks of an unidentified fern in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, brown with black mass at the top of conidiophores.

Mycelium partly immersed, partly superficial, composed of septate, hyaline to brown hyphae. *Conidiomata* 405–550 µm long, synnematous, solitary, straight or slightly flexuous, with subhyaline to olive-green or dark brown stems consisting of bundles of parallel, longitudinal, closely compacted hyphae. *Conidiophores* macronematous, bunched forming synnemata, subhyaline to olivaceous green to brown, erect, cylindrical, unbranched to branched, septate, smooth to verrucose, with percurrent proliferation. *Conidiogenous cell* 5.8–13 × 1.4–2 µm ($\bar{x}$ = 9.8 × 1.6 µm, n = 15), phialidic, with constriction at the apex with a collarette, terminal, subcylindrical, smooth-walled, hyaline to brown, with darker pigmentation at the c*onidiogenous* loci. *Conidia* 6–8.5 × 2.4–2.9 µm ($\bar{x}$ = 7.5 × 2.6 µm, n = 25), aseptate, smooth, becoming pigmented with age, fusiform to ellipsoid, often with a small prominence when young, subhyaline to pale brown.

Culture characteristics: Conidia germinating on WA within 13 h. Colonies growing on PDA under natural light, reaching ca.13 mm diameter in 20 days at 26°C, circular with entire margin, flat with a protuberance in the center, dry, velvety, white in reverse from the center to margin of the colony, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Qiandongnan Miao and Dong Autonomous Prefecture, Liping County, Yongcong Town, 26.0781942N, 109.1568557E, on dead fronds of ferns near a river in a forest, 27 March 2022, J.Y. Zhang, J364 (HKAS 129785, holotype; GZAAS 23–0717, isotype), ex-type living culture KUNCC 23–14017; *ibid*., J362-1, (HKAS 129784), living culture KUNCC 23–14016.

Notes: Morphologically, *Myxospora synnematosa* is similar to *M. poaceicola* in the shapes of conidiomata, conidiogenous cells and conidia. However, *M. synnematosa* differs from *M. poaceicola* in having notably shorter conidiomata (405–550 µm vs. 823–1455 µm) and verrucose conidiophores. Phylogenetically, *M. synnematosa* formed a separate lineage, which is sister to *M. crassiseta* within *Myxospora* (Figure 3.97). The results of BLASTn searches also confirmed the novelty of *M. synnematosa*. The closet matches of *M. synnematosa* are *Myxospora* sp. MUCL 55239 [ITS, 98.58% (554/562

bp, including 5 gaps)], *M. aptrootii* CBS 101263 [CAL, 91.53% (551/602 bp, including 9 gaps)], and *M. crassiseta* CBS 121141 [*rpb2*, 93.72% (671/716 bp, no gap; *tef1-α*, 87.36% (394/451 bp, including 13 gaps)], and *M. musae* CPC 25150 [(*Tub2*, 96.6% (313/324 bp, no gaps)].

Sirastachys L. Lombard & Crous, Persoonia 36: 215 (2016)

Index Fungorum number: IF816021; Facesoffungi number: FoF05576; one species associated with pteridophyte.

Type species: *Sirastachys phaeospora* L. Lombard & Crous

Notes: The monophyletic genus *Sirastachys* was introduced by Lombard et al. (2016b) for seven stachybotrys-like taxa but in a phylogenetically distinct clade. The genus is characterized by hyphomycetous asexual morph, which has cylindrical synnemata consisting of longitudinal, rope-like hyphae, macronematous, mononematous conidiophores arising laterally, phialidic, elongate doliiform to clavate to subclavate conidiogenous cells with conspicuous collarettes, and aseptate, hyaline to pale olivaceous brown to dark brown conidia (Lombard et al., 2016b; Crous et al., 2018b). Currently, nine species have been accepted in *Sirastachys*, all of which have been verified with molecular data (Lombard et al., 2016b; Crous et al., 2018b; Hyde et al., 2020b). *Sirastachys* species appears to be saprobes based on its host preference for soil and decaying plant material (Lombard et al., 2016b; Crous et al., 2018b). There are no *Sirastachys* species found on pteridophytes. In this study, one known species, *Sirastachys longispora* was isolated from a fern in a terrestrial habitat in China.

Sirastachys longispora (Matsush.) L. Lombard & Crous, Persoonia 36: 217 (2016)

≡ *Stachybotrys longisporus* Matsush., *Icon. microfung. Matsush. lect.* (Kobe): 145 (1975)

Index Fungorum number: IF816024; *Facesoffungi number*: FoF17053; Figure 3.76

Holotype: MFC-2174

Saprobic on dead frond stalks of an unidentified fern in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, hyaline, with, with black mass at the top of conidiophores. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline to pale brown hyphae. *Conidiophores* 34–60 × 3.5–5.5 µm ($\bar{x}$ = 47 × 3.8 µm, n = 15) near the base, macronematous, mononematous, erect, solitary, straight or slightly flexuous, cylindrical, unbranched, 2–3(–4)-septate, thick-wall attached with multi sub-hyaline to golden guttulae at the surface, hyaline to pale brown. *Conidiogenous cells* 7.5–10.5 × 3–4.5 µm ($\bar{x}$ = 8.8 × 3.6 µm, n = 18), monophialidic, discrete, in groups of 5–9 at *the* apex of each conidiophore, terminal, obovoid with thickening at the top, smooth, hyaline to pale brown. *Conidia* 8.5–10.5 × 1.8–2.2 µm ($\bar{x}$ = 9.3 × 2 µm, n = 25), aseptate, simple, often aggregated as large glistening black heads, clavate, rounded at both ends, smooth-walled, sub-hyaline to middle brown.

Culture characteristics: Conidia germinating on WA within 133 h and germ tube produced from conidia. Colonies growing on PDA under natural light, reaching 18 mm diameter in 20 days at 26°C, circular, flat with entire margin composed of thin mycelia, white from above; dark brown to orange to middle yellow from center to edge from reverse side, not producing pigmentation in culture.

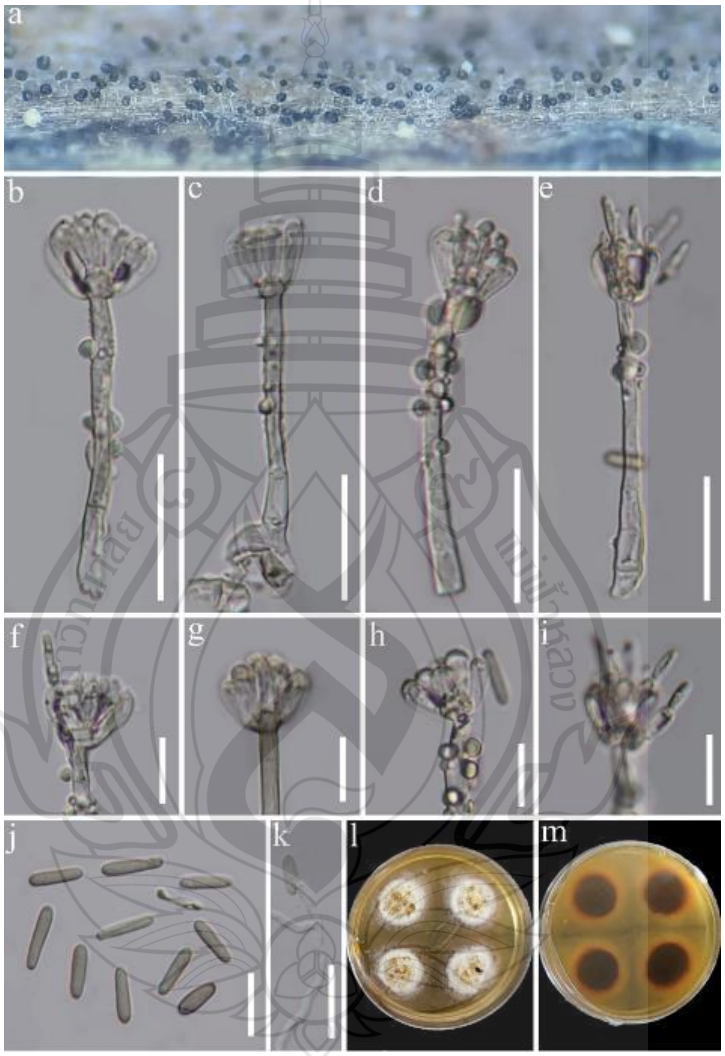
Material examined: CHINA, Guizhou Province, Guiyang City, on dead frond unidentified ferns in a terrestrial habitat, 1 June 2022, J.Y. Zhang, A13 (HKAS 129675), living culture KUNCC 23–13831.

Known hosts: Fern (this study), *Ilicis latifoliae* (Matsushima, 1975).

Distribution: China (this study), Japan (Matsushima, 1975).

Notes: *Sirastachys longispora* was introduced by Matsushima (1975), and only ITS sequence data is available for this species (Wang et al., 2015). There are no significant nucleotide differences between our new isolate and ex-type sequence data (AF081482) in the ITS region, with similarity of 99.47% (565/568 bp, with one gap). Morphologically, our new collection resembles *S. longispora* but shows slight

differences in having shorter conidiophores (34–60 µm) with attached multi sub-hyaline to golden guttulae at the surface, whereas *S. longispora* has 56–76 µm long conidiophores without guttulae attached the surface. These differences are insufficient to distinguish our new collection and *S. longispora*, we therefore identified this collection as *S. longispora*, which is new to ferns in China.



Note a Colonies on the host. b–e Conidiophores and conidiogenous cells. f–i Conidiogenous cells. j Conidia. k Germinated conidium. l, m Colonies on PDA from above and below. Scale bars: b–e, k = 20 µm, f–i = 10 µm

Figure 3.76 *Sirastachys longispora* (HKAS 129675)

Myrmecridiales Crous, Persoonia 34: 219 (2015)

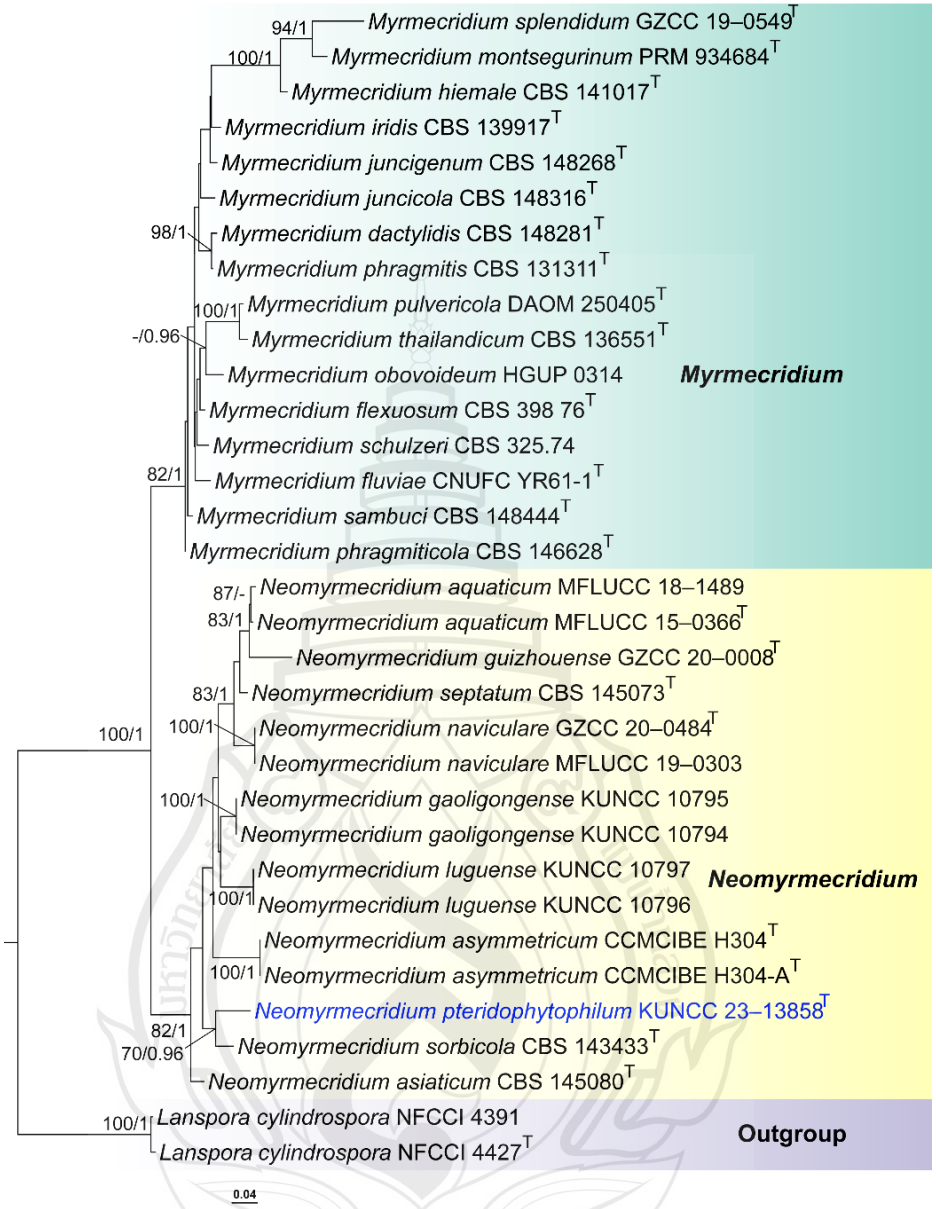
Myrmecridiaceae Crous, Persoonia 34: 219 (2015)

Neomyrmecridium Crous, in Crous et al., Persoonia 41: 287 (2018)

Index Fungorum number: IF828190; *Facesoffungi number*: FoF 10294; one species associated with pteridophytes; Figure 3.77

Type species: *Neomyrmecridium septatum* Crous

Notes: *Neomyrmecridium* was introduced as the second genus in Myrmecridiaceae (Myrmecridiales, Sordariomycetes, Ascomycota) by Crous et al. (2018a) to accommodate *Neomyrmecridium asiaticum*, *N. septatum* and *N. sorbicola*. Nine species with both morphology and molecular data were accepted in this genus (Xu et al., 2023b). The genus is characterized by unbranched, septate, medium brown conidiophores, polyblastic, terminal, denticulate conidiogenous cells andsubclavate to fusoid to ellipsoid, septate conidia with upper two-thirds usually encased in mucoid sheath (Crous et al., 2018a; Hyde et al., 2020d; Serrano et al., 2020; Yang et al., 2023). A synopsis including morphological characteristic, hosts and distribution of *Neomyrmecridium* species was provided by Xu et al. (2023b). These nine species can be found on dead bark and leaves of *Sorbus aucuparia*, *Theobroma cacao*, vine and unidentified plants from both freshwater and terrestrial habitats in China, Ecuador, Germany and Thailand (Hyde et al., 2020d; Xu et al., 2023b). In this study, we introduce *Neomyrmecridium pteridophytophilum* sp. nov., making the first link to fern for *Neomyrmecridium* species.



Note Phylogram generated from maximum likelihood analysis based on combined LSU and ITS sequence data. Bootstrap support values for ML equal to or greater than 70% and prior probabilities (PPs) equal to or greater than 0.95 are given above the nodes as ML/PP. The tree was rooted to *Lanspora cylindrospora* NFCCI 4391 and *L. cylindrospora* NFCCI 4427. Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.77 Phylogenetic tree of *Neomyrmecridium*

Neomyrmecridium pteridophytophilum J.Y. Zhang, K.D. Hyde & Y.Z. Lu, ***sp. nov.***

Index Fungorum number: IF 903201; *Facesoffungi number*: FoF 17054; Figure 3.78

Etymology: The species epithet "*pteridophytophilum*" reflects to the host of pteridophyte plant.

Holotype: GZAAS 23–0664

Saprobic on dead rachis of Pteridaceae in a terrestrial habitat. **Sexual morph:** undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, single, hairy, brown. *Mycelium* immersed, composed of, branched, septate, hyaline to pale brown hyphae. *Conidiophores* 150–224 × 2.7–4.9 μm ($\bar{x}$ = 185 × 3.7 μm), macronematous, mononematous, solitary, erect, straight or slightly flexuous, smooth, unbranched or branched rarely, cylindrical, septate, thick-walled, brown at the base, paler towards the apex. *Conidiogenous cells* 20–55.5 × 2.5–4(–4.5) μm ($\bar{x}$ = 35.8 × 3.2 μm), polyblastic, integrated, terminal, intercalary, denticulate, pare brown to subhyaline towards apex, sympodial. *Conidia* 8.5–11 × 3–4 μm ($\bar{x}$ = 10 × 3.7 μm, n = 20), obovoid, tapering at the base, 0–1-septate, not constricted at the septum, rough-walled, hyaline to pale brown.

Culture characteristics: Conidia germinating on PDA within 13 h. Colonies growing on PDA under natural light, reaching ca. 32 mm diameter in 15 days at 26°C, circular with filamentous margin, flat, brown, paler to subhyaline towards the margin, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Zunyi City, Chishui County, Hushi Town, Chishui Alsophila Natural Reserve, on dead frond stalks of Pteridaceae sp. in terrestrial habitats, 28 July 2022, J.Y. Zhang, BL9 (GZAAS 23–0664, holotype), ex-type living culture KUNCC 23–13858.

Notes: *Neomyrmecridium pteridophytophilum* is similar to *N. luguense* in having macronematous, septate conidiophores, polyblastic, denticulate conidiogenous cells producing obovoid, subhyaline to pale brown conidia tapering at the base (Xu et

al., 2023b). However, *N. pteridophytophilum* differs from *N. luguense* by its smaller (8.5–11 × 3–4 μm vs. 12–15 × 4–7 μm) and more septate [0–1 vs. (0–)2–3] conidia without a mucilaginous sheath, whereas *N. luguense* has conidia sometimes surrounded by a mucilaginous sheath (Xu et al., 2023b). In the phylogenetic tree (Figure 3.78) , *N. pteridophytophilum* nested within *Neomyrmecridium* and formed a distinct clade sister to *N. sorbicola*, reinforcing the notion that they are separate species.

Note a Colonies on the host substrate. b–e Conidiophores with conidiogenous cells. f–h Conidiogenous cells. i–m Conidia. n Germinated conidium. o, p Colony on PDA from above and below. Scale bars: b–e = 30 μm, f–h, n = 10 μm, i–m = 5 μm

Figure 3.78 *Neomyrmecridium pteridophytophilum* (GZAAS 23-0664, holotype)

Sporidesmiales Crous, Persoonia 40: 377 (2018)

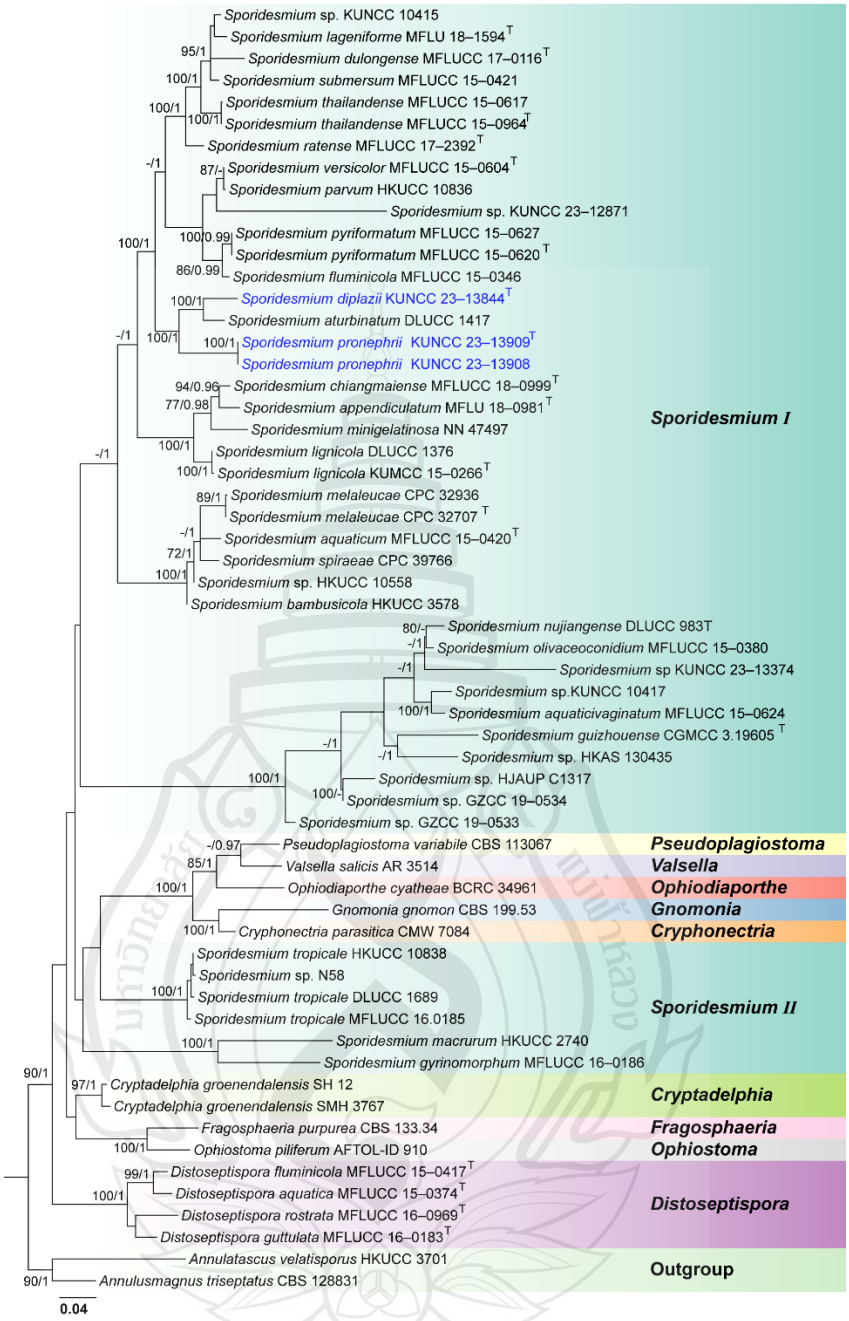
Sporidesmiaceae Summa veg. Scand., Sectio Post. (Stockholm): 504 (1849)

Sporidesmium Link, Mag. Gesell. naturf. Freunde, Berlin 3(1–2): 41 (1809)

Index Fungorum number: IF10024; *Facesoffungi* number: FoF 01750; two species associated with pteridophytes; Figure 3.79

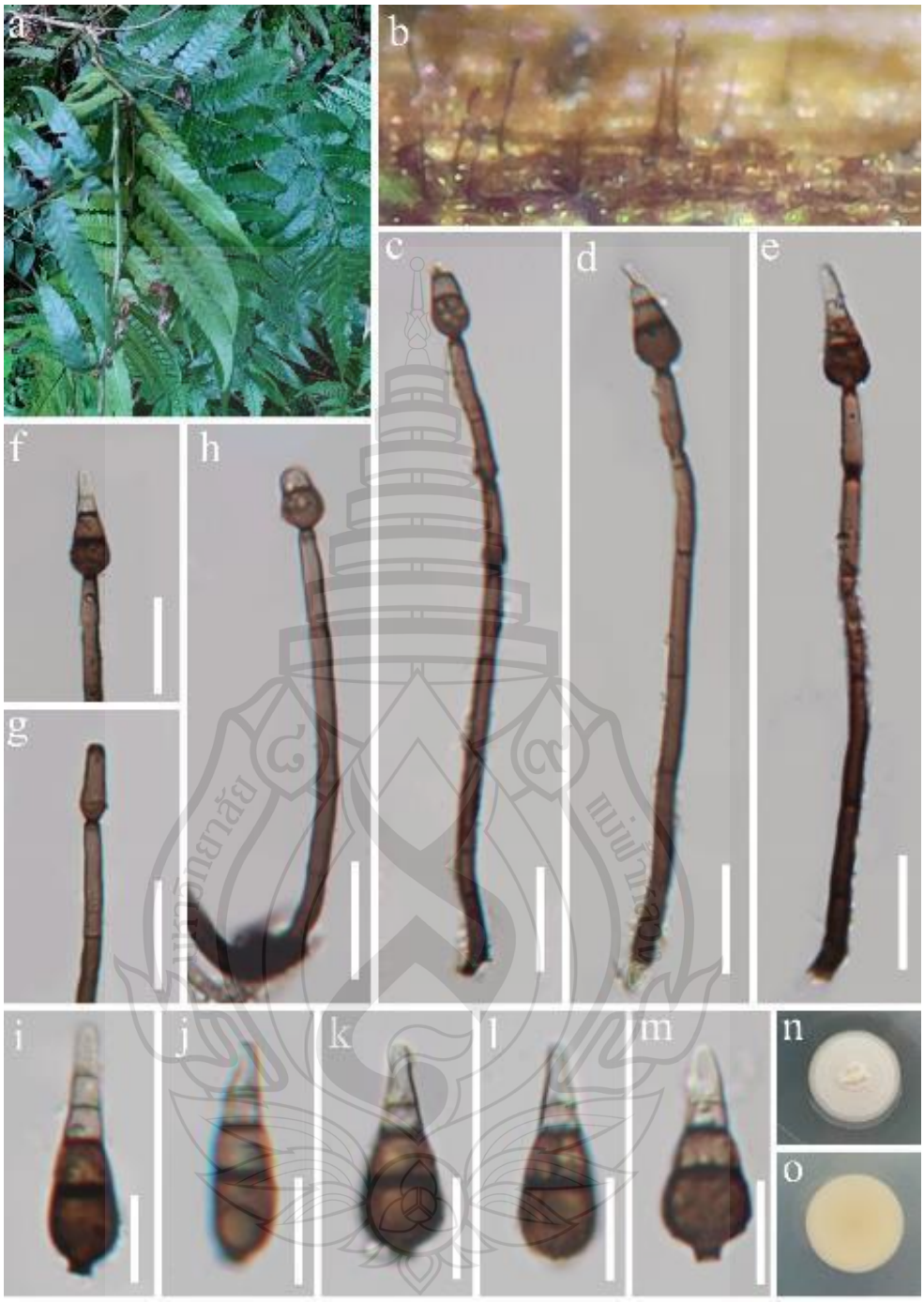
Type species: *Sporidesmium ehrenbergii* M.B. Ellis

Notes: Link (1809) introduced the genus *Sporidesmium*, with *S. atrum* as the type species. Shenoy et al. (2006) revealed that *Sporidesmium sensu lato* was polyphyletic across the Ascomycota. Su et al. (2016) subsequently restricted the genus to a monophyletic clade as *Sporidesmium sensu stricto*. Based on the morphological characteristics of conidiophores, conidiogenous cells, and conidia, several new genera have been segregated from *Sporidesmium*, such as *Distoseptispora*, *Ellisembia*, *Repetophragma*, and *Sporidesmiella* (Subramanian, 1992; Hernandez-Gutierrez & Sutton, 1997, Su et al., 2016, Liu et al., 2024). This genus is typical of hyphomycetes, characterized by macronematous, mononematous, erect or somewhat repent, cylindrical, brown, septate conidiophores, monoblastic, holoblastic, percurrent conidiogenous cells, and ovoid, obpyriform, or rostrate, euseptate or distoseptate conidia, with or without an appendage or mucilaginous sheath (Hernandez-Gutierrez & Sutton, 1997; Su et al., 2016; Yang et al., 2018; Luo et al., 2019, Hyde et al., 2020c). The genus is speciose, with 502 epithets listed in Index Fungorum (August 2024). These species are commonly found on various dead plant substrates worldwide but are not reported from pteridophytes. In this study, we introduced two new *Sporidesmium* species (*S. diplazii* and *S. pronephrii*) collected from ferns.



Note Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, *rpb2*, SSU and *tef1-α* sequence data. The tree was rooted to *Annulatascus velatisporus* HKUCC 3701 and *A. triseptatus* CBS 128831. Ex-type strains are marked with T after the strain number. The newly generated sequences are indicated in blue.

Figure 3.79 Phylogenetic tree of *Sporidesmium*



Note a The host. b Colonies. c–e, h Conidiophores with conidiogenous cells. f, g Conidiogenous cells. i–m Conidia. n, o Colony on PDA from above and below. Scale bar: c–h = 20 μm, i–m = 10 μm

Figure 3.80 *Sporidesmium diplazii* (HKAS 129687, holotype)

Sporidesmium diplazii J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903202; *Facesoffungi* number: FoF17055; Figure 3.80

Etymology: The species epithet "*diplazii*" reflects to the host genus *Diplazium.*

Holotype: HKAS 129687

Saprobic on dead stem of *Diplazium dilatatum* (Athyriaceae) in terrestrial habitat. **Sexual morph:** Undetermined. **Asexual morph:** Hyphomycetous. *Colonies* on natural substrate superficial, effuse, hairy, dark brown to black. *Mycelium* mostly immersed in the substratum, composed of septate, branched and brown with smooth hyphae. *Conidiophores* 85–120 × 2.7–4.6 µm ($\bar{x}$ = 104 × 3.6 µm, n = 25), macronematous, mononematous, solitary or sometimes in a small group, cylindrical, straight or slightly flexuous, with up to three successive profilerations, septate, dark brown and paler towards the apex. *Conidiogenous cells* 13–23 × 2.8–4.4 µm ($\bar{x}$ = 17 × 3.5 µm, n = 25), integrated, terminal, holoblastic, monoblastic, cylindrical and sometimes with percurrent proliferation through the scar. *Conidia* 18–28 × 7–9.3 µm ($\bar{x}$ = 22 × 8 µm, n = 25), acrogenous, solitary, dry, pyriform, rostrate, tapering to the apex, truncate at base, straight or slightly curved, 3–4-septate, slightly constricted at septa, two upper cells subhyaline to hyaline, lower cells brown and guttulate.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from the apex part of conidia. Colonies growing on PDA, grown slowly, reaching 15 mm diameter in 20 days at 25°C, circular, flat with entire margin, wrinkled and raised in the center, yeast-like, white, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Zunyi City, Chishui County, Swan Castle Forest Park, on dead stems *Diplazium dilatatum* (Athyriaceae), 28 July 2022, J.Y. Zhang, A66 (HKAS 129687, holotype), ex-type living culture KUNCC 23–13844.

Notes: Our new species, *Sporidesmium diplazii*, fits well with the generic concept and is most similar to *S. aturbinatum* and *S. pronephrii* in morphological

characteristics (Ellis, 1958; 1976, Bao et al., 2021, this study). However, the most notable feature of *S. diplazii* is its yeast-like colonies. In our phylogenetic analysis, *S. diplazii*, formed a distinct lineage within the genus and shared a sister relationship with *S. aturbinatum*. Furthermore, a comparison of the ITS gene region shows their difference. *Sporidesmium diplazii* differs from *S. aturbinatum* and *S. pronephrii* in 58 bp (89%, including 21 gaps) and 104 bp (81%, including 38 gaps) differences, respectively. Therefore, *S. diplazii* is described here as a new species based on morphology and phylogeny.

Sporidesmium pronephrii J.Y. Zhang, Y.Z. Lu & K.D. Hyde, *sp. nov*.

Index Fungorum number: IF 903203; *Facesoffungi number*: FoF 17056; Figure 3.81

Etymology: The species epithet "*pronephrii*" refers to the host genus.

Holotype: HKAS 129721

Saprobic on dead stem of *Pronephrium penangianum* (Thelypteridaceae) in terrestrial habitats. **Sexual morph:** Undetermined. **Asexual morph:** *Hyphomycetous*. *Colonies* on natural substrate superficial, effuse, hairy, dark brown to black. *Mycelium* mostly immersed in the substratum, composed of septate, branched and brown with smooth hyphae. *Conidiophores* 109–145.5 × 2.5–3.7 µm ($\bar{x}$ = 122.5 × 3 µm, n = 20), macronematous, mononematous, erect, solitary or in groups, solitary, straight or slightly flexuous, sometimes with knots, cylindrical, with up to three successive profilerations, septate, dark brown and paler towards the apex. *Conidiogenous cells* 9–20.5 × 2.5–4 µm ($\bar{x}$ = 14.7 × 3 µm, n = 20), integrated, terminal, holoblastic, monoblastic, cylindrical and sometimes with percurrent proliferation through the scar. *Conidia* 14.5–20 × 5.3–6.4 µm ($\bar{x}$ = 17.7 × 5.7 µm, n = 25), acrogenous, rarely pleurogenic, solitary, dry, pyriform, rostrate, tapering to the apex, truncate at base, straight or slightly curved, 3(–4)-septate, slightly constricted at septa, two upper cells subhyaline to hyaline, lower cells olive green to brown and guttulate.

Culture characteristics: Conidia germinating on WA within 12 h and germ tube produced from the apex part of conidia. Colonies growing on PDA, reaching 32 mm diameter in 14 days at 25°C, circular with slightly wavy margin, flat with a protuberance in the center, cream yellow, not producing pigmentation in culture.

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, on dead frond stalks of *Pronephrium penangianum* (Thelypteridaceae), 13 December 2021, J.Y. Zhang, J101 (HKAS 129721, holotype); ex-type living culture KUNCC 23–13909; *ibid*., J100 (HKAS 129720), living culture KUNCC 23–13908.

Notes: *Sporidesmium pronephrii* is similar to *S. aturbinatum* and *S. diplazii* in the shapes of microstructures. However, *S. pronephrii* has acrogenous and pleurogenic conidiogenous cells, while *S. aturbinatum* and *S. diplazii* have only acrogenous conidiogenous cell. Furthermore, *S. pronephrii* has longer and narrower conidiophores ($\bar{x}$ = 122.5 × 3 µm) compared to *S. aturbinatum* ($\bar{x}$ = 88.5 × 4.5 µm) and *S. diplazii* ($\bar{x}$ = 104 × 3.6 µm). Phylogenetically, two strains representing *S. pronephrii* sp. nov. formed a distinct clade, which shares sister relationship with the clade including *S. aturbinatum* and *S. diplazii*.

Note a The host. b Colonies on the host substrate. c–g Conidiophores with conidiogenous cells. h–k Conidia. l Germinated conidium. m, n Pure culture from above and below. Scale bars: c–e =20 μm, f–l = 10 μm

Figure 3.81 *Sporidesmium pronephrii* (HKAS 129721, holotype)

3.4 Conclusion and Discussion

3.4.1 Overall Conclusion

In this study, we obtained 111 new collections, which were collected from ferns in Guizhou and Yunnan province, southwestern China. These new collections are identified based on the evidence from morphology and phylogeny. In a result, these collections representing 59 species were distributed across four classes, 11 order, 22 families, and 39 genera within Ascomycota (Figure 3.82). This highlights the diversity of fern-associated fungi. Moreover, we introduced one new family, Xenoberkleasmiaceae, six new genera (*Cyatheomyces*, *Microlepicola*, *Muriformyces*, *Pseudopalawanella*, *Synnematouspora* and *Xenopleopunctum*), 38 new species, *viz*., *Achroiostachys equiseti*, *Arthrobotrys angiopteridis*, *Camposporium pteridicola*, *Codinaeella plagiogyriae*, *Corynespora septate*, *Crassiclypeus appendiculatus*, *Cyatheomyces synnematosa*, *Cyphellophora alsophilae*, C. *guizhouensis*, *C. multiseptata*, *Dictyochaeta diplopterygii*, *Dictyocheirospora guizhouensis*, *Equiseticola guizhouensis*, *Memnoniella discreta*, *M. pteridophytorum*, *Microlepicola guizhouensis*, *Monilochaetes guizhouensis*, *M. pronephrii*, *M. pteridophytophila*, *Myxospora synnematosa*, *Neomyrmecridium pteridophytophilum*, *Neopodoconis colorata*, *Nothodactylaria fusiformis*, *N. guizhouensis*, *N. polyblastis*, *N. woodwardiae*, *Oxydothis woodwardiae*, *Phragmocephala cyatheae*, *Pseudopalawanella woodwardiae*, *Sporidesmium diplazii*, *S. pronephrii*, *Synnematouspora pronephria*, *Thysanorea pronephrii*, *T. guttulate*, *Torula guizhouensis, T. woodwardiae*, *Xenopleopunctum guizhouensis* and *X. sporodochiale*, and 11 new host records, five new host and habitat records, three new host and geographical records, and one new terrestrial habitat record. Additionally, five new combinations are also proposed: *Muriformyces micronesiacum* (≡ *B. micronesiacum*), *M. nigroapicale* (≡ *B. nigroapicale*), *Xenoberkleasmium pandani* (*B. pandani*), *X. crunisia* (*B. crunisia*), *X. typhae* (≡ *B. typhae*). *Tainosphaeria phialogeniculata* is synonymized under *T. jonesii* based on conspecific phylogenetic relationship and similar morphology. *Periconia elaeidis* and *P. verrucosa* are synonymized under *P. cookei*. we report. A bar chart clearly shows the number of new taxa

(Figure 3.82).

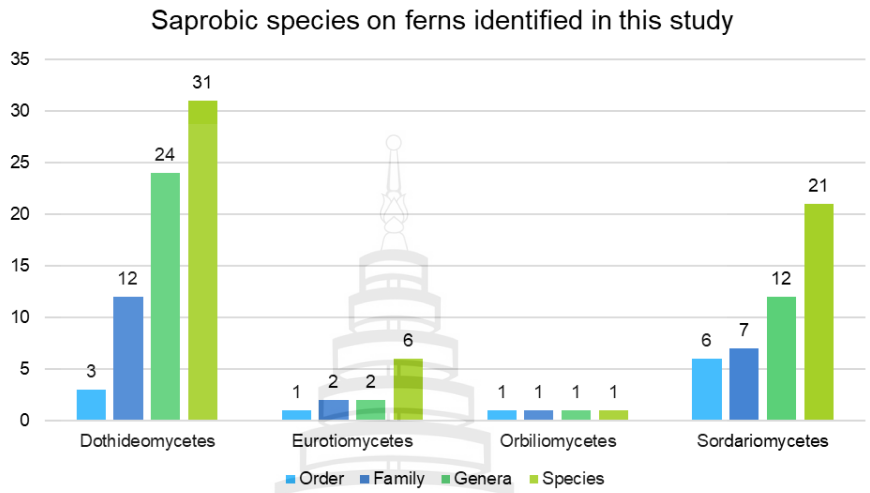


Figure 3.82 Saprobic species identified in this study

3.4.2 Lifestyle and Lifestyle Switching of Fungi Associated with Pteridophytes

Fungi can inhabit various substrates of pteridophytes, exhibiting different life patterns, including roots, stems, leaves, sporophytes, or gametophytic cells (Peterson et al., 1981; Del Olmo-Ruiz & Arnold, 2014; Petrini, 1992). Endophytic fungi spend all or part of their life cycle in the healthy tissues of plant hosts (Atsatt & Whiteside, 2014; Kumar et al., 2021; Bhunjun et al., 2024). However, when the host undergoes factors such as aging or a decline in vitality, the host's internal defenses are weakened, potentially leading to the onset of disease or a transition to a saprobic stage during fungal development (Fisher & Petrini, 1992; Langer et al., 2021). This transition involves one or more physiological alterations in lifestyle (Fisher & Petrini, 1992; Langer et al., 2021). The shift in life patterns indicates increased fungal adaptation to environmental and physiological conditions (Strobel, 2018). For instance, the endophyte *Stagonospora pteridiicola* extensively colonizes the fronds of *Pteridium aquilinum*, and is also found in dead bracken fronds as a saprobe (Fisher & Punithalingam, 1993; Fisher, 1996). The concept of "endophytic saprobe" is used to describe situations where the typical endophytic mode of life (without causing

disease symptoms) transitions to saprobic upon death of the plant (Fisher & Petrini, 1992; Fisher, 1996). Additionally, two known pathogens, *Aureobasidium pullulans* and *Stagonospora* sp., are dominant components of the endophytic mycota of *Pteridium aquilinum*, and are therefore considered candidates for use in the biological control of *Pteridium aquilinum* (Frankland, 1966, 1976; Petrini, 1992; Fisher & Punithalingam, 1993; Fisher, 1996). Notably, early researchers often struggled to accurately differentiate between saprobic fungi and parasitic fungi since they primarily focused on the fungi themselves rather than their interaction with the host (Gregor, 1938). However, as research on fungi advanced, it became evident that understanding fungi is inseparable from their impact on the host, leading to an increased emphasis on the relationship between fungi and hosts (Gregor, 1938; Antonovics, 2020; Mehltreter, 2010). Next, we provide an explanation of endophytic fungi, saprobic fungi, and pathogenic fungi associated with pteridophytes.

3.4.2.1 Endophytic fungi associated with pteridophytes

Endophytes, which are endosymbiotic microbiota, are microorganisms that colonize the internal tissues of healthy plants without causing any direct, noticeable negative effects (Hyde & Soytong, 2008; Rashmi et al., 2019). Endophytic fungi synthesize bioactive compounds with significant potential in anti-cancer, hypoglycemic, biocontrol, plant growth promotion, bio-fertilization, immunosuppression, and insecticidal activities (Strobel & Daisy, 2003; Gautam & Avasthi, 2019; Fadiji & Babalola, 2020; Kumar et al., 2021; Pecundo et al., 2021). These compounds hold exceptional promise for drug development and potential applications in the medicine, agriculture, food, and cosmetics industries (Strobel & Daisy, 2003; Gautam & Avasthi, 2019; Kumar et al., 2021).

While research on endophytic fungi has become a popular trend and is one of the most widely studied fungal groups, the focus has mainly been on angiosperms, followed by gymnosperms (Schulz et al., 2002; Wiyakrutta et al., 2004; Rashmi et al., 2019;). Research on endophytic fungi associated with pteridophytes is quite limited (Schulz et al., 2002; Wiyakrutta et al., 2004; Younginger & Ballhorn, 2017; Rashmi et al., 2019), despite the availability of abundant information about the mycorrhizal symbionts of ferns and their

allies (Hepden, 1960; Zhao, 2000; Zhang et al., 2004; Kessler et al., 2014; Pressel et al., 2016). An exception is the fern species bracken (*Pteridium aquilinum*), which was systematically studied early in the UK (Petrini, 1992; Fisher & Punithalingam, 1993; Fisher, 1996). There are also some endophytes isolated from pteridophytes. For example, Kumaresan et al. (2013) reported 40 fungal endophytes from five species of pteridophytes, and four new endophytic *Apiospora* species were isolated from medicinal fern plants of three *Dicranopteris* species in Guizhou, China (Zhang et al., 2023a). Furthermore, both ferns and endophytes achieve maximum diversity in tropical forests (Uetanabaro et al., 2009; Kumaresan et al., 2013; Del Olmo-Ruiz & Arnold, 2017). Dreyfuss and Petrini (1984) conducted the first study of endophytes from tropical ferns, investigating the mycota with 23 fungal species from tropical ferns based on examining five fern species in Brazil and Colombia. Later, Samuels and Rogerson (1990) reported some ascomycetes occurring on tropical ferns. Subsequently, Del Olmo-Ruiz and Arnold (2014) carried out a study on the incidence, diversity, community composition, interannual variation, and host affiliations of endophytic fungi associated with healthy aboveground tissues of seven fern species in Costa Rica, which indicated that the dominated fungal group was Sordariomycetes, mainly limited to Xylariomycetidae. Notably, a high diversity of endophytic fungi is found on pteridophytes (Del Olmo-Ruiz & Arnold, 2017; Cook & Taylor, 2023).

Endophytes in pteridophytes exhibit a certain degree of host-, organ- or tissue-specificity or preferences (Del Olmo-Ruiz & Arnold, 2014), but, the species composition and frequency are significantly influenced by site-specific conditions (Petrini et al., 1993). For example, the endophyte *Stagonospora pteridiicola* demonstrates a host preference for extensively colonizing the fronds of *P. aquilinum*, rather than colonizing the leaves of other sympatric ferns or flowering plants (Fisher & Punithalingam, 1993; Fisher, 1996). Similarly, *Aureobasidium pullulans* has been observed to preferentially colonize the leaf rachis and veins (Mehltreter, 2010). It is important to note that low host-specificity of endophytic fungi is observed in ferns and their allies, and several studies have demonstrated this in some tropical ferns and epiphytic ferns (Del Olmo-Ruiz & Arnold, 2017; Cook &

Taylor, 2023). Petrini (1992) obtained fungal endophytes isolated from bracken (*Pteridium aquilinum*) in moorland or woodland sites, revealing a weak organ specificity of the endophyte communities, and no significant difference in patterns of seasonal succession or endophyte community composition between the two sites. The organ-specificity of endophytic fungi results from certain endophytes adapting to particular microbial and physiological conditions present in a given organ (Sieber, 1989; Fisher & Petrini, 1992; Petrini, 1992; Petrini et al., 1993).

Verified findings for the fern species of bracken (*Pteridium aquilinum*) indicate that the endophytic community of the rhizome differs from that of the aboveground part; in contrast, the endophytic communities of the pinnae, rachis, and veins of bracken appear very similar, with only specific species being more abundant in particular organs (Petrini, 1992). For example, the pinnules are most commonly colonized by *Stagonospora* sp., whereas the rachis and leaf veins are often inhabited by *Aureobasidium pullulans* and *Cladosporium tenuissimum* (Petrini, 1992). These fundings provide evidence suggesting organ-specificity in pteridophytes. Moreover, several interesting studies have been conducted on aquatic hyphomycetes as root endophytes from pteridophytes (Raviraja et al., 1996; Sati & Belwal, 2005; Sati et al., 2009).

As mentioned in the introduction, pteridophytes are rich in active chemical substances or secondary metabolites, making them a major potential source for new drugs and contributing significantly to human health. The unique phytochemical profiles of pteridophytes have attracted significant attention as a valuable resource for drug discovery and development (Anishmon & Thomas, 2005; Singh et al., 2010; Goswami et al., 2016; Srivastava & Paul, 2016; Wani et al., 2016; Baskaran et al., 2018b; Zaman et al., 2019). Furthermore, it is recognized that endophytic fungi have significant potential to discover or synthesize more bioactive compounds, mimicking the structure and function of host compounds (Stierle et al., 1993; Stierle et al., 1995; Rashmi et al., 2019; Rana et al., 2020). The exploration of endophytic fungi associated with pteridophytes holds great promise for identifying novel bioactive compounds with therapeutic potential, thereby expanding the

scope of natural product-based drug research and development (Kumaresan et al., 2013). Therefore, the synergy between endophytic fungi and pteridophytes is expected to present an exciting avenue for advancing the discovery and production of pharmaceutical compounds with diverse applications in medicine.

3.4.2.2 Saprobic fungi associated with pteridophytes

Saprobic fungi from pteridophytes, as decomposers, feed on dead or decaying organic material, participate in nutrient cycling, and help to maintain a sustainable ecosystem of plants sharing the same habitat (Setälä & McLean, 2004; Kubartová et al., 2009; Cook & Taylor, 2023). These fungi do not adversely affect the lifespan of pteridophytes and are therefore often overlooked, providing a great opportunity to discover new and interesting fungi while studying saprobic fungi (Mehltreter, 2010; Kirschner et al., 2019). This suggestion has been supported by several subsequent studies. For example, Holm and Holm (1978) provided descriptions of 16 pteridicolous Ascomycetes, including new or noteworthy species, based mainly on material examination. Kirschner et al. (2019) detailed new findings on ferns in Taiwan Province, China, from a fungal group in the order Helotiales (Ascomycota), which is ecologically defined as a specific humus decomposer of dead plant material.

A comprehensive five-year-long case study was carried out in the UK to investigate the decomposition of bracken (*Pteridium aquilinum*) petioles aided by fungi in six adjacent soil types (Frankland, 1966, 1969, 1976). These studies analyzed changes in gross physical features, chemical composition, pH and dry weight. It was also the first detailed study of fern decomposers. The succession of some common fungi on petioles of bracken revealed cellulose- and lignin-decomposers predominated before sugar fungi: Hyphomycetes + (Sphaeropsidales -- Basidiomycetes -- Phycomycetes) (Frankland, 1966). The fungal succession on *Pteridium aquilinum* differs from that of other plants, exhibiting characteristics of both woody and non-woody substrates (Frankland, 1976). Furthermore, the research attributed the chemical changes in bracken to the activity of certain dominant fungi, such as *Aureobasidium pullulans*, *Mucor hiemalis* and *Mycena galopus* (Frankland,

1966, 1969, 1976). This provides additional evidence for the role of cellulose and/or lignin decomposers followed by sugar fungi in the succession of the most abundant fungi (Frankland, 1966). In addition, a checklist of fungal species recorded on decomposing petioles of bracken was provided (Frankland, 1976), and the species *Mycena galopus* was highlighted for its important role as the most vigorous decomposer of cellulose and lignin in bracken (Frankland, 1966, 1969, 1976). Subsequently, Singh (1970) also provided a study on the succession of fungi on decaying leaves of some pteridophytes. A brief overview of the substrates and agents of decomposition of pteridophytes was provided by Frankland (2012), mainly based on the research related to bracken (*Pteridium aquilinum*) (Frankland, 1966, 1969, 1976). Recognizing that the ecological and potential economic value of bracken depends on the properties of its litter rather than the living plant (Frankland, 1976, 2012), it is essential to explore and study the succession processes of species closely associated with litter decomposition. Notably, this can also provide new ideas for controlling the decomposition of bracken litter, which has become a serious weed in Europe and New Zealand (Stevenson, 1945). Given the integral ecological role of ferns as mentioned above, understanding the saprobic fungi on ferns can help us better understand the dynamics and complex ecological interactions of forest ecosystems.

3.4.2.3 Pathogens associated with pteridophytes

Pteridophytes can be subject to infection from a variety of fungal pathogens, leading to various symptoms such as tissue rot, spots, wilting, and discoloration (Mehltreter, 2010; Smith, 2015; Rai & Agarkar, 2016; Kirschner et al., 2019; Seifollahi et al., 202). For example, *Pellicularia koleroga* has been noted to cause “Koleroga” disease on ferns in tropical and subtropical regions (Stevenson, 1945); *Inocyclus angularis* has been observed to cause tar spots on ferns in Brazil (Guatimosim et al., 2014b); *Desmella*, *Hyalopsora*, *Milesina* and *Uredinopsis* are the main fungal genera that cause rust disease worldwide (Helfer, 2006; Ono, 2020; Kabaktepe & Akata, 2023); *Completoria complens* and *Rhizoctonia solani* have been found to lead to “damping-off” or Rhizoctonia blight, causing infected tissues to become blackened and die (Stevenson, 1945; Kannaiyan & Kumar, 2005;

Lee et al., 2011); *Alternaria* sp. infects *Polypodium* in a Canadian greenhouse, causing lesions on fronds and stems (Stevenson, 1945); Forty-four cercosporoid species are associated with frond spot symptoms of *pteridophytes* worldwide, including 13 *Cercospora* spp., two *Passalora* spp., 28 *Pseudocercospora* spp. and one *Zasmidium* sp. (Braun et al., 2013); anthracnose disease caused by *Colletotrichum gloeosporioides* affects *Lygodium microphyllum* and *L. japonicum* in the USA (Jones et al., 2003).

Even though most pathogens can be controlled by fungicides, they have a relatively significant impact on fern horticulture (Norman & Strandberg, 2012). Based on fern aesthetics, fern horticulture plays an important role in poverty alleviation due to its economic value (see the introduction for more details) (Ranil et al., 2005; Singh et al., 2010; Ranil et al., 2015; Singh & Johari, 2018). Notably, *Rumohra adiantiformis* is the most common fern used in floral arrangements due to its long shelf life and distinctive shape and color (Kloepper et al., 2010). However, this plant is widely affected by pathogens of *Colletotrichum* spp., which are the most significant diseases affecting *R. adiantiformis*, resulting in leaf spots and others severe anthracnose (Strandberg, 1999; Norman & Strandberg, 2012). Current antifungal measures have not shown significant effectiveness in controlling it (Strandberg, 1999; Norman & Strandberg, 2012). Similarly, the Boston fern (*Nephrolepis exaltata*), widely used for interior decoration, also suffered from pathogens of anthracnose group (Stevenson, 1945b; Mehltreter, 2010).

Additionally, we listed the top ten genera comprising species that occurred most frequently on pteridophytes, namely *Cercospora*, *Hyalopsora*, *Lachnum*, *Milesina*, *Phaeosphaeria*, *Pseudocercospora*, *Ramularia*, *Taphrina*, *Uredinopsis* and *Uredo*, all of which are well-known pathogens. Detailed notes on these ten genera, including their taxonomic attributes, phylogenetic relationships, ecological issues, and redrawn photo plates for each genus, are provided. Among them, the genera *Hyalopsora*, *Milesina* and *Uredinopsis* consist of obligately parasitic fungi, which are also known as fern rust fungi (Smith, 2015). Notably, the group of rust fungi is an important part of pteridophyte pathogens. *Desmella*, though not included in these top ten genera, is another rust genus that

includes species specialized in parasitizing ferns (Faull, 1947; Ono, 2020; Cummins & Hiratsuka, 2003). Detailed notes and redrawn photoplates have been provided (in the Result section 2.1). In summary, rust fungi on ferns can be mainly grouped into two to four main categories within the order Pucciniales: in Pucciniaceae, where *Desmella* is located, there are no known alternate hosts (Faull, 1947; Hennen & Ono, 1978; Cummins & Hiratsuka, 2003; Helfer, 2006; Ono, 2020; Okane et al., 2021); and in the suborder Melampsorineae, *Milesina*, and *Uredinopsis* within Milesinaceae, as well as *Hyalopsora* in Puccinastraceae (Aime & McTaggart, 2021; Wang et al., 2021), are rust fungi that alternate hosts between ferns and *Abies* spp. (Hiratsuka, 1958; Ji et al., 2018; Bennell & Henderson, 1985; Cummins & Hiratsuka, 2003; Tănase & Negrean, 2007; Bubner et al., 2019).

In some cases, parasitic fungi on pteridophytes can aid in the identification of the species of pteridophyte species, based on the host-specificity of parasitic fungi, such as rust fungi (Bennell & Henderson, 1985; Mehltreter, 2010). Braun et al. (2013) have gathered data on cercosporoid hyphomycetes, which are primarily plant parasites of pteridophytes found worldwide, by compiling information from literature and herbariums. Moreover, cercosporoid fungi are known for their host specificity, typically identified by comparing their morphology with congeneric species found within the same host genus or family (Crous & Braun, 2003; Braun et al., 2013; Hongsanan et al., 2020a).

Oberwinkler (1994) speculated that there are relatively fewer pathogens on pteridophytes, without involving quantitative assessment. Until recently Antonovics (2020) verified that fern plants exhibit higher resistance compared to Angiosperms and contain fewer pathogenic fungi. The expanded research later conducted verified the hypothesis that older host lineages have fewer pathogens compared to younger host lineages by examining the disease rates of fungal pathogens in fern families of different origin times over a span of 300 million years (Antonovics, 2023). The reasons behind the phenomenon of fewer pathogens are not clear, but two important conjectures have been proposed: (1) Based on the hypothesis that pathogen diversity depends on host diversity, fern plants show a decline in species richness in older evolutionary clades (Rabosky et al., 2012); (2) Older lineages

have evolved resistance to these plant groups over a longer period of time. More details and discussions on the diversity of fungal pathogens on ferns are provided (Antonovics, 2020, 2023).

Given that common plant pathogens in higher plants, such as downy or powdery mildews have not been found in ferns, a major upcoming task is to combine genome sequencing of ferns and to further explore the identification of resistance-related genes for different pathogen lineages. This aims to comprehend the molecular basis of stronger resistance (Antonovics, 2020, 2023). Such knowledge holds great significance for the development of effective measures for disease prevention and control. Therefore, studying fungal pathogens in pteridophytes contributes to the preservation of these plant resources and advances the conservation of rare species of ferns and fern allies. Additionally, this study discusses pteridophytes pathogens, focusing on dominant pathogen groups while providing detailed notes, offering significant insights into the dominant pathogens in the biological control of fern weeds (such as *Pteridium aquilinum* in Europe) (Fisher & Petrini, 1992; Hutchinson, 1976).

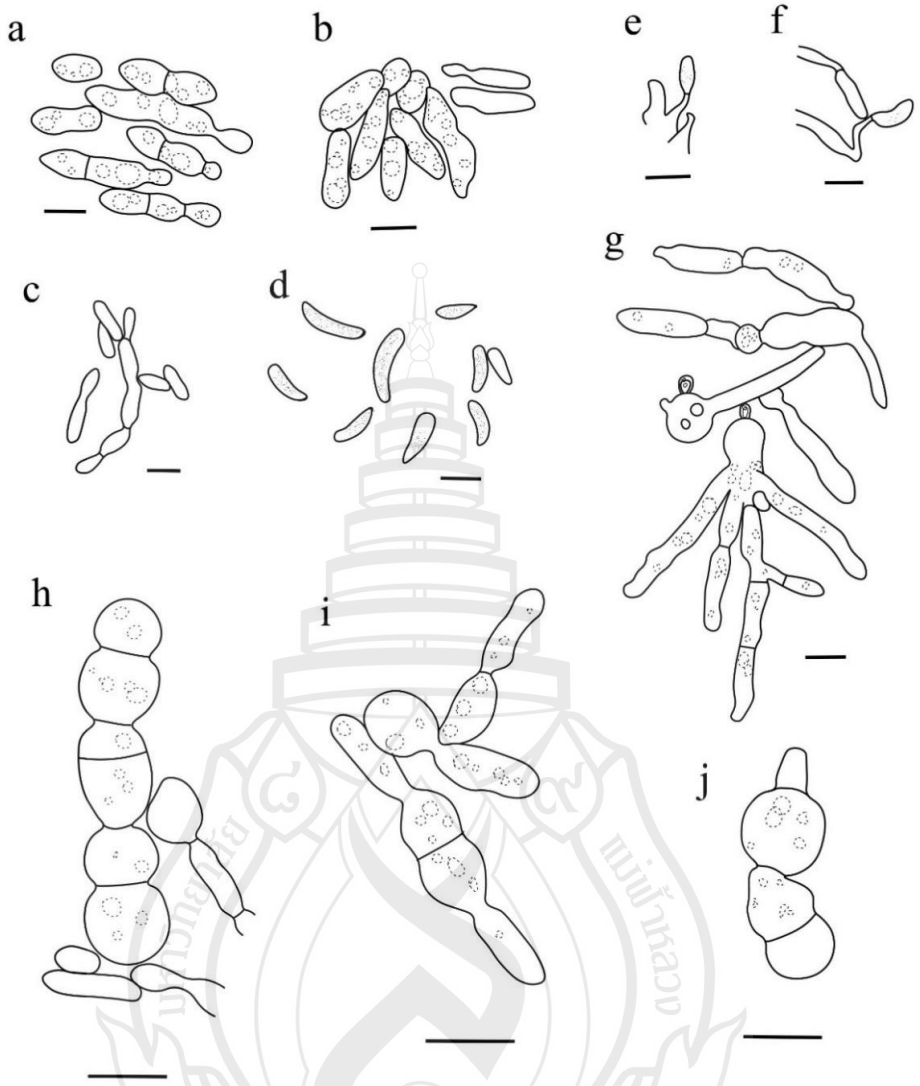
3.4.3 Host-jump of Fungi Associated with Pteridophytes

There is some evidence to suggest that the phenomenon of-host jumping is present in pteridophytes-related fungi. Some fungi transfer from other hosts, or some fungi jump from pteridophytes to other hosts. For instance, in phylogenetic analyses, *Pseudocercospora* species occurring on ferns and seed plants show a scattered distribution (Kirschner & Liu, 2014; Kirschner et al., 2019). This might indicate frequent host jumping in the process of speciation rather than co-speciation with the host plants (Kirschner & Liu, 2014). Host jumps greatly shape the diversity of species (Zhou & Hyde, 2001; McTaggart et al., 2016).

A case of monotypic genera can be illustrated in detail. *Violaceomyces* was introduced as a monotypic genus in Violaceomycetaceae (Violaceomycetales, Ustilaginomycetes) by Albu et al. (2015) to accommodate *Violaceomyces palustris* based on morphology and phylogeny. *Violaceomyces* is only known from its type species, and is

characterized by fast-growing colonies producing many two-celled yeasts that were distinctly hourglass or peanut-shaped, and occurred singly or in chains and copious ballistoconidia forming pseudohyphae (Figure 3. 83; Albu et al., 2015). *Violaceomyces palustris* was obtained from many collections mainly in aquatic ecosystems, including *Salvinia* spp., mosquito fern (*Azolla caroliana*), duckweed (*Spirodela polyrrhiza*), an elm seedling (*Ulmus* sp.), American spongeplant (*Limnobium spongia*), and common aquatic plants. It showed a host preference for *Salvinia*, including *S. minima* and *S. molesta*, which are two species of fern. An ecological consideration is that all of these hosts are in direct contact with *Salvinia*, except for the host *Ulmus* sp, where a mat of *Salvinia* was formed directly below the sampled host in the same spatial area (Albu et al., 2015). This strongly suggests that *Violaceomyces palustris* may have undergone host jumping, speculating that *Salvinia* is the original host and later transferred to other plants in the same area.

It is worth noting that host jumping often accompanies a switching in lifestyle, as it is said that fungi based on host-specific endophytes can live asymptomatically inside their host and transition to a saprobic lifestyle after the death of the plant (Fisher & Petrini, 1992; Langer et al., 2021; Bhunjun et al., 2024). In the latter case, the fungus can be more broadly and equally distributed to other plants in the habitat. We have detailed 36 genera with host-specificity, and a significant portion of these was discovered as saprobic fungi based on multiple specimens (such as *Dangeardiella, Pleurothyrium, Poculopsis* and *Rommelaarsia*) indicating that this is not a coincidental phenomenon. Given the close relationship with specific fern hosts, we hypothesize that it is possible that some of these were originally endophytic fungi. More research is needed in the future to validate the relationship between these hosts and fungi.



Notes *Violaceomyces palustris*. **a, b** Primary yeast cells with vacuoles and lipid bodies in PDB. **c** Yeast cells growing in a chain with lateral budding. **d** Ballistoconidia after sporulating plate **e, f** Ballistoconidia on sterigmata before discharge. **g** Two-celled yeasts with reduced cell and evacuolated cytoplas. A network of filaments is emanating from the larger cell. **h** Two-celled yeast with central septum germinating at both poles. **i** Three catenulate two-celled yeast. **j** Two-celled yeast. Bar = 10 μm. Redrawn from Albu et al. (2015).

Figure 3.83 *Violaceomyces palustris*

3.4.4 Molecular Clock Analysis in This Study

Justifying the age and phylogenetic position of key fossils is vital for calibrating divergence dating nodes and applying divergence times in classification (Liu et al., 2017). During molecular clock analyses within Dothideomyctes, even Ascomycota, the fossil Metacapnodium succinum (Metacapnodiaceae) has frequently been used as a calibration to calibrate the minimum age of Capnodiales (Dothideomyctes, Ascomycota) (Mapook et al., 2016a; Phukhamsakda et al., 2016; Liu et al. 2018a; Zhang et al., 2019; Hongsanan et al., 2020a; Bhunjun et al., 2021). However, Faezeh (2024) has demonstrated that Metacapnodiaceae was placed in Eurotiomycetes, indicating that this fossil *Metacapnodium* specimen has been improperly used to estimate the age of Capnodiales. Therefore, it is likely that improving divergence times estimates of Dothideomyctes or Ascomycota is necessary. Our study serves as one of the initial efforts by selecting three fossils, excluding the fossil *Metacapnodium succinum*, which possess reliable minimum ages and suitable fossil justifications (Samarakoon et al., 2019a). Note that this does not negate the prior research that used *Metacapnodium succinum* as a calibration point; the findings from earlier studies still possess certain referential value. This is due to the fact that there are typically additional calibration points, which facilitate mutual calibration among them. In addition, the selection of taxa and their richness within the group, the net diversification rate, the timescale, and the model configuration can also influence the estimation of divergence time (Zwickl & Hillis, 2002; Pollock et al., 2002; Liu et al., 2017). Therefore, it is considered reasonable for divergence times to vary within a small range across different studies.

In this study, the split between Arthoniomycetes and Dothideomycetes occurred around 265 (224-313) MYA during the Permian period based on the MCC tree (Figure 3.17), which the crown age is estimated at 253(219-292) during the Late Permian period as well. This result almost consistent with the result provided by Liu et al. (2018a) with estimating the crown age as 255 (166–344) MYA in Late Permian. For Pleosporales, the crown and stem ages are estimated at 192 (161–229) and 233 (200–272) MYA,

during the early Jurassic and Triassic periods, which is line with recommendations for ranking order status (Hyde et al., 2017; Liu et al., 2017). This is also similar to the results of previous studies (Liu et al., 2018a; Liu et al., 2017; Zhang et al., 2019; Bhunjun et al., 2021; Phukhamsakda et al., 2016). Among the new taxa proposed in this study, two genera namely *Cyatheomyces* and *Pseudopalawanella* are introduced within Muyocopronaceae, Muyocopronales. Muyocopronales/Muyocopronaceae diverged with Palawaniaceae in the Jurassic period (about 179 MYA), and the crown age is around 146 (119-178) MYA. Mapook et al. (2016a) conducted a study, resulting in the divergence time estimate of Muyocopronales is 52 MYA (Crown age). The crown group comprises the living species along with their ancestors, extending back to their most recent common ancestor and including all of that ancestor's descendants (WIKIPEDIA: https://en.wikipedia.org/wiki/Crown_group). This means that the selection of taxa and their quantity within a group has a significant impact on the crown age (Zwickl & Hillis, 2002; Pollock et al., 2002). This is the most important cause the substantial difference in results compared to the study of Mapook et al. (2016a), as our sampling of Muyocopronales far exceeded former. Furthermore, the stem age is generally consistent with previous studies (Hongsanan et al., 2020a; Mapook et al., 2016a), providing evidence for the reliability of our research. Similarly, we introduce two new genera, *Muriformyces* and *Synnematouspora*, within the family Lentimurisporaceae. The estimated ages for this family are 65 (39-96) for crown age and 120 (97-145) for stem age. These estimates are earlier than those reported in the original analysis by Liu et al. (2018) but still align with the family's status as proposed by Hyde et al. (2017) and Liu et al. (2017). The new family Xenoberkleasmiaceae shares the most common ancestor with Hypsostromataceae and is estimated approximately 38 (21–58) MYA (crown age) during the Eocene, with a stem age of approximately 96 (71–124) MYA Cretaceous period. The estimates for Xenoberkleasmiaceae are also consistent with the recommended divergence times between 20–100 Mya (crown age) and 50–150 MYA (stem age) (Hyde et al., 2017; Liu et al., 2017).

CHAPTER 4

MORPHO-MOLECULAR CHARACTERIZATION OF CULTURABLE ENDOPHYTIC FUNGI ASSOCIATED WITH *DICRANOPTERIS* SPP (MEDICINAL FERNS)

4.1 Introduction

Endophytic fungi inhabit healthy plant tissues without causing any visible disease symptoms in their hosts, forming a mutualistic relationship with the plant (Petrini, 1990; Saikkonen et al., 1998; Azevedo et al., 2000; Saikkonen et al., 2004). These fungi occupy a distinctive ecological niche, residing within plants for extended periods. They depend on nutrient extraction from the host plant to sustain their growth (Abeywickrama et al., 2023). In return, they produce specific metabolites that not only promote the plant's growth and development but also significantly boost the plant's resistance to both biotic and abiotic stresses (Gao et al., 2010; Bhardwaj et al., 2014; Fontana et al., 2021; Poveda et al., 2021). One particularly important role of endophytic fungi is their ability to synthesize metabolites within the host plant, which can greatly impact the quality of medicinal plants (Jia et al., 2016). In recent years, researchers have isolated bioactive secondary metabolites from the endophytic fungi of various medicinal plants, which are either identical or very similar to those produced by the host plants (Zhao et al., 2010, 2011; Kusari et al., 2013; Palanichamy et al., 2018), such as yew (Stierle et al., 2000; Tayung et al., 2011; Rivera-Orduña et al., 2011; Somjaipeng et al., 2015; Khan et al., 2022). This discovery has vastly expanded the potential of natural pharmaceutical resources. Additionally, the tremendous biological diversity of endophytic fungi allows them to produce a wide variety of secondary metabolites with unique structures and activities, including antibacterial, anti-tumor, stress resistance, insecticidal, immune-regulating, and antiviral properties (Schulz et al., 2002; Kaul et al., 2012; Patil et al., 2016; Ratnaweera et al., 2017; Meena et al., 2019; Ancheeva et al., 2020). These compounds create a vast natural product library that continues to inspire and drive innovation in pharmaceutical development (Patil et al., 2016; Uzma et al., 2019).

Endophytes, with their remarkable adaptability, exhibit a range of behaviors, including saprobic and pathogenic, and may shift between these roles depending on environmental conditions and host interactions (Sturz et al., 2000; Newsham et al., 2011; De Silva et al., 2017; Bhunjun et al., 2023). Under specific environmental or physiological stresses, endophytes can transit their life modes from beneficial symbionts to pathogens or saprobes (Fisher & Petrini, 1992; Promputtha et al., 2007; Hilári & Gonçalves, 2023; Wang et al., 2024) as saprobes, they begin decomposing dead or decaying organic matter, particularly when plant tissues die, thereby recycling nutrients back into the ecosystem (Promputtha et al., 2007; Rodriguez et al., 2008). On the other hand, endophytes may adopt a pathogenic role when the host plant experiences stresses, such as nutrient deficiency or drought, allowing them to proliferate within plant tissues and potentially cause disease symptoms (Newsham et al., 2011). This shift is driven by a combination of environmental factors and intriguing genetic interactions between the host and the endophyte (Photita et al., 2004; Promputtha et al., 2007; Hardoim et al., 2015). For example, *Neotyphodium* species typically have a mutualistic relationship with grasses, and can become harmful under stressful conditions (Yao & Liu, 2012). This remarkable adaptability enables endophytes to navigate between beneficial and harmful states, allowing them to occupy diverse ecological niches and respond flexibly to changes in their environment.

In recent years, the diversity of endophytic fungi found in medicinal plants has become a hotpot of research; numerous studies on endophytic fungi from medicinal plants have been conducted (Huang et al., 2008; de Siqueira et al., 2011; Bhagat et al., 2012; Mishra et al., 2021; Hussein et al., 2024). Endophytes, as a novel type of microbial resource, they offer unique opportunities for the discovery of new bioactive compounds (Schulz et al., 2002; Kumar et al., 2012; Liu et al., 2018; Ancheeva et al., 2020). Via in-depth studies of plant endophytes, researchers are not only uncovering new antibacterial agents effective against drug-resistant bacteria and valuable natural products such as anti-tumor compounds but also addressing challenges like the scarcity of medicinal plant resources and long growth cycles (Jia et al., 2016). Therefore, harnessing the symbiotic relationship between endophytes and host plants and their beneficial effects on plant metabolism by isolating and screening endophytes that produce highly active compounds from abundant plant resources has become an

important pathway for developing new drugs that are low in toxicity, environmentally friendly, and highly effective. This approach enriches the natural drug reservoir and addresses the issue of limited medicinal plant resources.

Dicranopteris is one of the medically important ferns with significant pharmacological properties (Li et al., 2006, 2007; Zakaria et al., 2008; Chen et al., 2014; Thomas et al., 2023). The genus comprises 12 species belonging to the family *Gleicheniaceae* (Yang et al., 2021). They are widely distributed in tropical and subtropical regions of the world (Zhao et al., 2012; Xu et al., 2014; Yang et al., 2021). *Dicranopteris* is drought-resistant, highly acidic, extremely adaptive to its environment, and grows spontaneously. It serves as an indicator plant for acidic soil and contributes to maintaining soil and water quality. *Dicranopteris* is rich in active compounds such as flavonoids, terpenes, saponins, phenolic derivatives, and polysaccharides, which exhibit various pharmacological activities including antioxidant, anti-cancer, antibacterial, anti-inflammatory, anti-HIV, and analgesic properties (Li et al., 2006, 2007; Zakaria et al., 2006, 2011; Chen et al., 2014; Kale, 2015; Aboshoufa et al., 2019; Bahardduin et al., 2021; Thomas et al., 2023). *Dicranopteris* holds significant therapeutic value and is used in traditional medicine to remove blood stasis, stop bleeding, clear heat, promote diuresis, and reduce edema (Li et al., 2006, 2007; Zakaria et al., 2006, 2008; Kale, 2015). Current research on *Dicranopteris* focuses primarily on its ecological and pharmacological effects, and its bioactive compounds have been extensively investigated. However, the endophytic fungi associated with *Dicranopteris* are poorly studied (Kirschner & Liu, 2014; Kirschner & Wang, 2015; Guatimosim et al., 2016; Zhang et al., 2023; Chen et al., 2024).

Guizhou Province, located in the southeast part of southwest China on the eastern side of the Yunnan-Guizhou Plateau, is one of China's richest regions in fern resources (Wang & Wang, 2001, 2003). The province experiences a warm and humid climate, with rain and heat occurring in the same season, typical of a subtropical humid monsoon environment. These unique geographical and climatic conditions promote fern growth, with *Dicranopteris* being the most abundant fern in Guizhou. A total of 429 species of medicinal ferns, distributed in 48 families and 126 genera, have been reported in the province. Additionally, within the region, several new species of ferns have been discovered in karst microhabitats, such as caves, cliffs, and cracks (Lu et al.,

2017, 2019; Zhang et al., 2019a). Endophytic fungi associated with medicinal plants found in karst microhabitats have likely evolved a distinct secondary metabolic network, different from common environmental fungi, through long-term co-evolution with their hosts (Tan et al., 2021; Zhou et al., 2022). However, Guizhou has not conducted a systematic study on the diversity of endophytic fungi in medicinal ferns.

This study aims to systematically investigate the diversity of endophytic fungi associated with medicinal ferns, particularly focusing on three species of *Dicranopteris viz. D. ampla*, *D. linearis*, and *D. pedata*, which are widely distributed in Guizhou and are rich in active substances with potential for producing novel structural compounds. The objectives of this study are as follows: (1) to investigate the diversity of endophytic fungi associated with *Dicranopteris* in Guizhou Province; (2) to describe novel species, with illustrations and comparisons to similar species; (3) to collect cultures of endophytic fungi for further screening of novel bioactive compounds.

4.2 Materials and Methods

4.2.1 Sample Collection

Fresh healthy plant tissues such as leaves, rhizomes, roots, and stems of *Dicranopteris pedata*, *D. linearis*, and *D. pedata* were collected from Guizhou Province, China. After associated metadata such as date, locality, and host were noted (Rathnayaka et al., 2024), materials were kept in Ziplock bags and taken to the laboratory. Fungal isolation was carried out within 24 hours of collection.

4.2.2 Isolation of Fungal Endophytes

Tissues (leaves, stems, rhizomes, and roots) were washed with running tap water and surface sterilized to eliminate epiphytic microorganisms in a benchtop by immersing them in 75% (v/v) ethanol for 1–3 min (ca. 1 min for leaves and stems; ca. 3 min for rhizomes and roots, then rinsing with sterilized distilled water for 2 min, then soaked with10% (v/v) NaClO for 0.5–2 min (ca. 0.5 min for leaves and stems; ca. 2 min for rhizomes and roots), and finally rinsing with sterile distilled water three times continuously. Materials were dried on sterilized filter papers and then cut into small cubes (ca. 3 mm in length of segments) and placed on fresh potato dextrose agar (PDA)

containing antibiotic (50 μg/mL penicillin). Samples were incubated in a constant temperature incubator (25°C). The plates were observed daily, and mycelia from the edge of fungal colonies were transferred to fresh PDA to obtain pure cultures. The specimens of dry cultures were deposited at the herbarium of the Cryptogams Kunming Institute of Botany Academia Sinica (KUN-HKAS) and the Guizhou Academy of Agriculture Sciences (Herb. GZAAS). Living cultures were deposited at the Kunming Institute of Botany Culture Collection (KUNCC) and Guizhou Culture Collection (GZCC).

4.2.3 Morphological Study

The pure cultures were grown on PDA in a constant temperature incubator (26°C) and observed every five days. Culture characteristics, such as size, shape, colour, and texture, were recorded and examined using a stereomicroscope (SMZ168-BL, Motic, China). Micro-morphological characteristics were photographed using an ECLIPSE Ni-U compound microscope (Nikon, Japan) fitted with an EOS 90D digital camera (Canon, Japan) fitted on to an ECLIPSE Ni-U compound microscope (Nikon, Japan). Measurements of morphological characteristics (conidiomata, conidiogenous cells, conidia, and mycelia) were made with the Tarosoft® Image Frame Work. Figures and the photo plates were processed by Adobe Illustrator CS6 (Adobe Systems, USA).

4.2.4 DNA extraction, PCR Amplification, and Sequencing

Fresh fungal mycelia were scraped with sterilized scalpels. Genomic DNA was extracted by the Biospin Fungus Genomic DNA Extraction Kit (BioFlux, China), following the manufacturer's protocol. The primers are summarized in Table 4.1. The amplification reactions were performed in 25 μL of PCR mixtures containing 12.5 μL of 2×Power Taq PCR Master Mix (a premix and ready-to-use solution, including 0.1 Units/μL Taq DNA Polymerase, 500 μm dNTP Mixture each (dATP, dCTP, dGTP, dTTP), 20 mM Tris-HCl pH 8.3, 100 Mm KCl, 3 mM MgCl2, stabilizer and enhancer), 1 μL of each primer, 1 μL DNA template and 9.5 μL nuclease-free water. PCR amplification was confirmed on 1% agarose electrophoresis gels stained with ethidium bromide. The PCR products were purified and sequenced with the same primers at TsingKe Biological Technology (Kunming) Co., China.

Table 4.1 Information on loci and primers used in this study

Loci	Primer pairs	Sequences of primers (5'-3')	References
ITS	ITS5	GGAAGTAAAAGTCGTAACAAGG	White et al. (1990)
	ITS4	TCCTCCGCTTATTGATATGC	
LSU	LR0R	ACCCG TGAACTTAAGC	Vilgalys and Hester (1990)
	LR5	TCCTGAGGGAAACTTCG	
*rpb*2	fRPB2-5F	GAYGAYMGWGATCAYTTYGG	Liu et al. (1999)
	fRPB2-7cR	CCCATRGCTTGYTTRCCCAT	
act	ACT-512F	ATGTGCAAGGCCGGTTTCGC	Carbone and Kohn (1999)
	ACT-783R	TACGAGTCCTTCTGGCCCAT	
alt-α1	Alt-for	ATGCAGTTCACCACCATCGC	Hong et al. (2005)
	Alt-rev	ACGAGGGTGAYGTAGGCGTC	
chs-1	CHS-79F	TGGGGCAAGGATGCTTGGAAGAAG	Carbone and Kohn (1999)
	CHS-345R	TGGAAGAACCATCTGTGAGAGTTG	
*tub*2	BT2a	GGTAACCAAATCGGTGCTGCTTT	Glass and Donaldson (1995)
	Bt2b	ACCCTCAGTGTAGTGACCCTTGGC	
*his*3	CYLH3F	AGGTCCACTGGTGGCAAG	Crous et al. (2004)
	H3-1b	GCGGGCGAGCTGGATGTCCTT	
*tef*1-α	EF1-728F	CATCGAGAAGTTCGAGAAGG	Carbone and Kohn (1999)
	986R	TACTTGAAGGAACCCTTAC	
	EF2	GGARGTACCAGTSATCATG	O'Donnell et al. (2010)
	EF1	ATGGGTAAGGARGACAAGAC	
	983F	GCYCCYGGHCAYCGTGAYTTYAT	Rehner (2001)
	2218R	ATGACACCRACRGCRACRGTYTG	
gapdh	Gpd1-LM	ATTGGCCGCATCGTCTTCCGCAA	Myllys et al. (2002)
	Gpd2-LM	CCCACTCGTTGTCGTACCA	
	GDF1	GCCGTCAACGACCCCTTCATTGA	Templeton et al. (1992)
	GDR1	GGGTGGAGTCGTACTTGAGCATGT	
	GDP-1	CAACGGCTTCGGTCGCATTG	Berbee et al. 1999
	GDP-2	GCCAAGCAGTTGGTTGTGC	

4.2.5 Phylogenetic Analyses

Unassembled sequences were checked in BioEdit version 7.0.5.3 (Hall, 1999). BLAST searches (Altschul et al., 1997) in GenBank yielded the remaining homogenous sequences, and the majority of the reference sequences came from earlier publications. Alignments for each locus were performed in the MAFFT v7.307 online version (Katoh & Standley, 2016) and manually verified in AliView v1.19-beta1k (Larsson, 2014). The concatenation of different loci was done in SequenceMatrix 1.8 (Vaidya et al., 2011). The interleaved NEXUS files for Bayesian inference analyses were prepared by using

AliView v1.19-beta1k (Larsson, 2014). Phylogenetic analyses were conducted using maximum likelihood (ML) and Bayesian inference (BI) according to Dissanayake et al. (2020).

The Akaike information criterion (AIC), as implemented in MrModeltest v2 (Nylander, 2004), was used to determine the best evolution models for each gene region. ML analyses were performed in raxmlGUI 2.0 (Edler et al., 2021) with RAxML v8.2.10 (Stamatakis, 2014), using the ML + rapid bootstrap setting and the GTRGAMMAI (viz., GTR + GAMMA + I) substitution model with 1000 bootstrap replicates. Bayesian analysis was performed by MrBayes v3.1.2 (Ronquist et al., 2012). The model of evolution was estimated by MrModeltest 2.2 (Nylander, 2004). Posterior probabilities (Rannala & Yang, 1996) were performed by Markov Chain Monte Carlo Sampling (MCMC) in MrBayes v. 3.1.2. Six simultaneous Markov Chains were run for 1 billion generations, and trees were sampled every 1000 generation (resulting in 100,000 trees). The first 20000 trees representing the burn-in phase of the analyses were discarded and the remaining 80000 (post-burning) trees were used for calculating posterior probabilities (PP) in the majority rule consensus tree. Phylogenetic trees were drawn with FigTree v1.4.3 (Rambaut, 2017).

4.3 Results

We isolated 93 endophytic fungal strains from various tissues, identifying them as 65 distinct species distributed in 39 genera, 29 families, 18 orders, and four classes within the phylum Ascomycota based on both morphological characteristics and multi-locus phylogenetic analysis. A new family, *Massicellisporaceae*, three new genera *viz. Massicellispora*, *Miniglobosispora* and *Pseudopopulomyces*, and 29 new species *viz. Amorocoelophoma dicranopterisis*, *Apiospora aseptate*, *A. dematiacea*, *A. dicranopteris*, *A. globosa*, *Arxiella ellipsoidea*, *Biscogniauxia dicranopteridis*, *Castanediella dicranopteridis*, *Cladophialophora globosa*, *Colletotrichum dicranopterisis*, *C. guttulatisporum*, *Dactylonectria dicranopteridis*, *Diaporthe dicranopteridis*, *Geniculoseta dicranopteridis*, *Hypoxylon dicranopteridis*, *Ilyonectria dicranopteridis*, *Massicellispora dicranopteris*, *M. globosa*, *Miniglobosispora guizhounises*, *Neopestalotiopsis dicranopteridis*, *Nigrospora*

dicranopteridis, *Periconia dicranopterisis*, *Pezicula dicranopteridis*, *Pseudodactylaria dicranopteridis*, *Omnidemptus dicranopteridis*, *Pseudopopulomyces dicranopteridis*, S*phaerostilbella dicranopteridis*, *Trichocladium dicranopteridis*, and *Verruconis hyalina* are introduced. Additionally, 36 new host or geographical records are reported. In addition, several species are re-evaluated; *Diaporthe hainanensis* and *D. harriottiae* are synonymized under *D. arecae*, *Colletotrichum juglandis* is synonymized as *C. simulanticitri*, while, *C. gracile*, *C. oblongisporum*, and *C. nullisetosum* are combined into a single species as *C. jiangxiense*, and *Cashiella sticheri* was transferred to *Pezicula* as *P. sticheri* based on morphological and phylogenetic evidence. Endophytic species isolated and identified in this study are listed in Table 4.2.

Table 4.2 Endophytic fungi isolated from *Dicranopteris* in this study

Species	Host	Plant tissue	Note
Alternaria longipes	*D. pedata*	leave	
Amorocoelophoma dicranopteridis	*D. linearis*	root	New species
Apiospora aseptata	*D. pedata*	leaf	New species
A. dematiacea	*D. ampla*	stem	New species
A. dicranopteris	*D. ampla, D. pedata*	Leaf, stem, rhizome, root	New species
A. globosa	*D. linearis*	stem	New species
Arcopilus globulus	*D. pedata*	root	
Arcopilus globulus	*D. pedata*	root	
Arxiella ellipsoidea	*D. pedata*	rhizome	New species
Biscogniauxia dicranopteridis	*D. pedata*	leave	New species
Biscogniauxia petrensis	*D. pedata*	leave	
Castanediella dicranopteridis	*D. ampla*	rhizome	New species
Cladophialophora globosa	*D. ampla*	rhizome	New species
Cladosporium angulosum	*D. ampla*	stem	
C. benschiae	*D. pedata*	leave	
C. chlamydosporiformans	*D. ampla*	stem	
C. punicae	*D. pedata*	leave, stem	
Collariella pachypodioides	*D. ampla*	root	
Colletotrichum dicranopteridis	*D. ampla*	leave	New species
C. fioriniae	*D. ampla*	stem	
C. guttulataspore	*D. padata*	leave	New species
C. jiangxiense	*D. ampla*	leave	
C. plurivorum	*D. ampla*	leave	
C. simulanticitri	*D. pedata*	leave	
D. pauciseptata	*D. linearis*	rhizome	
Diaporthe arecae	*D. pedata*	stem	

Table 4.2 (continued)

Species	Host	Plant tissue	Note
D. dicranopteridis	*D. pedata*	stem	New species
D. tulliensis	*D. pedata*	stem	
D. xishuangbanica	*D. pedata*	rhizome	
Geniculoseta dicranopteridis	*D. ampla*	root	New species
Hypoxylon dicranopteridis	*D. linearis*	rhizome	New species
Ilyonectria dicranopteridis	*D. ampla*	root	New species
Massicellispora dicranopteridis	*D. pedata*	root	New species
M. globosa	*D. ampla*	root	New species
Miniglobosispora guizhounises	*D. ampla*	root	New species
Neofabraea actinidiae	*D. ampla*	stem	
Neofusicoccum sichuanense	*D. pedata*	stem	
Neopestalotiopsis dicranopteridis	*D. pedata*	rhizome	New species
N. piceana	*D. pedata*	leave	
N. samarangensis	*D. pedata*	leave	
N. sichuanensis	*D. pedata*	leave	
N. yongxunensis	*D. pedata*	stem	
Nigrospora aurantiaca	*D.pedata*, *D.linearis*	leave, stem	
N. camelliae-sinensis	*D. pedata*	leave	
N. chinensis	*D. pedata*	leave	
N. dicranopteridis	*D. ampla*	leave	New species
N. globospora	*D. pedata*	leave	
N. musae	*D. pedata*	leave	
N. oryzae	*D. pedata*	leave	
N. pyriformis	*D. pedata*	leave	
N. stoneae	*D. pedata*	stem	
Omnidemptus dicranopteridis	*D. ampla*	stem	New species
Paraboeremia litseae	*D. pedata*	rhizome	
Periconia dicranopteridis	*D. pedata*	root	New species
Pestalotiopsis chamaeropis	*D. pedata*	stem	
Pezicula dicranopteridis	*D. pedata*	stem, leave	New species
Phyllosticta capitalensis	*D. pedata*	leave, rhizome, stem	
Populomyces barnardiae	*D. pedata*	root	
Pseudodactylaria dicranopteridis	*D. pedata*	rhizome	New species
Pseudopopulomyces dicranopteridis	*D. pedata*	root	New species
Sphaerostilbella dicranopteridis	*D. pedata*	root	New species
Stagonospora tainanensis	*D. ampla*	root, rhizome, stem	
Tainosphaeria phialogeniculata	*D. ampla*	rhizome	
Trichocladium dicranopteridis	*D. pedata*	root	New species
Verruconis hyalinus	*D. pedata*	rhizome	New species

Ascomycota Caval. -Sm

Pezizomycotina O.E. Erikss. & K. Winka

Dothideomycetes O.E. Erikss & Winka

Botryosphaeriales C.L. Schoch, Crous & Shoemaker

Botryosphaeriales was introduced by Schoch et al. (2006) to accommodate *Botryosphaeriaceae*. The order currently comprises six families: *Aplosporellaceae*, *Botryosphaeriaceae*, *Melanopsaceae*, *Phyllostictaceae*, *Planistromellaceae*, and *Saccharataceae*. These families are well-supported by phylogenetic analysis and divergence time estimates (Phillips et al., 2019; Hongsanan et al., 2020a).

Botryosphaeriaceae Theiss. & Syd.

Botryosphaeriaceae was introduced by Theissen and Sydow (1918). Species of this family are endophytes, pathogens, and saprobes associated with a wide range of hosts with a worldwide distribution (Liu et al., 2012; Phillips et al., 2013, 2019). The taxonomy of *Botryosphaeriaceae* has long been complex until the molecular data were available and several authors have revised based on molecular data (Crous et al., 2006; Slippers et al., 2013; Dissanayake et al., 2016; Liu et al., 2017; Phillips et al., 2019), the most comprehensive study of *Botryosphaeriaceae* was provided by Phillips et al. (2019) who accepted 22 genera based on ITS and LSU sequences data, and the divergence time estimates of this family are also provided. In this study, we follow the latest treatment and updated accounts of *Botryosphaeriaceae* by Pem et al. (2024).

Neofusicoccum Crous, Slippers & A.J.L. Phillips

Neofusicoccum was established by Crous et al. (2006), with *N. parvum* as the type species. Members of this genus are recognized as endophytes, saprobes, and pathogens and are found on a wide range of hosts, including plants of agricultural, forestry, ecological, and economic significance (Lazzizera et al., 2008; Espinoza et al., 2009; Abdollahzadeh et al., 2013; Lopes et al. 2016). Initially, the species concept of *Neofusicoccum* was based solely on morphological characteristics. However, some species were incorrectly identified due to the minimal morphological differences. With advancements in molecular techniques, multi-locus DNA sequencing combined with morphological traits has become essential for accurately delineating *Neofusicoccum* species, leading to the discovery of many new species (Jayawardena et al., 2018; Hattori et al., 2021; Xu et al., 2022; Si et al., 2023). Currently, 71 species are listed in the Index

Fungorum (2024), out of which, 49 of them linked to sequence data.

Neofusicoccum sichuanense X.L. Xu & C.L. Yang, in Xu, Wang, Liu, Yang, Zeng, Wang, Liu & Yang, Frontiers in Microbiology 13(no. 1016548): 13 (2022)

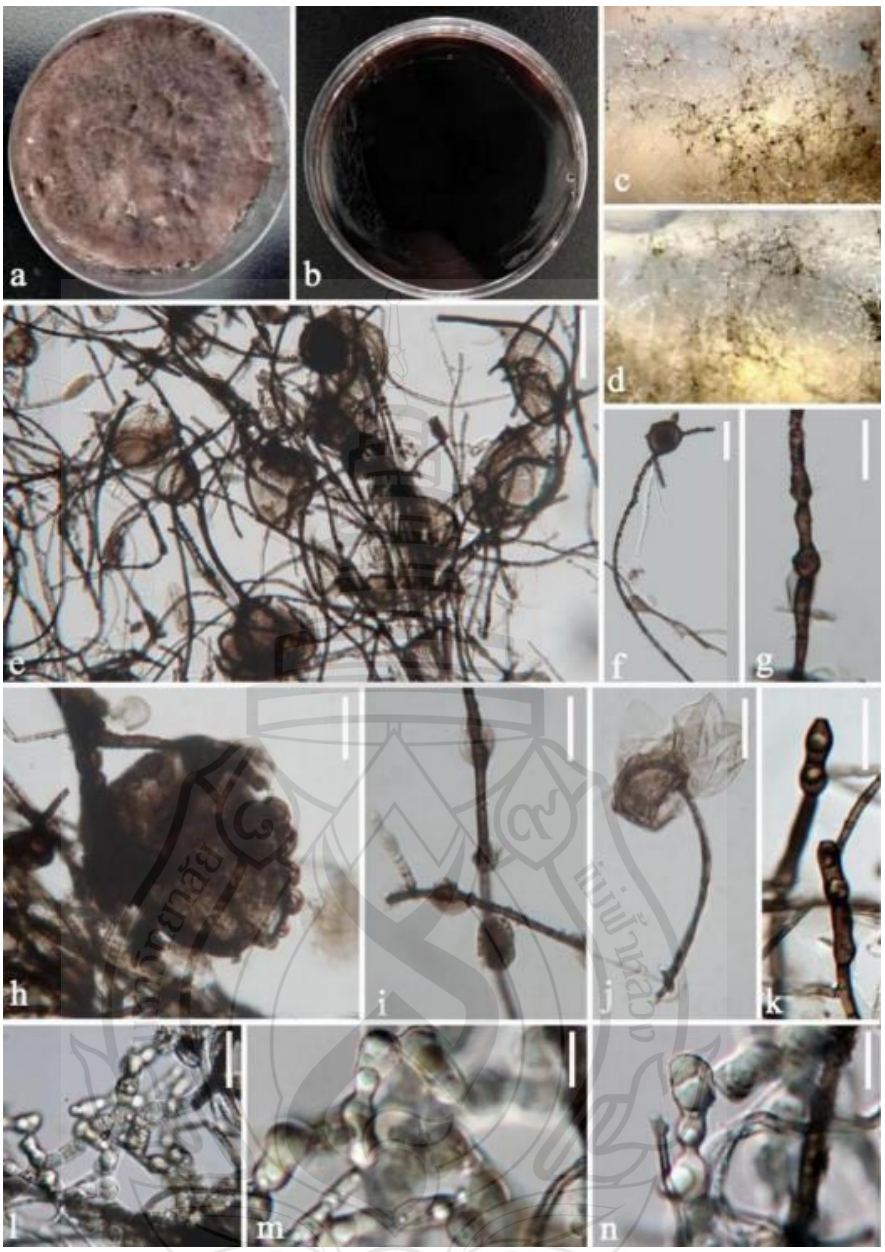
Fungal Names number: FN 845074; Figure 4.1

Endophytic in the stem of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Colonies* on MEA flat to slightly raised, reddish brown to dark brown with a velvety appearance. *Mycelium* 1.5–3.5 µm wide, superficial and immersed composed of septate, branched, brown to dark brown, verrucose and thick-walled hyphae, constricted at the septa, sometimes swollen at the septum, covered by a brown to dark brown sheath at the septa. *Chlamydospores* 11–17(–20) × 6–8 µm ($\bar{x}$ = 14 × 7 µm, n=20), cylindrical to ellipsoidal, rounded at the apex, truncated at the base, hyaline when young, become dark greyish-brown when mature, septate, constricted at the septa, guttulate, thick and smooth walled.

Culture characteristics: Colonies on MEA reaching 60 mm diameter after 7 days at 25°C, colonies circular, margin wavy, flat, velvety appearance with greyish aerial mycelia in the middle, colony from above: brown to dark brown; reverse: dark brown to black.

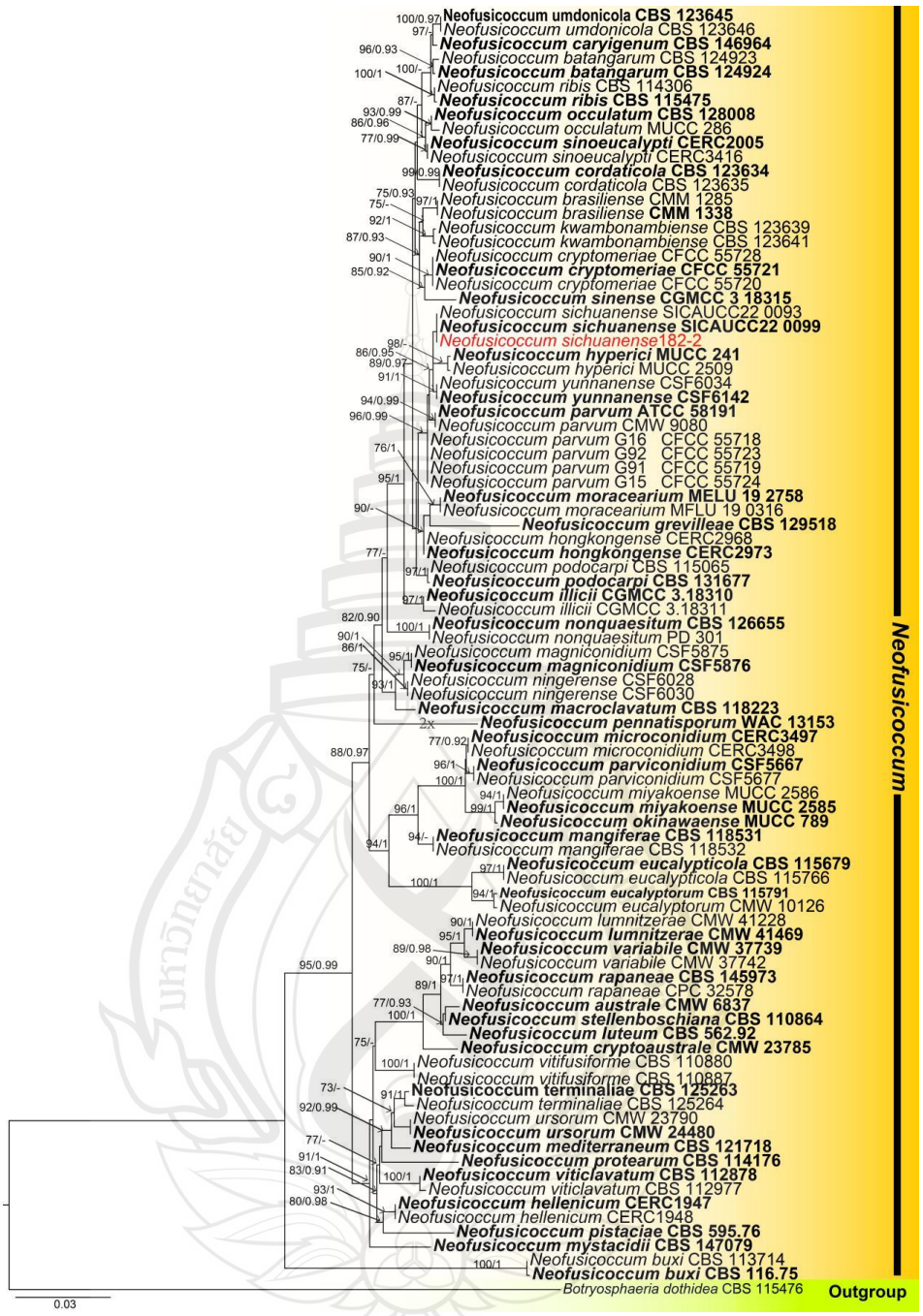
Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the stem of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS182–2.

Notes: In our phylogenetic analysis (Figure 4.2), our newly obtained strain (182–2) clustered with two strains of *Neofusicoccum sichuanense* (SICAUCC 22–0093 and SICAUCC 22–0099). We did not observe any sexual and asexual morphological structures for our strain, but the nucleotide of ITS and *tub*2 sequence data of our new isolate are identical to the strains of *N. sichuanense* (SICAUCC 22–0093 and SICAUCC 22–0099). Thus, based on phylogenetic analysis we identified our new strain as *N. sichuanense*. *Neofusicoccum sichuanense*, parasitic on the living twigs of *Juglans regia* was introduced by Xu et al. (2022). While, our new isolate is an endophyte isolated from the stem of *Dicranopteris pedata*; thus, we report our new isolate as a new host record from *D. pedata*.



Note a, b Cultures on MEA from above and below. c, d Colonies on MEA. e–j Mycelium with sheath. k–n chlamydospores. Scale bars: e, f, j = 50 µm, g–i, k–l= 20 µm, m, n = 10 µm

Figure 4.1 *Neofusicoccum sichuanense* (182–2)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *rpb*2, *tef*1-α, and *tub*2 sequence data. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP.

Figure 4.2 Phylogenetic tree of *Neofusicoccum*

Phyllostictaceae Fr.

Phyllostictaceae was proposed by Fries (1849) to accommodate *Phyllosticta*. Subsequently, Schoch et al. (2006) placed *Phyllosticta* in *Botryosphaeriaceae* (*Botryosphaeriales*) based on phylogenetic analysis, a classification that was accepted by Crous et al. (2006) and Liu et al. (2012). Wikee et al. (2013) redefined the genus and showed that the genus clustered sister to *Botryosphaeriaceae*, they therefore resurrected *Phyllostictaceae* to accommodate *Phyllosticta*. Subsequently, a new genus *Pseudofusicoccum*, was added to the family by Phillips et al. (2019). Currently, only the two genera are accepted in the family (Wijayawardene et al., 2022; Wang et al., 2023a; Pem et al., 2024).

Phyllosticta Pers.

Phyllosticta is a species-rich genus with more than 3000 epithets listed in the Index Fungorum (www.indexfungorum.org, accessed on 24 October 2024). The genus was introduced by Persoon (1818) with *P. convallariae* as the type species. The placement of this genus has long been debated, until Wikee et al. (2013), who redefined *Phyllosticta*, and showed that the genus clustered sister with *Botryosphaeriaceae*, thus the family *Phyllostictaceae* was resurrected to accommodate *Phyllosticta*; this has been accepted by later studies (Slippers et al., 2013; Hongsanan et al., 2020a; Wang et al., 2023a). *Phyllosticta* is characterized by pycnidial conidiomata containing aseptate conidia surrounding with a mucoid layer and bearing a single apical appendage; erumpent ascomata, 8-spored, clavate to broadly ellipsoid asci, and ellipsoid to limoniform ascospores (van der Aa, 1973; van der Aa & Vanev, 2002; Wikee et al., 2011). Previously, species identification criteria in *Phyllosticta* were based on morphology and host association (Wikee et al., 2011; Su & Cai, 2012). However, many *Phyllosticta* species exhibit only minor morphological variation among species and lack any discernible host selectivity. Therefore, relying solely on host-specificity and morphological traits for identification is inaccurate (Wikee et al., 2011; Su & Cai, 2012). In recent years, polyphasic taxonomic concepts, including multi-gene phylogenetic and morphological analyses, have used for the taxonomy of *Phyllosticta* species, which have significantly improved the identification of *Phyllosticta* species. Currently, *Phyllosticta* is divided into six species complexes *viz P. capitalensis*, *P. concentrica*, *P. cruenta*, *P. owaniana*, *P. rhodorae*, and *P. vaccinii* (Wang et al., 2023a; Jiang et al.,

2024). Species of this genus are mostly plant pathogens and endophytes from a broad range of hosts, with a worldwide distribution (Glienke et al., 2011; Rashmi et al., 2019; Norphanphoun et al., 2020; Bhunjun et al., 2021a, 2022; Gomdola et al., 2022). In this study, *P. capitalensis* was isolated from *Dicranopteris*, and we reported it as a new host record for *Dicranopteris*.

Phyllosticta capitalensis Henn., Hedwigia 48: 13 (1908)

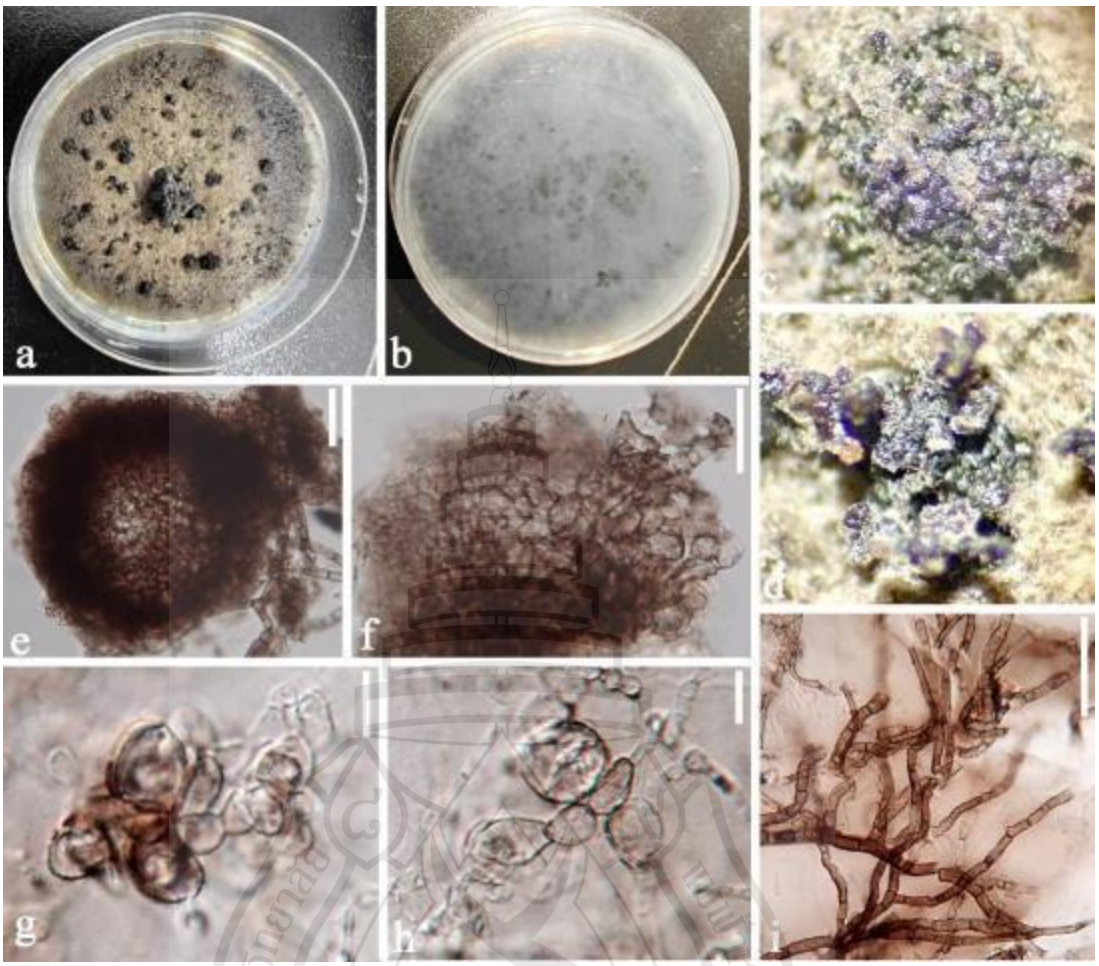
Fungal Names number: FN 168326; Figure 4.3

Endophytic in the leaves of *Dicranopteris pedata*. *Colonies* on PDA flat to slightly raised, light brown in the middle, dark brown in the margin, with black fruiting bodies at the surface. *Mycelium* superficial and immersed composed of septate, branched, 4–6.5 µm wide, brown to dark brown, with smooth and thick-walled hyphae, slightly constricted at the septa. *Chlamydospores* 7–13.5(–18) × 7–11.5 µm ($\bar{x}$ = 10.4 × 9.4 µm, n = 20), globose to subglobose or irregular shape, hyaline to pale brown, smooth-walled.

Culture characteristics: Colonies on PDA reaching 55 mm diameter after 20 days at 25°C, colonies circular, velvety appearance with greyish brown aerial mycelia in the middle, flat to slightly raised, light brown in the middle, dark brown in the margin, with black fruiting bodies at the surface, colony from above: light brown to dark brown; reverse: dark brown to black.

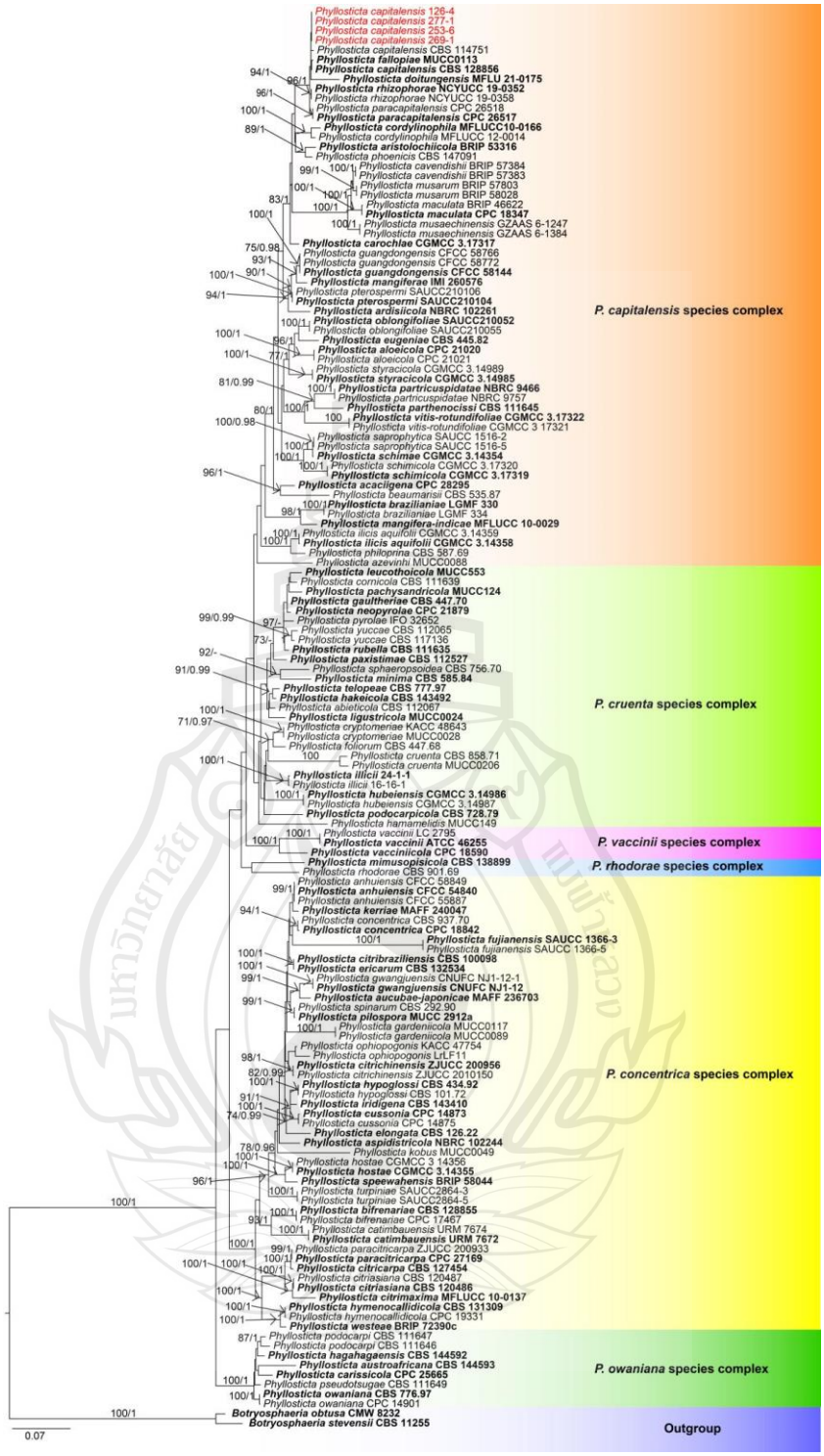
Material examined: CHINA, Guizhou Province, Ceheng County, Pomei Town, Southwest Guizhou Buyi and Miao Autonomous County, from the leave of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS126–4; from the rhizome of *D. linearis*, 16 March 2022, J.Y. Zhang, NS277–1; from a stem of *D. pedata*, 16 March 2022, J.Y. Zhang, NS253–6; from a stem of *D. linearis*, 16 March 2022, J.Y. Zhang, NS269–1.

Notes: In this study, four strains were isolated from fresh leaves, stem, and rhizomes of *Dicranopteris* spp.; phylogenetic analysis showed that the four strains clustered with *P. capitalensis* **(**Figure 4.4**)**. We did not observe any sexual and asexual morph for our new isolates, only chlamydospores were observed from culture, but the comparisons of our new strains in ITS, LSU, *act* and *tef*1-α gene regions are almost identical to *P. capitalensis* (CBS 114751). Therefore, we identify our strain as *P. capitalensis* based on phylogenetic affinity. *Phyllosticta capitalensis* is an endophyte and plant pathogen with a wide range of hosts, having been reported from 70 plant families worldwide. However, this is the first time this species has been reported from *Dicranopteris* spp.



Note a, b Cultures on PDA from above and below. c, d Fruiting bodies on PDA. e–f ascomata. g–h chlamydospores. i Mycelium. Scale bars: e, f = 30 µm, g, h = 10 µm, i = 50 µm

Figure 4.3 *Phyllosticta capitalensis* (126–4)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, *act*, *gapdh*, and *tef*1-α sequence data. The tree was rooted to *Botryosphaeria obtusa* (CMW 8232) and *B. stevensii* (CBS 11255). The newly obtained strains are in red and the type strains are in bold.

Figure 4.4 Phylogenetic tree of *Phyllosticta*

Cladosporiales Abdollahz. & Crous

Abdollahzadeh et al. (2020) established *Cladosporiales* with a single family *Cladosporiaceae* Nann. based on phylogenetic analysis. In this study, we followed the treatment of Abdollahzadeh et al. (2020) for this order.

Cladosporiaceae Nann.

Cladosporiaceae was introduced by Nannizzi (1934) with type genus *Cladosporium*. Currently, eight genera *viz. Cladosporium*, Cryoendolithus, *Davidiellomyces*, *Graphiopsis*, *Neocladosporium*, *Rachicladosporium*, *Toxicocladosporium*, and *Verrucocladosporium* are accepted in the family (Wijayawardene et al., 2022; Hyde et al., 2024).

Cladosporium Link

Cladosporium, one of the largest genera of dematiaceous hyphomycetes, was proposed by Persoon (1794) with *Dematium herbarum* Pers. as the type species, which was later described by Link (1816) as *C. herbarum* (Pers.:Fr.). *Cladosporium* is characterized by erect, straight, or geniculate conidiophores, coronate conidiogenous loci, conidial hila formed by a central convex dome surrounded by a raised periclinal rim, and acropetal branched chains of conidia (David, 1997). *Cladosporium* species are similar in morphology; however previous studies identified *Cladosporium* species primarily based on morphological characteristics, which has made the genus increasingly complex (David, 1997; Heuchert et al., 2005a, 2005b; Schubert, 2007, 2009; Bensch et al., 2012). With the molecular data available, various authors have continually revised this genus based on multi-locus phylogenetic analyses (Crous et al., 2007a; Sandoval-Denis et al., 2016; Bezerra et al., 2018; Iturrieta-González et al., 2021; Lee et al., 2023). Currently, three *Cladosporium* species complexes (*C. cladosporioides*, *C. herbarum* and *C. sphaerospermum*) have been identified.

Cladosporium angulosum Sand. -Den., Deanna A. Sutton & Guarro, in Sandoval-Denis, Gené, Sutton, Wiederhold, Cano-Lira & Guarro, Persoonia 36: 289 (2016), Figure 4.5

Fungal Names number: FN 815333

Endophytic in the stems of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Mycelium* superficial and immersed, composed of septate, branched, pale olivaceous brown, with smooth and thin-walled hyphae. *Conidiophores* 215–415 (–507) × 3.5–6.5 µm ($\bar{x}$ = 314.3 × 4.9 µm, n = 15), macronematous, mononematous,

erect, cylindrical, non-nodulose, septate, branched, frequently branching near the base, pale brown, smooth-walled. *Conidiogenous cells* terminal or intercalary, cylindrical, loci crowded at the apex forming clusters of pronounced scars, bearing up to two conidiogenous loci, darkened and refringent. *Conidia* 2.5–3.5 × 1–2 µm ($\bar{x}$ = 2.9 × 1.7 µm, n=40), in chains, subhyaline to pale brown, smooth and thin-walled, aseptate, with protuberant conidial hila, not darkened.

Culture characteristics: Colonies on PDA reaching 53–55 mm after 15 days at 25°C, brown to dark brown, flat, velvety to granular, with regular margin; reverse dark brown to black.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from a stem of *Dicranopteris ampla*, 17 March 2022, J.Y Zhang, 292–1.

Notes: Phylogenetic analysis showed that our isolate (292–1) grouped with two strains of *Cladosporium angulosum* (CPC 11526 and CBS 140692) with 96%ML and 1.00 PP (Figure 4.6). The nucleotide comparisons of ITS and *act* gene regions between our new isolate (292-1) and *C. angulosum* (CBS 140692) revealed 0bp and 4bp differences respectively; 292-1 differs from *C. angulosum* (CPC 11526) in ITS and *act* gene regions by 0bp and 6bp, respectively. This indicates that our new isolate was not significantly different from *C. angulosum* in molecular data. Morphologically, our new isolate is almost identical to *C. angulosum*. Therefore, we identified our new isolate as *C. angulosum*.

Cladosporium angulosum, a human pathogen isolated from human bronchoalveolar lavage, was introduced by Sandoval-Denis et al. (2016). Subsequently, this species has been isolated from plants of *Camellia sinensis* (Lv et al., 2023), *Austropuccinia psidii* (da Silva et al., 2023), *Corymbia foelscheana* and indoor air (Bensch et al., 2018), which showed that this species is highly adapted to the different environments. In this study, we report our new isolate from *Dicranopteris ampla* as a new host record.

Note a, b Cultures on WA from above and below. c Colonies on WA. d–f Conidiophores. g–i Conidiogenous cells and conidia. j–o Conidia. Scale bars: d–f = 50 µm, g–o = 5 µm

Figure 4.5 *Cladosporium angulosum* (292–1)

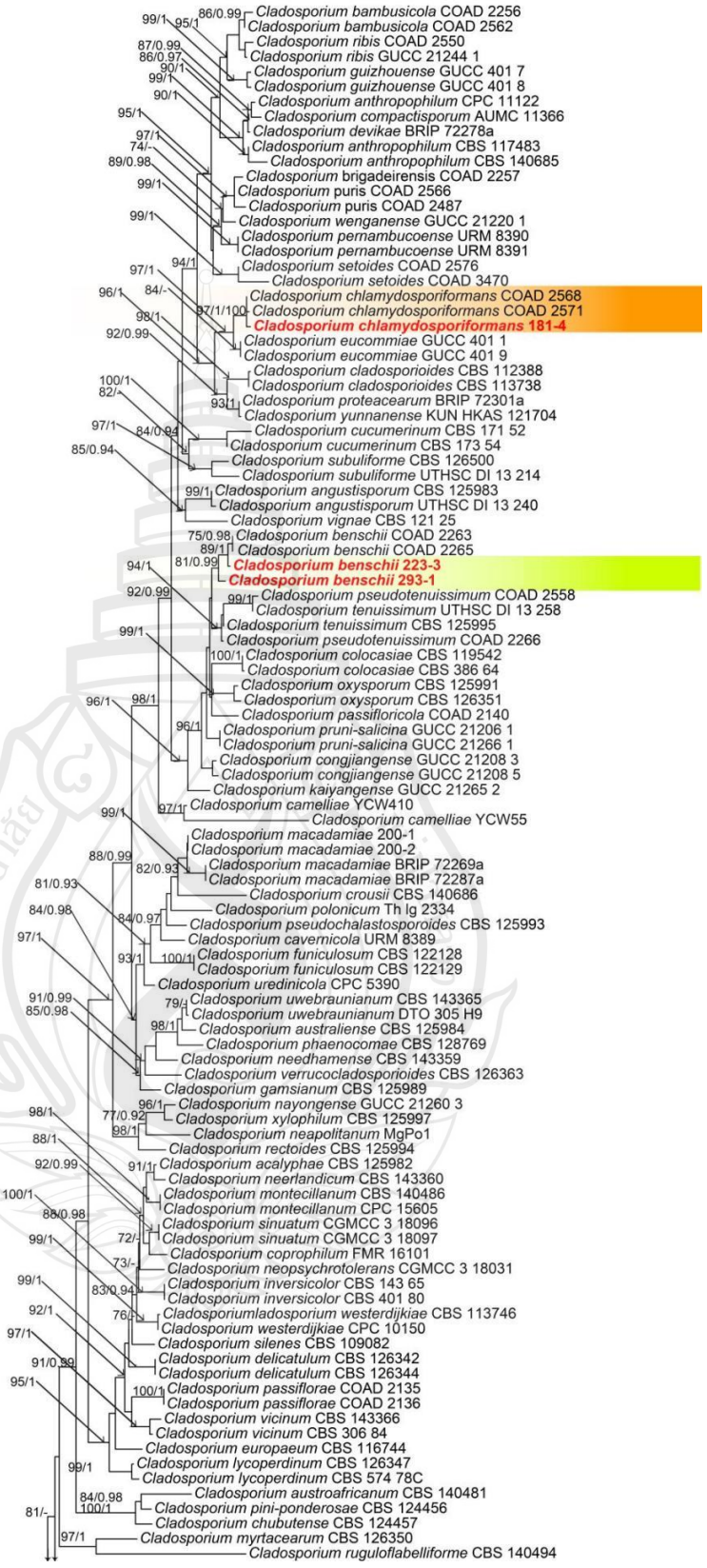
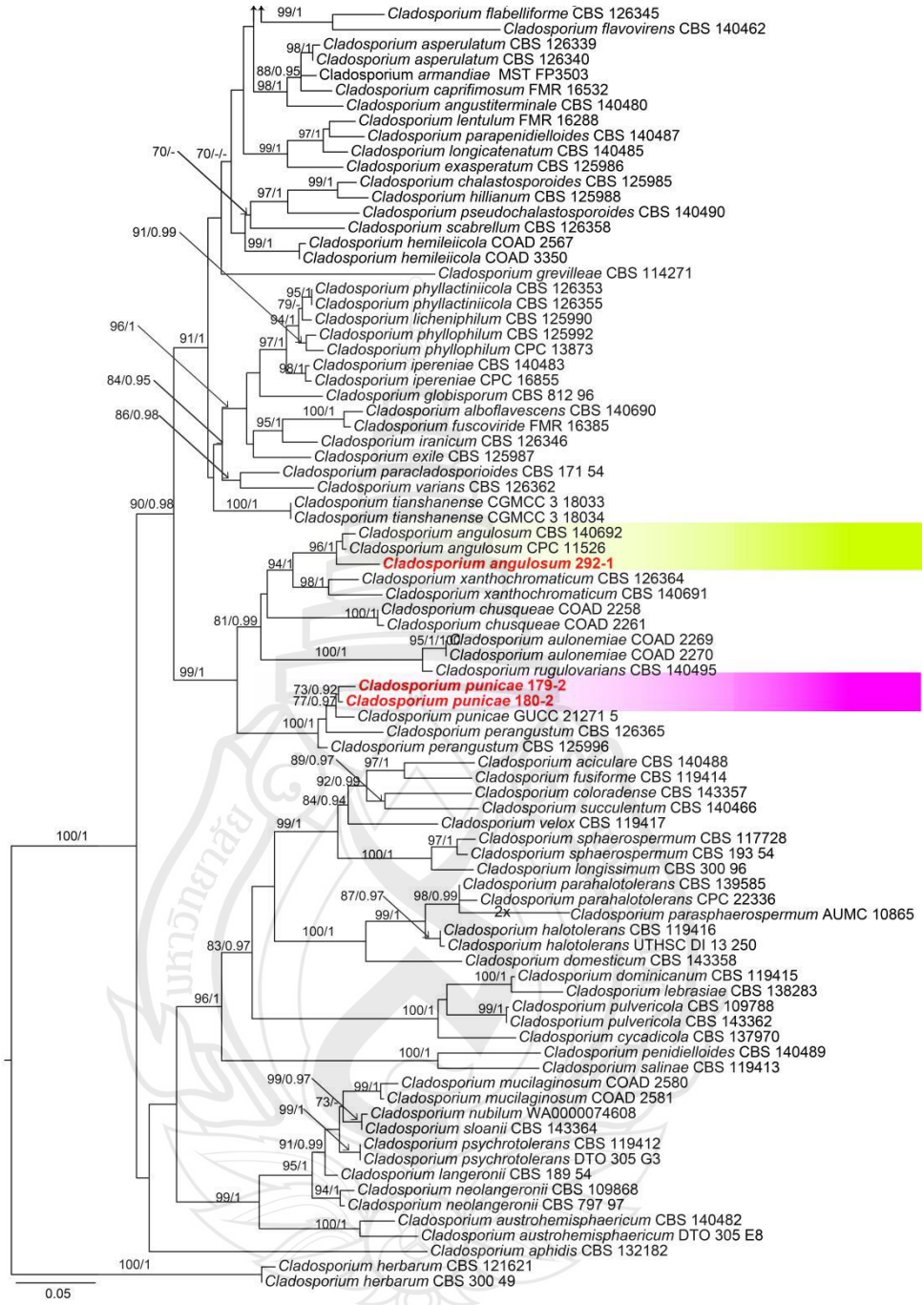


Figure 4.6 Phylogenetic tree of *Cladosporium*



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *act*, and *tef*1-α sequence data. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The newly obtained strains are in red and bold font.

Figure 4.6 (continued)

Cladosporium benschiae P.P. Costa, A.W.C. Rosado & O.L. Pereira [as 'benschii'], Phytotaxa 560(1): 17 (2022), Figure 4.7

Fungal Names number: FN 845498

Endophytic in the leaves of *Dicranopteris pedata.* Sexual morph: Not observed. Asexual morph: *Mycelium* sparse, pluriseptate, occasionally somewhat swollen and constricted at the septum, subhyaline to pale brown, irregularly rough-walled. *Conidiopho*res 87–205 × 2.5–5.5 µm ($\bar{x}$ = 146.4 × 4 µm, n = 15), solitary, macronematous, rarely micronematous, arising laterally from the hypha, erect or flexuous, cylindrical-oblong, cylindrical attenuated toward at the apex to sometimes filiform, non-geniculate, pale brown to brown, sometimes subhyaline, unbranched, pluriseptate, conspicuous, walls slightly thickened, pale brown. *Conidiogenous cells* integrated, terminal, cylindrical oblong or cylindrical slightly attenuated to apex, non-geniculate, sometimes swollen at apex, in terminal cells apex usually head-like swollen with pronounced subdenticulate to denticulate loci crowded at the tip, pale brown, with 1-5 loci at apex, conidiogenous loci non-protuberant or only slightly so, rarely thickened and darkened. *Ramoconidia* not observed. *Conidia* 3–5(–6) × 2–3.5 µm ($\bar{x}$ = 4.1 × 2.7 µm, n = 30) numerous, catenate, acrogenous, ellipsoid, limoniform, ovoid, subglobose, pale brown to brown.

Culture characteristics: Colonies on PDA attaining 55 mm diam, brown to dark brown, flat, dense, felty; reverse dark brown.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leaves of *Dicranopteris pedata*, 16 March 2022, J.Y Zhang, 223–3; *ibid*, 293–1.

Notes: Our phylogenetic analysis showed that the two new isolates (223–3 and 293–1) grouped with *C. benschii* in an independent clade, but our two new isolates and *C. benschii* formed separate clades (Figure 4.6). We compared the nucleotide sequences of our new isolates (223–3 and 293–1) with the ex-type strain of *C. benschii* (COAD 2263). The results showed that the ITS sequence data of our new strains, 223–1 and 293–1, differ from *C. benschii* (COAD 2263) by 0 and 3 bp, respectively. The act sequence data of 223–1 and 293–1 differ from *C. benschii* (COAD 2263) by 2 bp and 3 bp, respectively. Additionally, the *tef*1-α sequence data of 223–1 are identical to *C. benschii* (COAD 2263), while 293–1 shows 3 bp differences from *C. benschii*

(COAD 2263). The ITS, *act*, and *tef*1-α sequences of our two new strains are not significantly different from *C. benschii* (COAD 2263), which strongly suggests our new isolates are *C. benschii*. In addition, the morphology of our new isolate fits well with the description of *C. benschii* (Costa et al., 2022). Thus, we identified our new isolates as *C. benschii*, which was introduced by Costa et al. (2022) and collected on decaying leaves of *Aulonemia amplissima* from Brazil. This is the first time this species has been reported from China, isolated from *Dicranopteris pedata*.

Note a, b Cultures on WA from above and below. c Colonies on WA. d–h Conidiophores. i–k Conidiogenous cells. l–o Conidia. Scale bars: d = 30 µm, e–h = 20 µm, i–o = 5 µm

Figure 4.7 *Cladosporium benschiae* (223–3)

Cladosporium chlamydosporiformans C.M. Pereira & R.W. Barreto, in Pereira et al., Fungal Systematics and Evolution 14: 22 (2023), Figure 4.8

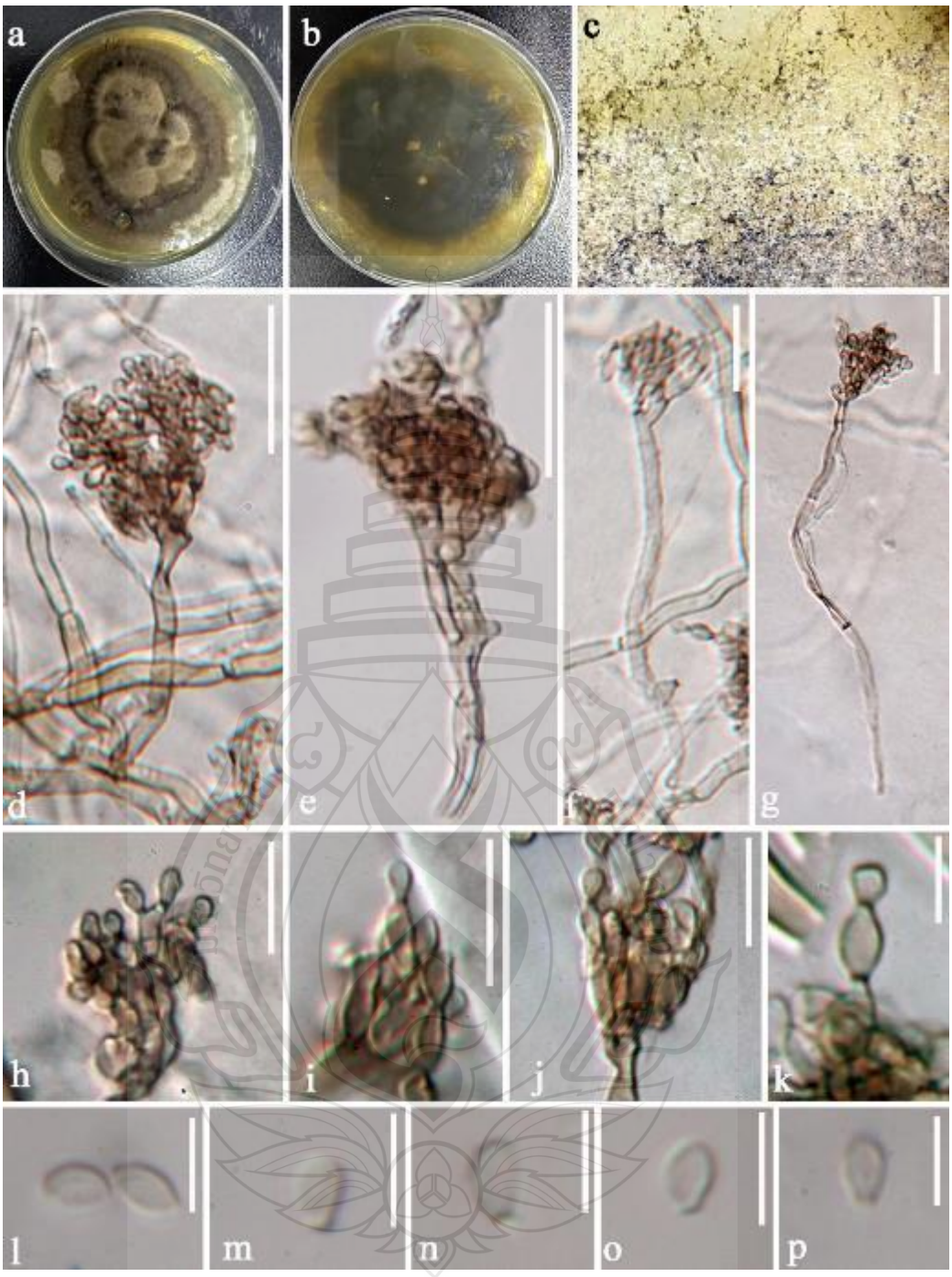
Fungal Names number: FN 850456

Endophytic in the stems of *Dicranopteris ampla*. Sexual morph: Not observed. Asexual morph: *Mycelium* superficial and immersed, composed of septate, branched, hyaline to pale brown, smooth-walled hyphae. *Conidiophores* 48–98 × 2–4 μm ($\bar{x}$ = 72.7 × 3.3 μm, n=15), mononematous, macronematous, solitary, erect to slightly flexuous, non-nodulose, sometimes subnodulose at the uppermost apex, unbranched or occasionally branched, septate, slightly constricted at septa, pale brown, smooth, sometimes somewhat irregularly rough-walled or verruculose. *Conidiogenous cells* terminal and intercalary, loci crowded at the apex forming clusters of pronounced scars, 1–2 conidiogenous loci formed at about the same level, loci often situated at lateral shoulders due to sympodial proliferation, *Conidia* 3–4.5(–5.5) × 2–3 μm ($\bar{x}$ = 3.8 × 2.3 μm, n = 35), solitary or in short unbranched chains, straight to slightly curved, cylindrical-oblong aseptate, sometimes slightly constricted at the septa, pale to pale medium olivaceous-brown.

Culture characteristics: Colonies on PDA attaining 45 mm diam after 14 days, dark brown to greyish brown, velvety, furrowed; reverse dark brown to black.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyim, and Miao Autonomous County, from stems of *Dicranopteris ampla*, 17 March 2022, J.Y Zhang, 181–4.

Notes: *Cladosporium chlamydosporiformans* was recently introduced by Pereira et al. (2024), it was isolated on uredinia of *Hemileia vastatrix* and leaves of *Coffea arabica* from Kenya. Our new isolate (181–4) is phylogenetically related to *C. chlamydosporiformans* (Figure 4.6). Morphologically, our new isolate is similar to *C. chlamydosporiformans* in having macronematous, solitary conidiophores which are arising terminal or laterally from hyphae, integrated, terminal, subcylindrical conidiogenous cells with 1–5 loci at the apex, and aseptate, light brown to brown, smooth-walled conidia which are in acropetal and branched chains (Pereira et al., 2024). Thus, based on both phylogenetic analysis and morphological characteristics, we identified our new isolate as *C. chlamydosporiformans* and reported it as a new host and geographical record from *Dicranopteris ampla* in China.



Note a, b Cultures on WA from above and below. c Colonies on WA. d–g Conidiophores, conidiogenous cells, and conidia. h–k Conidiogenous cells and conidia. l–p Conidia. Scale bars: d–g = 20 µm, h–j = 10 µm, k–p = 5 µm

Figure 4.8 *Cladosporium chlamydosporiformans* (181–4)

Cladosporium punicae Y.Q. Yang & Yong Wang bis, in Yang et al., Journal of Fungi 9(no. 250): 17 (2023), Figure 4.9

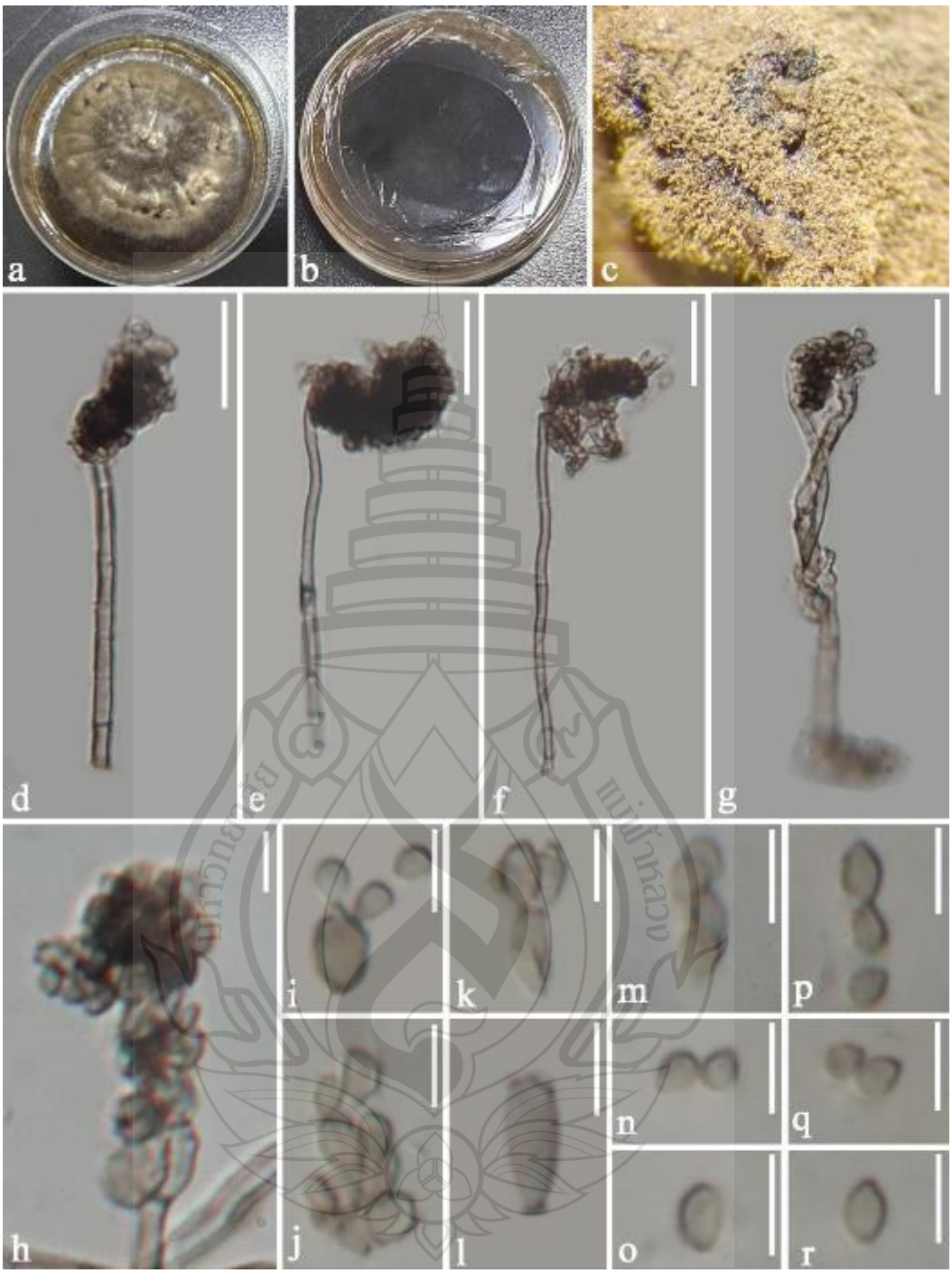
Fungal Names number: FN 900113

Endophytic in the stem of *Dicranopteris pedata.* Sexual morph: Not observed. Asexual morph: *Mycelium* superficial and immersed, hyphae branched, subhyaline to pale or medium olivaceous-brown, smooth and thin-walled. *Conidiophores* 55–132 × 2.0–4 µm ($\bar{x}$ = 93.9 × 3.3 µm, n = 15), macronematous, mononematous, solitary, arising terminally or laterally from plagiotropous or ascending and erect hyphae, erect, straight to slightly flexuous, cylindrical, sometimes slightly geniculate toward the apex, pale to medium brown, smooth to asperulate or minutely verruculose. *Conidiogenous cells* terminal or intercalary, cylindrical, loci crowded at the apex forming clusters of pronounced scars, bearing up to four conidiogenous loci. *Conidia* 2.5–4 × 1.5–2.5 µm ($\bar{x}$=3 × 2 µm, n =40), forming chains, ovoid, ellipsoid, rounded at the apex, ponited at the base, somewhat darkened and refractive conidial hila, subhyaline to pale greyish-brown, smooth to minutely verruculose or irregularly rough-walled.

Culture characteristics: Colonies on PDA reaching 50 mm diam after 15 days at 25°C, greyish brown with abundant and dense aerial mycelium, velvety to granular, with regular margin. Reverse dark brown to black.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the stems of *Dicranopteris pedata*, 17 March 2022, J.Y Zhang, 179–2; Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from leaves of *D. pedata*, 17 March 2022, J.Y Zhang, 180–2.

Notes: Our two new strains (179–2 and 180–2) grouped with the ex-type strain of *Cladosporium punicae* (GUCC 21271.5) in the phylogenetic analysis (Figure 4.6). The ITS sequences of our strains (179–2 and 180–2) were identical to those of *C. punicae* (GUCC 21267.1), with only 1 bp and 4 bp differences between strain 180–2 and GUCC 21271.5, and strain 179–2 and GUCC 21271.5, in the *act* and *tef1*-α gene regions, respectively. Morphologically, GUCC 21267.1 shares nearly identical colony morphology, conidiophores, conidiogenous cells, and conidia with the description of *C. punicae* (Yang et al., 2023a). Therefore, we report our new strains as a new host record of *C. punicae* on *Dicranopteris pedata*.



Note a, b Cultures on WA from above and below. c Colonies on WA. d–g Conidiophores. h–k Conidiogenous cells and conidia. l Conidiogenous cells. m–r Conidia. Scale bars: d–g = 20 µm, h–r = 5 µm

Figure 4.9 *Cladosporium punicae* (179–2)

Muyocopronales Mapook, Boonmee & K.D. Hyde

Muyocopronales was introduced by Mapook et al. (2016) to accommodate a single family *Muyocopronaceae* which formed a distinct clade within *Dothideomycetes* and is closely related to *Acrospermales* and *Dyfrolomycetales*. However, *Muyocopronaceae* is distinct from *Acrospermales* and *Dyfrolomycetales* by superficial, flattened, carbonaceous, brittle ascomata, pseudoparaphyses that are longer than the asci and ellipsoidal to ovate, unicellular ascospores (Mapook et al., 2016). Hongsanan et al. (2020a) confirmed the status of this order based on phylogenetic analysis and divergence time. Currently, the order comprises a single family with 12 genera (Hongsanan et al., 2020a; Worobiec et al., 2020; Senwanna et al., 2021).

Muyocopronaceae K.D. Hyde

Muyocopronaceae was originally introduced by Luttrell (1951), placed in *Hemisphaeriales* (Spegazzini, 1881). Hyde et al. (2013) accepted it as a distinct family in *Dothideomycetes* with a single genus *Muyocopron*. Mapook et al. (2016) proposed a new order *Muyocopronales*, to accommodate this family. Hongsanan et al. (2020a) accepted nine genera *viz. Arxiella*, *Leptodiscella*, *Mycoleptodiscus*, *Muyocopron*, *Neocochlearomyces*, *Neomycoleptodiscus*, *Paramycoleptodiscus*, *Setoapiospora*, and *Pseudopalawania* in the family based on phylogenetic analysis. Subsequently, two new genera *viz. Muyocopromyces* and *Quadrisporella* were added to the family (Worobiec et al., 2020; Senwanna et al., 2021). We follow the latest update accounts of this family provided by Hyde et al. (2024).

Arxiella Papendorf

Arxiella was introduced by Papendorf (1967) for a hyphomycetous species *A. terrestris*, which has reniform conidia with obliquely cornute ends. Subsequently, four *Arxiella* species viz. *A. celtidis*, *A. dolichandrae*, *A. longispora* and *A. lunata* were introduced (Ruscoe, 1970; Crous et al., 2014; Tennakoon et al., 2021; Xu et al., 2023). Except for *A. celtidis* (Tennakoon et al., 2021), all other species have been reported as asexual morphs, and characterized by 1- to multi-celled, simple or branched, hyaline to slightly olivaceous hyphae conidiophores, and reniform ends obliquely cornute, hyaline or faintly coloured, 1-septate, smooth conidia which are single or in short chains or in small irregular groups, usually with apical and basal horn-like appendages (Papendorf, 1967; Ruscoe, 1970; Crous et al., 2014). Only *A. celtidis* has been reported as sexual

morphs, characterized by globose to subglobose, glabrous, ostiolate ascomata with minute papilla, bitunicate, cylindrical to cylindric-clavate asci with an indistinct ocular chamber and uniseriate to bi-seriate, fusiform with acute ends, 1-septate, hyaline, guttulate, smooth-walled ascospores surrounded by thin mucilaginous sheath (Tennakoon et al., 2021).

Recent studies showed that *A. celtidis*, *A. dolichandrae*, *A. longispora*, and *A. terrestris* formed a monophyletic clade within *Muyocopronaceae*, while *A. lunata* clustered outside of the monophyletic *Arxiella* group, our analysis obtained a similar result (Figure 4.11). Morphologically, *A. lunata* differs from other *Arxiella* species by its conidia with a curved inner side similar to a crescent, while others have a straight inner side similar to a boat (Papendorf, 1967; Ruscoe, 1970; Crous et al., 2014). Thus, the placement of this species needs to be clarified in the future.

Arxiella ellipsoidea J.Y. Zhang, K.D. Hyde, D.F. Bao & Y.Z. Lu, sp. nov., Figure 4.10

Etymology: The name refers to its ellipsoidal conidia.

Holotype: KUN-HKAS 129879

Endophytic in the rhizome of *Dicranopteris pedata*. Sexual morph: undetermined. Asexual morph: *Mycelium* septate, branched, hyaline to brown, guttulate. *Conidiophores* 3–5 µm wide, macronematous to semi-macronematous, mononematous, solitary, straight or flexuous, cylindrical, brown, septate, guttulate, thick-walled. *Conidiogenous cells* monoblastic, integrated, terminal and intercalary, pale brown. *Conidia* 5–8 × 3–5 µm ($\bar{x}$ = 6.5 × 4 µm, n = 30), solitary or occasionally interconnected or irregular group with the members of interconnected, subglobose to ellipsoidal, pale to brown, aseptate, often with two or more distinct guttules, smooth-walled, sometimes with apical and basal horn-like appendages, usually with a widely truncate and slightly raised hilum at the base where the basal appendage joins the conidium body.

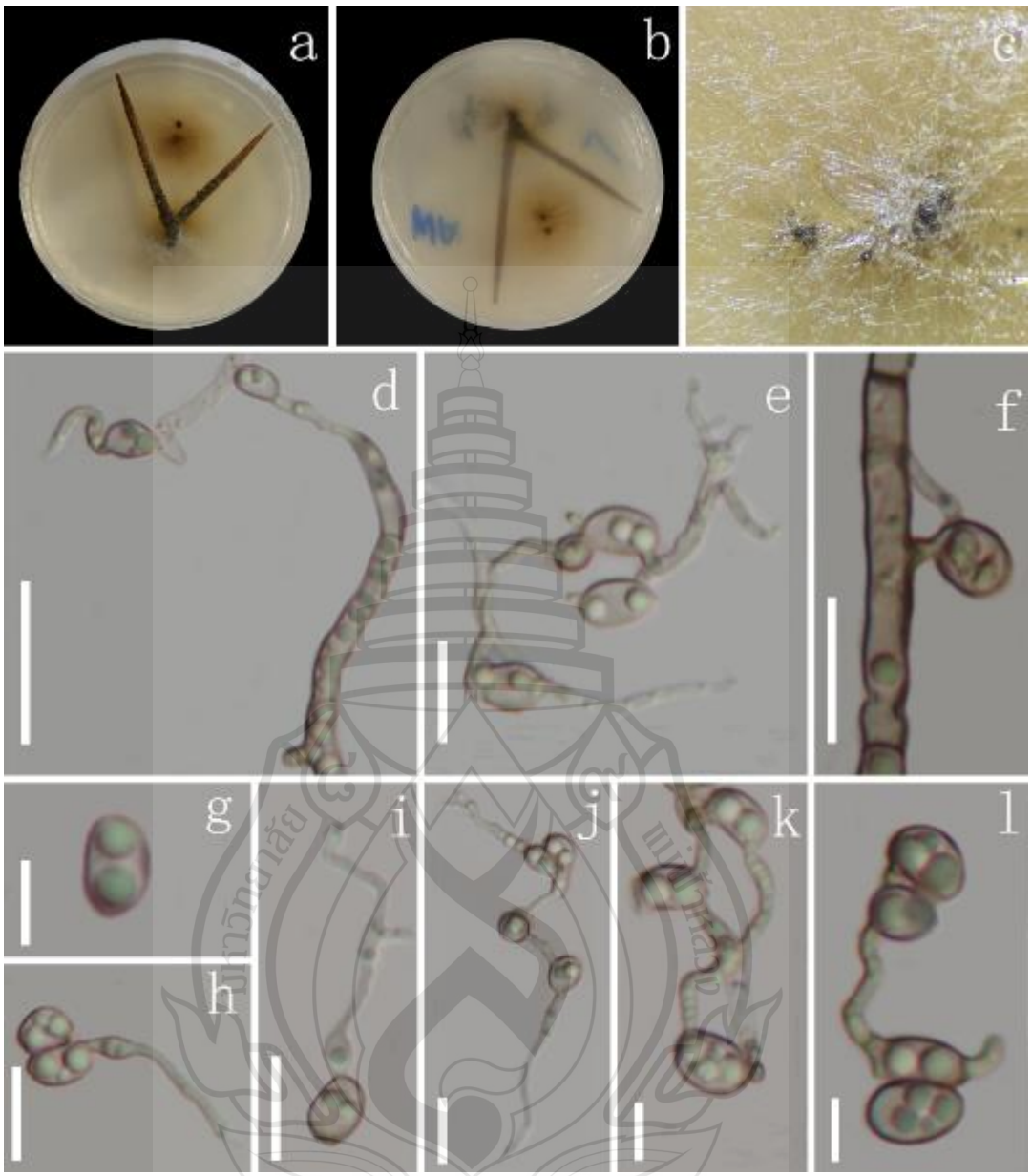
Culture characteristics: C*olonies* on WA medium sporiferous, circular, immersed mostly, entire margin with filamentous margin, flat with thin aerial hyphae, white to brown, black spots visible at 1-2 spots.

Material examined: China, Guizhou Province, Southwest Guizhou Buyi, and Miao Autonomous Prefecture, Chengheng County, isolated from the healthy rhizome

of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS143–4 (KUN-HKAS 129879, holotype), ex-type living culture, KUNCC23–14173.

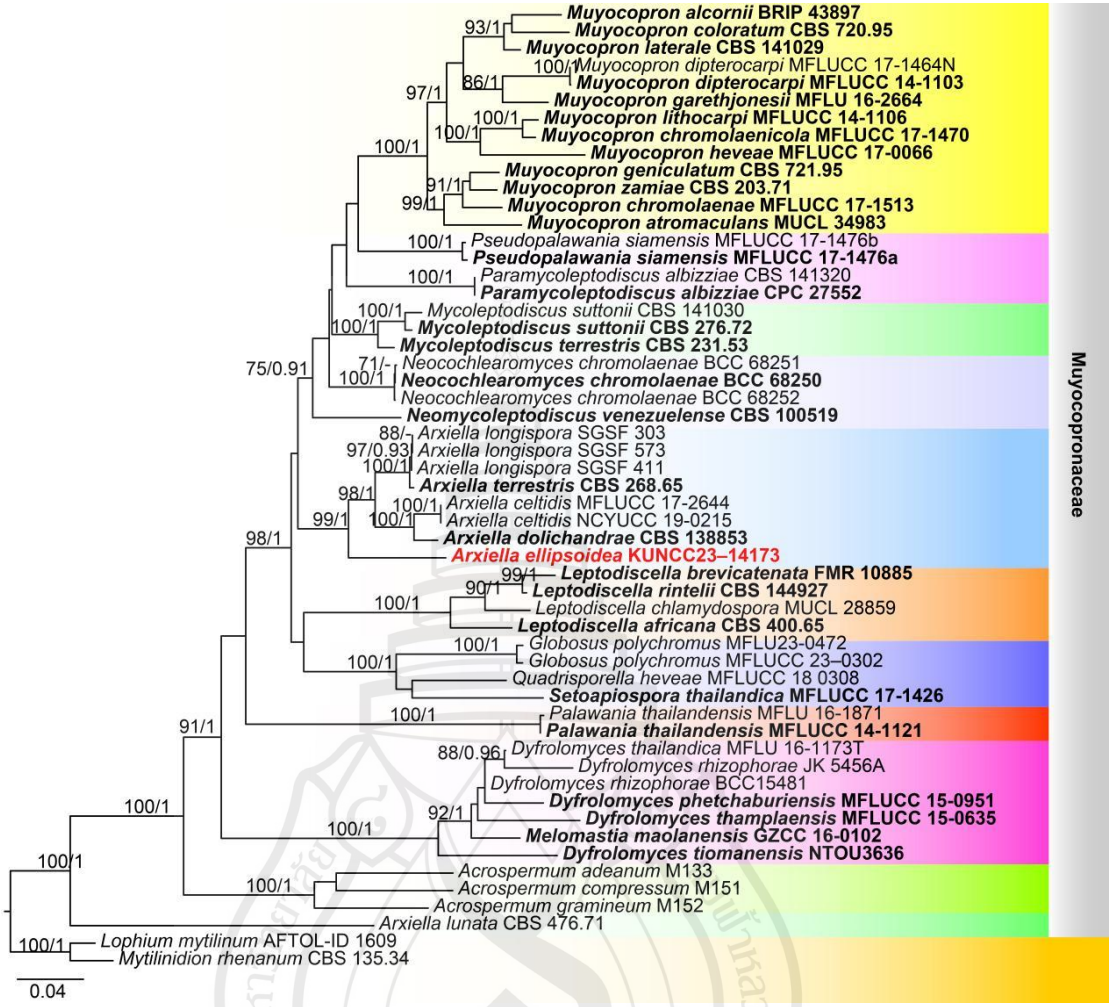
Notes: Our phylogenetic analysis showed that *A. ellipsoidea* (KUNCC23–14173) grouped with *A. celtidis*, *A. dolichandrae*, *A. longispora*, and *A. terrestris* in a well-supported clade but formed a distinct lineage basal to *Arxiella* species, whereas, *A. lunata* was placed outside of the monophyletic *Arxiella* group (Figure 4.11). Thus, the placement of this species needs to be revised.

Conidia of *A. ellipsoidea* are single or in short chains or in small irregular groups with apical and basal horn-like appendages, which confirms the morphology of the generic conception in *Arxiella*. However, *A. ellipsoidea* differs from the existing species by its subglobose to ellipsoidal, brown conidia. While, conidia of other *Arxiella* species are reniform or cylindrical, and hyaline (Xu et al., 2023; Crous et al., 2014) among the *Arxiella* species, *A. ellipsoidea* is similar to *A. terrestris*; conidia of both species are solitary or occasionally interconnected or irregular groups with the members of interconnected, with apical and basal horn-like appendages, usually with widely truncate and slightly raised hilum at the base where the basal appendage joins the conidium body (Papendorf, 1967). However, *A. ellipsoidea* can be distinguished from *A. terrestris* in having subglobose to ellipsoidal, pale to brown, and aseptate conidia. In contrast, conidia of *A. terrestris* are 1-septate and reniform. Therefore, we introduce *A. ellipsoidea* as a new species based on phylogeny and morphology (Figure 4.11).



Note a, b Cultures on WA from above and below. c Colonies on WA. d–l Hyphae, conidiogenous cells, and conidia. Scale bars: d, j = 20 μm, e, f, i, k = 10 μm, g, h, l = 5 μm

Figure 4.10 *Arxiella ellipsoidea* (KUN-HKAS 129879, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, SSU, and *tef*1-α sequence data. A total of 55 taxa were included in the combined analyses, which comprised 3557 characters after alignment. The best scoring RAxML tree with a final likelihood value of -23665.622673 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Lophium mytilinum* (AFTOL-ID 1609) and *Mytilinidion rhenanum* (CBS 135.34). The newly obtained strain is in red and the type strains are in bold.

Figure 4.11 Phylogenetic tree of *Arxiella*

Pleosporales Luttr. ex M.E. Barr.

Pleosporales is the largest order in the class *Dothideomycetes*. We follow the latest updated account of *Pleosporales* included in Hyde et al. (2024).

Didymellaceae Gruyter, Aveskamp & Verkley

Didymellaceae was introduced by de Gruyter et al. (2009); it is the largest family in *Pleosporales*, with 50 genera being accepted in this family (Hyde et al., 2024). For a brief introduction to the family, see Hongsanan et al. (2020b).

Paraboeremia Qian Chen & L. Cai

Paraboeremia was introduced by Chen et al. (2015) and placed in *Didymellaceae*. It is a well-studied genus with all species associated with sequence data. The genus is characterized by superficial or immersed, globose to subglobose or irregularly-shaped pycnidial conidiomata, ostiolate, sometimes with a short neck around the ostioles, phialidic, hyaline, smooth, globose to flask-shaped conidiogenous cells and ellipsoidal, hyaline or sometimes greenish, aseptate, guttulate conidia; pseudothecial, subglobose to pyriform, ostiolate ascomata and subcylindrical, hyaline ascospores with wider upper cell, constricted at the septum (Chen et al., 2015). Species of this genus have been isolated from soil, e.g., *P. yungensis*, *P. rekkeri*, and *P. truiniorum* (Jiang et al., 2017; Peralta et al., 2021), diseased plant leaves, such as, *P. camelliae* and *P. litseae* (Jiang et al., 2017; Peralta et al., 2021), a few species have been found from submerged wood in freshwater habitats e.g., *P. clausa* (Magaña-Dueñas et al., 2021). *Paraboeremia* species have been reported in China, Spain, and the Netherlands (Chen et al., 2015; Jiang et al., 2017; Peralta et al., 2021; Magaña-Dueñas et al., 2021). Currently, 11 species are accepted in the genus (Index Fungorum, 2024). In this study, we reported *P. litseae* as an endophytic fungus isolated from *D. pedata* in Guizhou Province, China.

Paraboeremia litseae J.R. Jiang & L. Cai, in Jiang, Chen & Cai, Mycol. Progr. 16(4): 291 (2016), Figure 4.12

Fungal Names number: FN 818243

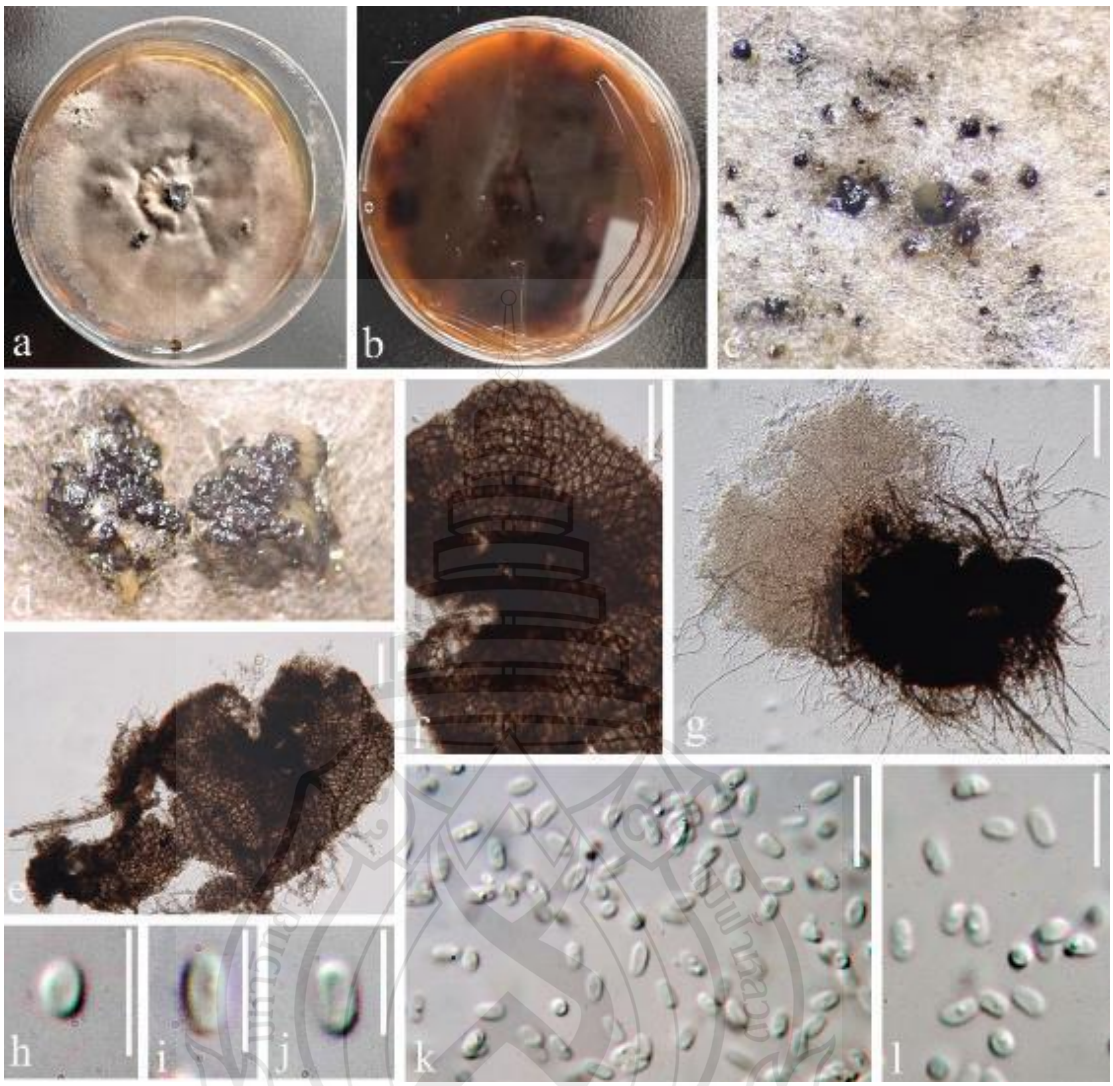
Endophytic in the rhizome of *Dicranopteris pedata*. Sexual morph: undetermined. Asexual morph: *Conidiomata* pycnidial in culture on MEA, gregarious, semi-immersed or nearly superficial, globose to subglobose, black. *Conidiomatal wall* pseudoparenchymatous, composed of semi-immersed or nearly superficial isodiametric

cell. *Conidiogenous cells* phialidic, hyaline, smooth, ampulliform to doliiform. *Conidia* 2.5–3.5 × 1–2 µm ($\bar{x}$ = 3.1 × 1.6 µm, n = 40), ellipsoidal to cylindrical with round ends, aseptate, hyaline, smooth-walled, guttulate. *Chlamydospores* not observed in culture.

Culture characteristics: Colonies on MEA reaching 55–60 mm diam after one month at room temperature 25°C, flattened, velvety, margin regular, grayish brown; reverse dark reddish brown.

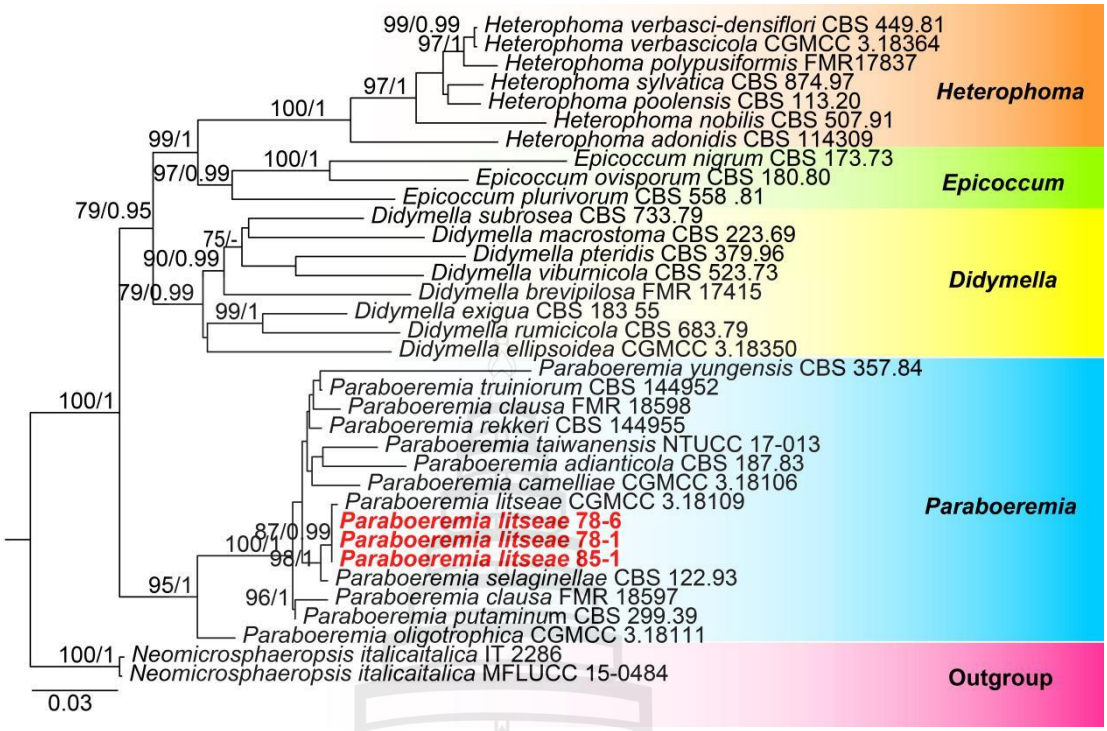
Material examined: China, Guizhou Province, Southwest Guizhou Buyi, and Miao Autonomous Prefecture, Cengheng County, isolated from the rhizome of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, 85–1. Tongren City, Songtao County, from the rhizome of *D. pedata*, 21 February 2022, J.Y. Zhang, 78–1.

Notes: In our phylogenetic analysis of combined ITS, *rpb*2, and *tub*2 sequence data, three new isolates (85–1, 78–6 and 78–1) clustered with *Paraboeremia litseae* CGMCC 3.18109 as the same species (Figure 4.13). Our new isolates share similar morphological characters with *P. litseae* in having semi-immersed or nearly superficial, globose to subglobose conidiomata, ellipsoidal to cylindrical, aseptate, hyaline, smooth-walled conidia (Jiang et al., 2017). Therefore, based on both phylogeny and morphology, we identified our new isolates as *P. litseae*. *Paraboeremia litseae* was described by Jiang et al. (2017), isolated from diseased leaves of *Litsea* sp. (*Lauraceae*) in China. Our new isolate was obtained from *Dicranopteris pedata* and is the first *Paraboeremia* species recorded on *Dicranopteris*.



Note a, b Culture on PDA from above and below. c, d Conidiomata on MEA. e, f Conidiomatal wall. g Conidiomata. h–l Conidia. Scale bars: e, f = 50 µm, g = 100 µm, h–j, l = 5 µm, k = 10 um

Figure 4.12 *Paraboeremia litseae* (85–1)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *rpb*2, and *tub*2 sequence data. 35 taxa were included in the combined analyses, which comprised 1414 characters after alignment. The best scoring RAxML tree with a final likelihood value of -8294.983988 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Neomicrosphaeropsis italicaitalica* (MFLUCC 15–0484 and IT 2286), the newly obtained strains are in red and bold.

Figure 4.13 Phylogenetic tree of *Paraboeremia*

Periconiaceae Nann.

Periconiaceae was introduced by Nannizzi (1934) with *Periconia* as the type genus. This family has long been ignored in modern taxonomic treatments and was placed as a member of *Massarinaceae*. Tanaka et al. (2015) showed that *Periconiaceae* formed a strongly supported clade sister to *Massarinaceae*. They, therefore, resurrected this family with acceptance of four genera *viz. Bambusistroma*, *Flavomyces*, *Noosia* and *Periconia*. However, the phylogenetic status of *Bambusistroma* and *Noosia* remains questionable as they clustered with *Periconia* species in *Periconiaceae*. Yang et al.

(2022) re-evaluated the taxonomic status of *Bambusistroma* and *Noosia* based on morphological and multi-gene phylogenetic analyses, their results showed that *Bambusistroma* has similar morphology with the sexual morph of *Periconia* species, and *Noosia* is not significantly different from *Periconia* species those sporulated in vitro. Hence, these two genera were synonymized under *Periconia.* Currently, *Periconiaceae* comprises two genera, *Flavomyces* and *Periconia*. Nevertheless, as *Flavomyces* lacks morphological characteristics and clusters with *Periconia* species, its generic position is likewise dubious and needs to be clarified.

Periconia Tode

Periconia was introduced by Tode (1791) with *P. lichenoides* Tode as the type. Most *Periconia* species are only known as asexual morphs which are characterized by macronematous, mononematous, branched, or unbranched, and pale to dark brown conidiophores, monoblastic to polyblastic conidiogenous cells that are discrete on the terminal or intercalary of the stipe and globose to ellipsoidal, catenate or solitary, smooth or verruculose, and pale brown to brown conidia (Tanaka et al., 2015; Liu et al., 2017b). Several species have been reported as sexual morphs, characterized by scattered or grouped, globose ascomata with a central ostiole, hyaline periphyses, 8-spored asci, and broadly fusiform,1-septate, hyaline, and smooth ascospores with an entire sheath (Hongsanan et al., 2020b). *Periconia* species are widely distributed and mainly occur as saprobes and endophytes on various hosts, with a few being plant and human pathogens (Ellis, 1971, 1976; Markovskaja & Kačergius, 2014; Liu et al., 2017b; Hongsanan et al., 2020b; Yu et al., 2024). For example, *P. circinata* was reported as a pathogen causing blackening and rotting of wheat roots and stem bases (Goga, 2000), while *P. keratitis* is a human pathogen causing mycotic keratitis in India (Sarkar et al., 2019).

There are 230 records of *Periconia* listed in the Index Fungorum with 30 of which have been transferred to other genera (http://www. indexfungorum.org, accessed 28 November 2024). However, most species have been accepted in the genus based on morphological characters; only 46 species are correlated with molecular data with most species only having ITS and LSU sequence data, which are insufficient to separate them at the species level (Yang et al., 2022). Hence, more phylogenetic markers are required to better understand the species boundaries in this highly diverse genus. In this study, a

new species *Periconia dicranopterisis* is introduced based on morphological and multi-locus phylogenetic analyses.

Periconia dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & J.C. Kang, sp. nov., Figure 4.14

Etymology: the specific epithet dicranopterisis refers to *Dicranopteris*, the fern genus from which the type strain was isolated.

Holotypes KUN-HKAS 129879

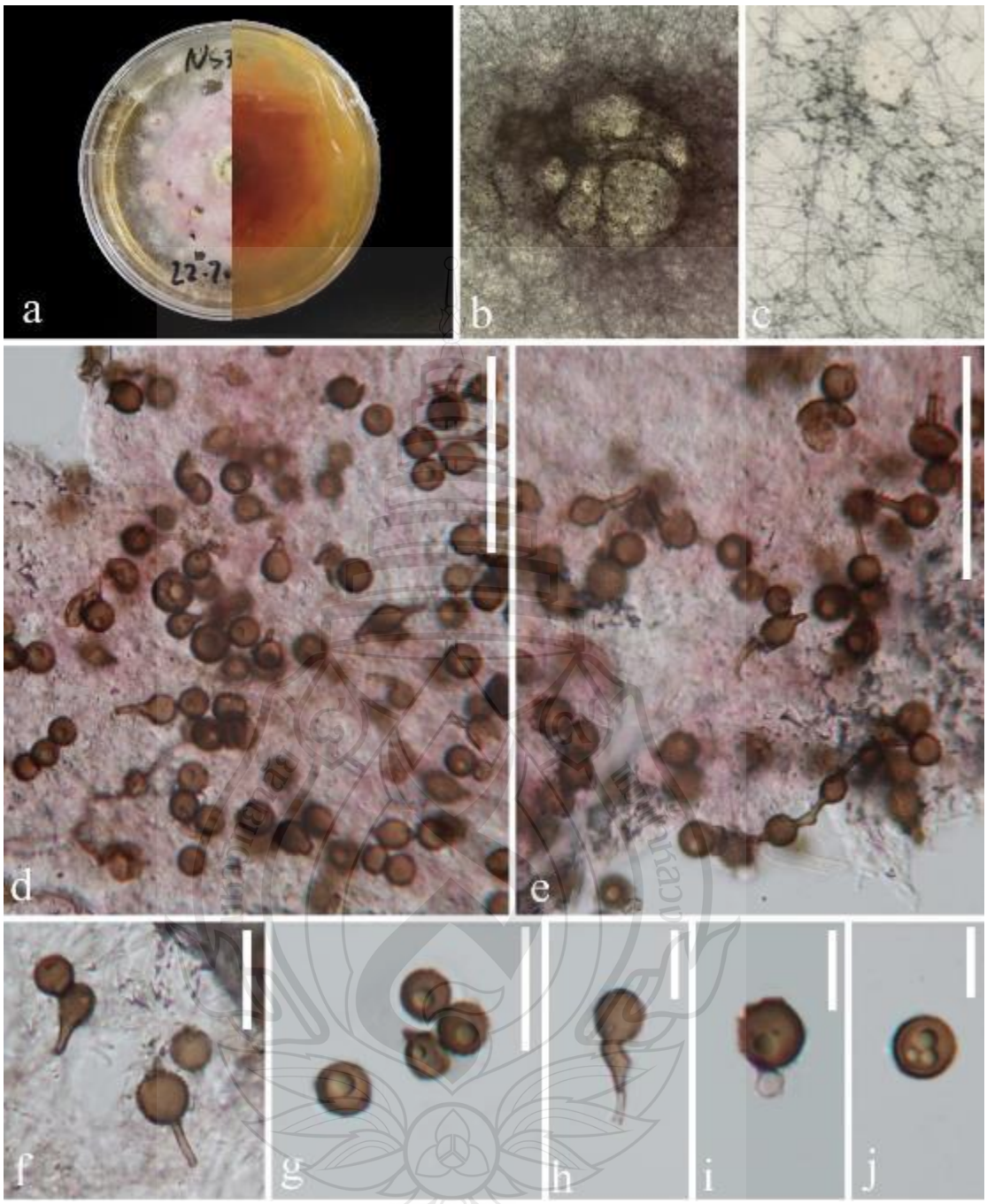
Endophytic in the roots of *Dicranopteris pedata*. Sexual morph: undetermined. Asexual morph: *Mycelium* 1.5–6 µm wide, hyaline to pale brown, branched, septate, smooth, thick walled. *Conidiophores* reduced to conidiogenous cells, cylindrical, brown, aseptate or septate, thick-walled. *Conidiogenous cells* monoblastic to polyblastic, discrete or integrated, determinate, or inconspicuous, cylindrical, brown. *Conidia* 8–11 µm diam ($\bar{x}$ = 9 µm, n = 30), solitary or in short chains, globose, brown to dark brown, aseptate, smooth to verrucose, sometimes with short spines, thick-walled, guttulate.

Culture characteristics: Colonies on MEA reaching 25 mm diameter after seven days at 25°C, irregular, medium dense, flattened, dull, dry, velvety appearance, white hyphal, with pink pigmented at the surface, reverse dark pink at the middle, paler towards the edge.

Material examined: CHINA, Guizhou Province, Sanhe Town, Sandu Shui Autonomous County, Qiannan Buyi, and Miao Autonomous Prefecture, from the roots of *Dicranopteris pedata*, 11 April 2022, J.Y. Zhang, NS364–3 (KUN-HKAS 129879, holotype), ex-type living culture, KUNCC23–14173.

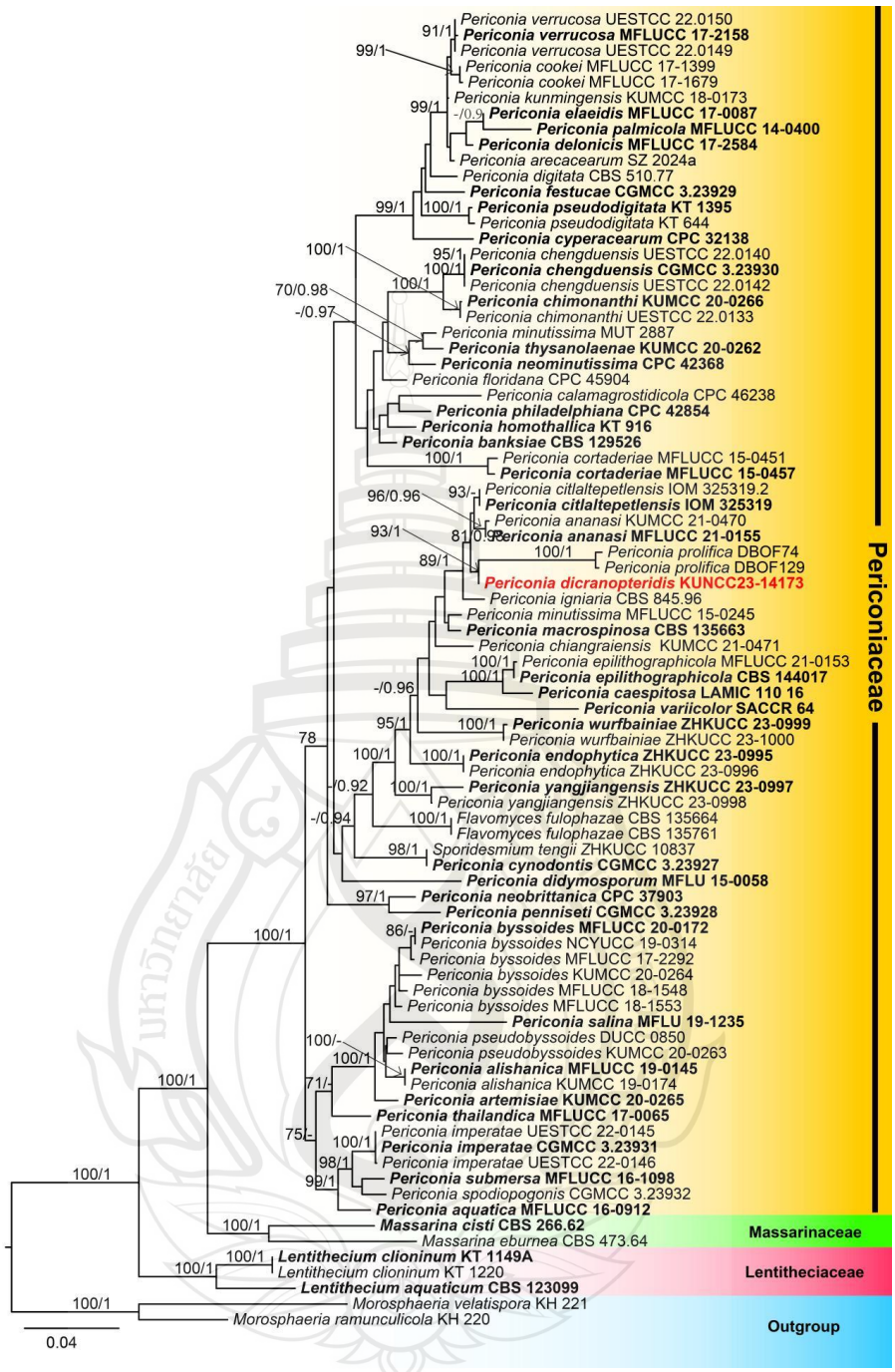
Notes: Our phylogenetic analysis showed that *P. dicranopteridis* clustered as a sister taxon to *P. prolifica* (Figure 4.15). However, *P. dicranopteridis* can be easily distinguished from *P. prolifica* in having guttulate, verrucose conidia with spines. In contrast, conidia of *P. prolifica* are smooth-walled. In addition, pairwise nucleotide comparisons showed that *P. dicranopteridis* (KUNCC23–14173) is significantly different from *P. prolifica* (MFLUCC 21–0155) in 26/508 bp (4.5%) of the ITS. Thus, we introduce *P. dicranopteridis* as a new species based on phylogeny and morphology.

The morphology of *P. dicranopteridis* matches with the generic concept of *Periconia* in having holoblastic, monoblastic, or polyblastic conidiogenous cells and catenate or solitary, brown, spherical to sub-spherical, and aseptate conidia. However, most *Periconia* species have macronematous conidiophores, while conidiophores of *P. dicranopteridis* are micronematous and mostly reduced to conidiogenous cells. Yang et al. (2022) found that *Periconia* species sporulated in cultures resulted in micronematous conidiophores, as opposed to macronematous conidiophores in natural substrates. Our study is consistent with Yang et al. (2022); the new species is an endophyte that sporulates in culture and lacks conspicuous conidiophores. This suggests that the morphology of the same species on natural substrates may differ from the sporulates in culture.



Note a Culture on PDA from above and below. b, c Colonies on PDA. d–j Conidiogenous cells and conidia. Scale bar: d, e = 50 µm, f, g = 20µm, h–j = 10 µm

Figure 4.14 *Periconia dicranopteridis (*KUN-HKAS 129879, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, SSU, and *tef*1-α sequence data. The tree was rooted to *Morosphaeria ramunculicola* (KH 220) and *M. velatispora* (KH 221); the newly obtained strain is in red and the type strains are in bold.

Figure 4.15 Phylogenetic tree of *Periconia*

Phaeosphaeriaceae M.E. Barr

Phaeosphaeriaceae is a highly diverse family comprising 87 genera within *Dothideomycetes* (Hyde et al., 2024). The family was introduced by Barr (1979) with *Phaeosphaeria* as the type genus, which originally comprised 15 genera. Phookamsak et al. (2014) revised this family, accepting 28 genera based on generic type studies, representative specimens, and multi-gene phylogenetic analyses. Since then, many new genera have been consequently introduced to this family; up to now, 87 genera are included in this family (Wijayawardene et al., 2022; Wanasinghe & Maharachchikumbura, 2023; Hyde et al., 2024).

Stagonospora (Sacc.) Sacc.

Stagonospora is a species-rich genus with more than 500 entries listed in Index Fungorum (Index Fungorum, 2024). However, only about 220 species are currently accepted in *Stagonospora* (Wijayawardene et al., 2022; Bhagya et al., 2024). The genus is characterized by erumpent, globose, brown ascomata with a minute ostiole, bitunicate, clavate asci, and ellipsoidal, 1-septate, ascospores with guttules in each cell (Quaedvlieg et al., 2013); immersed, globose to subglobose pycnidia with a single ostiole, conidiophores are reduced to conidiogenous cells with percurrent proliferations and holoblastic conidiogenesis, hyaline, cylindrical to ellipsoidal conidia with minute guttules (Brahmanage et al., 2020). Members of this genus are cosmopolitan, and exhibit diverse lifestyles as saprobes, endophytes, and pathogens of economically important plants with a worldwide distribution (Kobayashi et al., 2005; Quaedvlieg et al., 2013; Thambugala et al., 2017; Bhagya et al., 2024). In this study, five strains were isolated from *Dicranopteris*, and the five strains were identified as *S. tainanensis* based on phylogenetic analysis. This is the first species of *Stagonospora* reported from *Dicranopteris*. In addition, our phylogenetic analysis showed that *Stagonospora* is polyphyletic, and *S. pseudopaludosa* is clustered out of the genus, which is consistent with Bhagya et al. (2024). Therefore, further studies are needed to clarify the accurate placement of this species.

Stagonospora tainanensis W.H. Hsieh, Mycologia 71(5): 893 (1979), Figure 4.16

Fungal Names number: FN 324010

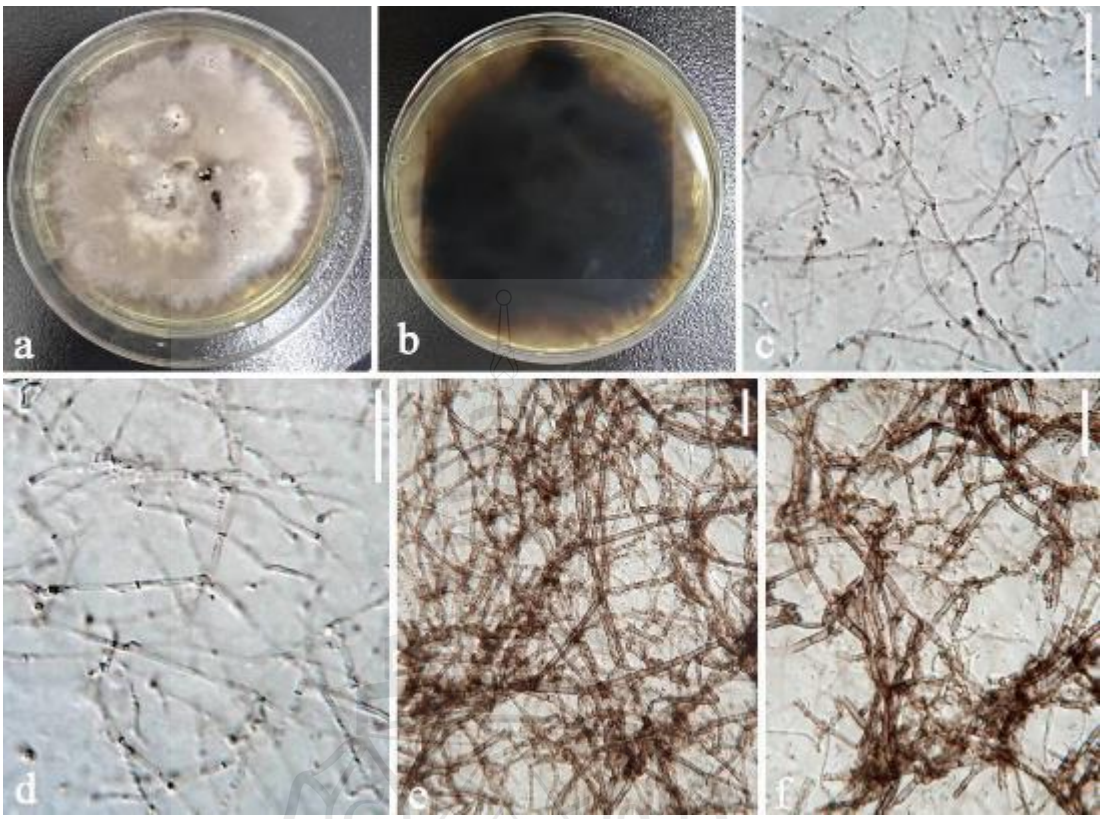
See description in Bensch et al. (2010)

Culture characteristics: Colonies on PDA occupied the whole plate after 20 days at 25°C, colonies circular, margin wavy, flat, velvety appearance with cream to greyish aerial mycelia in the middle, colony from above: greyish brown; reverse: dark brown centre and brown margin.

Material examined: CHINA, Guizhou Province, Songtao County, Tongren City, from the roots of *D. pedata*, 21 February 2022, J.Y. Zhang, NS285–5; Zhengfeng County, Southwest Guizhou Buyi and Miao Autonomous County, from the rhizome of *D. ampla*, 17 March 2022, J.Y Zhang, 137–3; Chengheng County, Qianxinan Buyi and Miao Autonomous Prefecture, from a stem of *D. pedata*, 16 March 2022, J.Y. Zhang, NS182–3; *ibid* NS 253-3; from a stem of *D. ampla*, 16 March 2022, J.Y. Zhang, NS311–3.

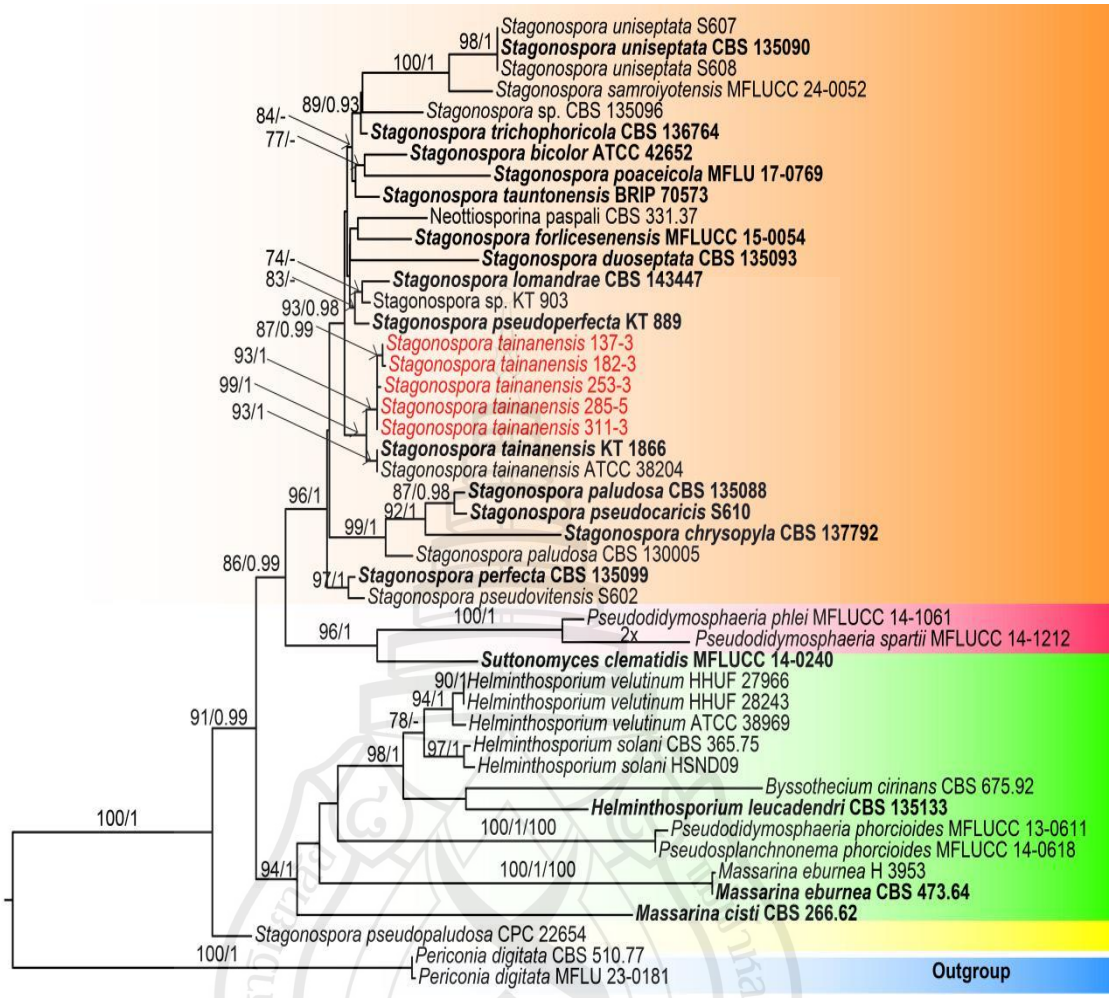
Notes: Based on the combined ITS, LSU, and SSU phylogeny, our new isolates grouped together sister to *Stagonospora tainanensis* (KT 1866 and ATCC 38204) with 100% ML, 99% MP, and 1 BYPP support (Figure 4.17). We were unable to observe the asexual or sexual morph characters in the culture. There were only 7bp, 1, and 0 bp differences in ITS, LSU, and SSU, respectively, between our new strains and *Stagonospora tainanensis* (KT 1866), which does not significantly support our new strains to be a new species. Thus, based on phylogenetic analysis, we identified our new strains as *S. tainanensis*.

Stagonospora tainanensis is a significant pathogen infecting sugarcane, and causes a disease known as sugarcane leaf blight, which causes high cane yield and sugar losses in susceptible cultivars (Xu et al., 2021; Wang et al., 2021; Huang et al., 2023). In this study, we isolated *S. tainanensis* from *Dicranopteris pedata* as an endophyte and it is reported as a new host record.



Note a, b Cultures on WA from above and below. c–f hyphae. Scale bars: c = 30 um, d–f = 20 um

Figure 4.16 *Stagonospora tainanensis* (285–5)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, and SSU sequence data. 46 taxa were included in the combined analyses, which comprised 2426 characters after alignment. The best scoring RAxML tree with a final likelihood value of -9635.061423 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Periconia digitata* (MFLU 23–0181 and CBS 510.77). The newly obtained strains are in red and the type strains are in bold.

Figure 4.17 Phylogenetic tree of *Stagonospora*

Pleosporaceae Nitschke

Pleosporaceae is the largest family in *Pleosporales* (Wijayawardene et al., 2014; Ariyawansa et al., 2015). *Pleosporaceae* species occur worldwide as endophytes and saprobes on various plants or opportunistic human and plant pathogens (Ariyawansa et al., 2015; Hongsanan et al. 2020b). The classification of this family has been a major challenge due to lack of molecular data and reference strains (Ariyawansa et al., 2015). Hyde et al. (2013) accepted 23 genera in this family based on morphology along with molecular data. Ariyawansa et al. (2015) provided a backbone tree for *Pleosporaceae* and accepted 18 genera. To date, the family includes 28 genera (Hyde et al., 2024).

Alternaria Nees

Alternaria is a species-rich dematiaceous hyphomycete genus, with over 800 species epithets (Index Fungorum, 2024); however, only about 417 species are accepted in the genus (Li et al., 2022, 2023) a*lternaria* species are ubiquitous and exist in a variety of ecological niches, including endophytes on asymptomatic plant tissues, saprobes on diverse hosts and substrates, and pathogens of plants and animals, worldwide (Thomma, 2003; Woudenberg et al., 2013, 2015; Gannibal & Lawrence, 2016; Li et al., 2022, 2023). The genus is characterized by mononematous, macro- or micronematous, unbranched or branched conidiophores, mono- to polytretic, integrated to discrete, conidiogenous cells, solitary or catenate, phragmo- or dictyoseptate, straight or curved, medium brown to dark brown, smooth or verrucose, conidia with rounded or narrowly-beaked tip (Li et al., 2022, 2023) a*lternaria* species delimitation has long been disputed and challenging; multi-locus phylogeny has considerably improved species delimitation in the genus and allows for a better resolution of this group (Woudenberg et al., 2013, 2015; Gannibal & Lawrence, 2016; Ghafri et al., 2019; Li et al., 2023). Lately, Li et al. (2023) updated the species limits, evolution, multi-locus phylogeny, and classification of *Alternaria*; currently, 29 sections have been identified in the genus.

Alternaria longipes (Ellis & Everh.) E.W. Mason, Mycological Papers 2: 19 (1928)

Fungal Names number: FN 269712; Figure 4.18

Endophytic in fresh leaves of *Dicranopteris pedata.* Sexual morph: undetermined. Asexual morph: *Mycelium* hyaline to brown, branched, septate, smooth, thick walled. *Conidiophores* 25–85 × 3–4 µm ($\bar{x}$ = 49.5 × 3.5 µm, n = 10), macronematous, mononematous, straight, or flexuous, cylindrical, brown to dark brown, septate, branched, smooth, thick-walled. *Conidiogenous cells* 4–12 × 2.5–4.5 µm ($\bar{x}$ = 6 × 3.5 µm, n = 20), mono- to polytretic, integrated, terminal, cylindrical, brown, smooth, with a distinct apical conidiogenous loci. *Conidia* 16–27 × 8–14 µm ($\bar{x}$ = 20.5 × 11.5 µm, n = 30), acrogenous, catenate, formed in acropetal chains, subglobose, ovoid to obpyriform, beakless, brown to dark brown, 1–4 transversely euseptate, with 1–2 longitudinal or oblique septa in some transverse divisions, smooth, formed apically secondary conidiophores with 1–2 conidiogenous loci.

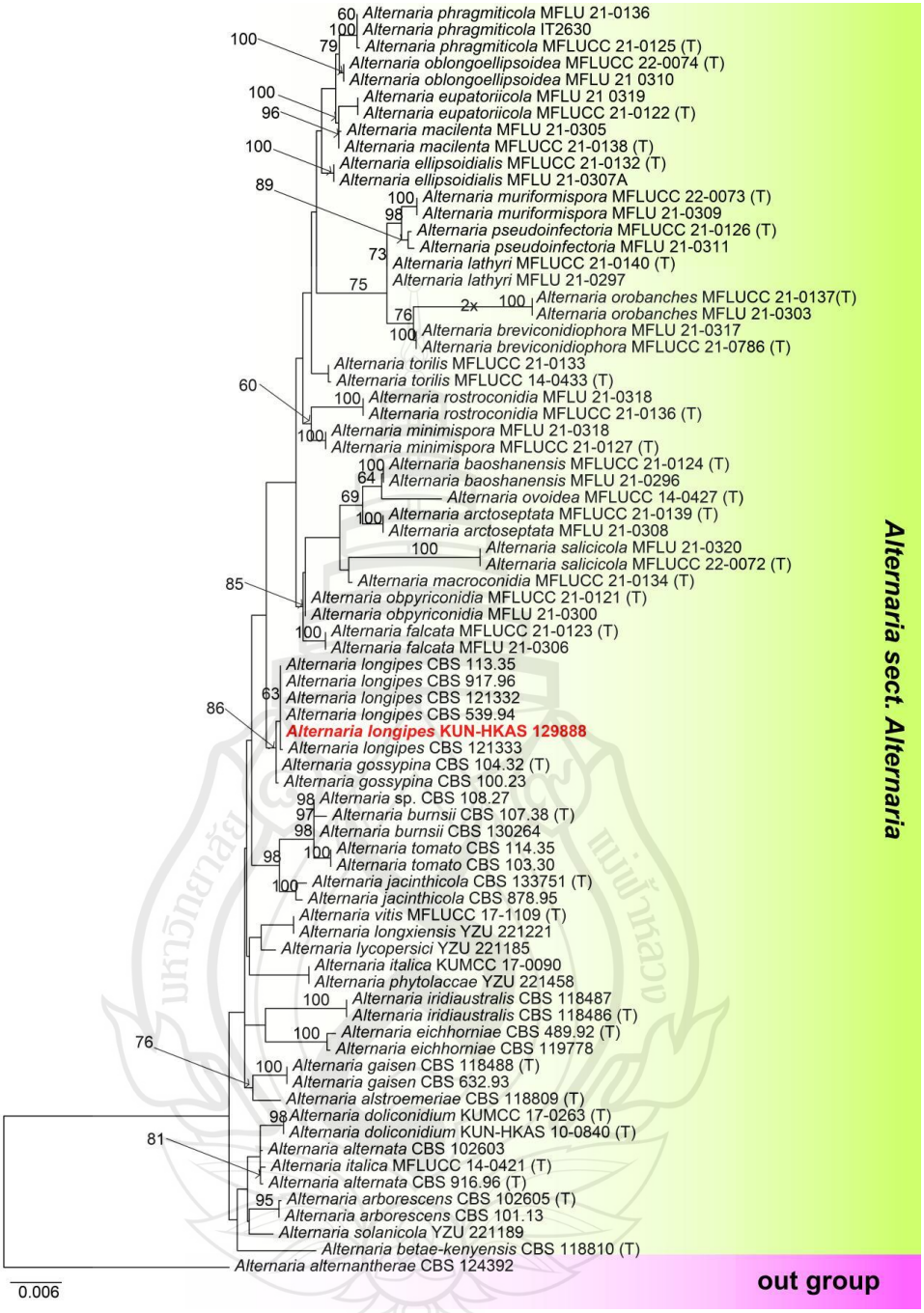
Culture characteristics: C*olonies* on PDA medium circular, with flat surface, edge entire, superficial and partially immersed, reaching 50 mm diam. in 10 days at 26°C, dark brown, and does not produce pigmentation in culture.

Material examined: CHINA, Guizhou Province, Southwest Guizhou Buyi and Miao Autonomous Prefecture, Zhenfeng County, isolated from the leaves of *Dicranopteris pedata*, 17 March 2022, J.Y Zhang, NS189–1 (KUN-HKAS 129888).

Notes: Mason (1928) introduced *Alternaria longipes*, a plant pathogen that causes leaf spots (Hou et al., 2016; Wang et al., 2020). In the phylogenetic analyses, our strain clustered with *A. longipes* as the same species (Figure 4.19). In addition, our strain matches well with *A. longipes* in morphology (Ellis, 1971). Based on morphology and phylogeny, we identify our strain as *A. longipes* and report it as a new host record in Thailand.

Note a, b Cultures on PDA. c Colonies on PDA. d–f Conidiophores. g, h Conidiogenous cells with conidia. i–y Conidia. Scale bars: d = 100 μm, e–g, i = 20 μm, j–y = 10 μm, h = 5 μm

Figure 4.18 *Alternaria longipes* (KUN-HKAS 129888)



Note Phylogram generated from maximum likelihood analysis based on combined SSU, LSU, ITS, *rpb*2, *gadph*, *tef*1-α and *alt*-α sequence data. 76 taxa were included in the combined analyses, which comprised 4317 characters after alignment. The newly obtained strains are in red and bold.

Figure 4.19 Phylogenetic tree of *Alternaria*

Amorosiaceae Thambug. & K.D. Hyde

Amorosiaceae was proposed for a hyphomycete genus *Amorosia* (type genus) along with a newly established genus *Angustimassarina* by Thambugala et al. (2015) based on phylogenetic analysis and morphological characteristics. Four additional genera *viz. Alfoldia*, *Amorocoelophoma*, *Neoangustimassarina*, *Neothyrostroma* and *Podocarpomyces* were subsequently introduced to the family (Crous et al., 2019a; Jayasiri et al., 2019; Yu et al. 2022). Currently, five genera are included in *Amorosiaceae*, except *Amorocoelophoma* and *Angustimassarina*; all other genera are monotypic and comprise a single species.

Amorocoelophoma Jayasiri, E.B.G. Jones & K.D. Hyde

Amorocoelophoma was established to accommodate a coelomycetous fungus, *A. cassiae* which was collected on fallen pods of *Cassia* sp. (*Fabaceae*) from Thailand (Jayasiri et al., 2019). Three species, *viz. A. camelliae*, *A. neoregeliae* and *A. sinensis* were subsequently added to the genus based on morphological characteristics and phylogenetic analyses. *Amorocoelophoma camelliae* was collected from leaves of *Camellia sinensis* (*Theaceae*) (Ariyawansa et al., 2020), *A. neoregeliae* from leaf spots of *Neoregelia* sp. (*Bromeliaceae*) (Crous et al., 2021a), while *A. sinensis* was isolated from soil (Zhang et al., 2024a). Only coelomycetous asexual morphs are known for *Amorocoelophoma*, which is characterized by pycnidial, solitary to gregarious, ovoid to globose, brown conidiomata, phialidic, doliiform, hyaline conidiogenous cells and hyaline, cylindrical, aseptate conidia (Jayasiri et al., 2019). Recent studies showed that *Amorocoelophoma* is polyphyletic. Yu et al. (2022) showed that *A. cassiae* and *A. neoregeliae* clustered with *Alfoldia vorosii* and *Neothyrostroma cassiae* in a weakly supported clade, while *A. camelliae* formed a distinct lineage within the family. The phylogenetic analysis of Zhang et al. (2024a) obtained a similar result as Yu et al. (2023); their result showed that *A. camelliae* clustered into a single clade and separated from *A. cassiae*, *A. neoregeliae*, and *A. sinensis*. Thus, the genus is polyphyletic and the placement of *A. camelliae* needs to be re-evaluated. In this study, we introduce a new endophytic species, *A. dicranopterisis* isolated from *Dicranopteris linearis*.

Amorocoelophoma dicranopteridis J.Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov*, Figure 4.20

Etymology: the specific epithet dicranopterisis refers to *Dicranopteris*, the fern genus from which the type strain was isolated.

Holotype: KUN-HKAS 129908

Endophytic in the root of *Dicranopteris linearis*. Sexual morph: Undetermined. Asexual morph: *Conidiomata* dark brown to black, solitary to gregarious or confluent, stromatic, erumpent, globose, pycnidial, multilocular or unilocular. *Conidiomatal wall* composed two cell types; outer layers of *textura angularis* to *textura globosa* to with brown to dark brown cells, inner layers of *textura globosa* with pale brown to hyaline, cells. *Conidiophores* lining the inner cavity, reduced to conidiogenous cells, hyaline, smooth. *Conidiogenous cells* 5–8 × 2–3 µm ($\bar{x}$ = 6.6 × 2.5 µm, n = 20), hyaline, phialidic, determinate, ampulliform to subcylindrical, or obovoid, smooth. *Conidia* 2.5–3.5 × 1–2 µm ($\bar{x}$ = 3.2 × 1.6 µm, n = 40), solitary, ellipsoid, subglobose to globose, hyaline, smooth-walled, guttulate.

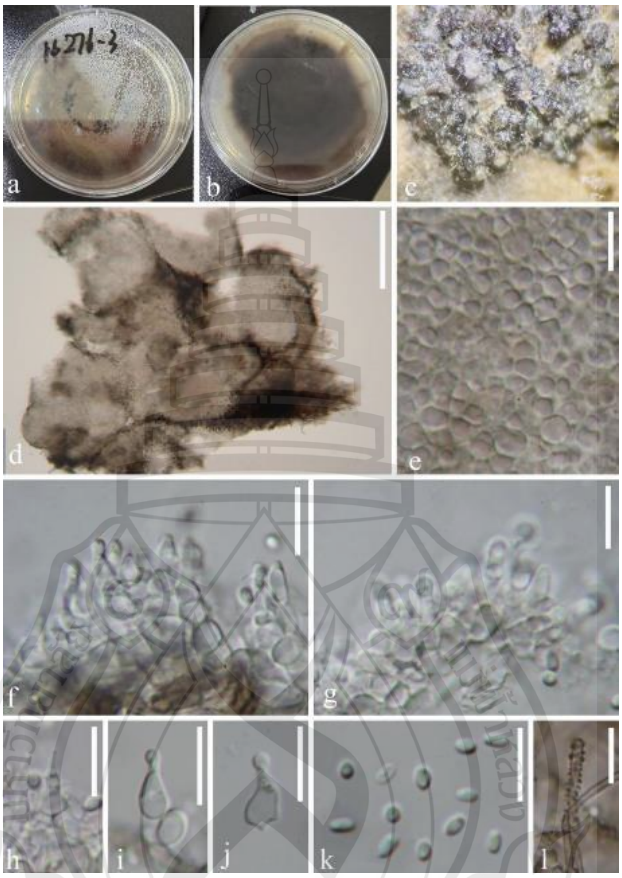
Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the root of *Dicranopteris linearis*, 16 March 2022, J.Y. Zhang, NS276–3 (KUN-HKAS 129908, holotype), ex-type living culture (KUNCC 23–14198).

Culture characteristics: Colonies on PDA medium reach 40–50 mm diam. after 2 weeks at room temperature, colonies circular, medium dense, flattened, dull, sponge-like areas in middle, from above, brown to dark brown, rough; from below pale brown at the margin, dark brown at the center.

Notes: Our phylogenetic analysis showed that *Amorocoelophoma* is polyphyletic which is consistent with Yu et al. (2022), and the new isolate (KUNCC 23–14198) formed a distinct clade sister to *A. neoregeliae* in *Amorosiaceae*, while *Amorocoelophoma camelliae* clustered out of *Amorocoelophoma*, sister to *Neothyrostroma encephalarti* (Figure 4.21). Thus, the placement of this species needs to be clarified based on further phylogenetic and morphological analyses.

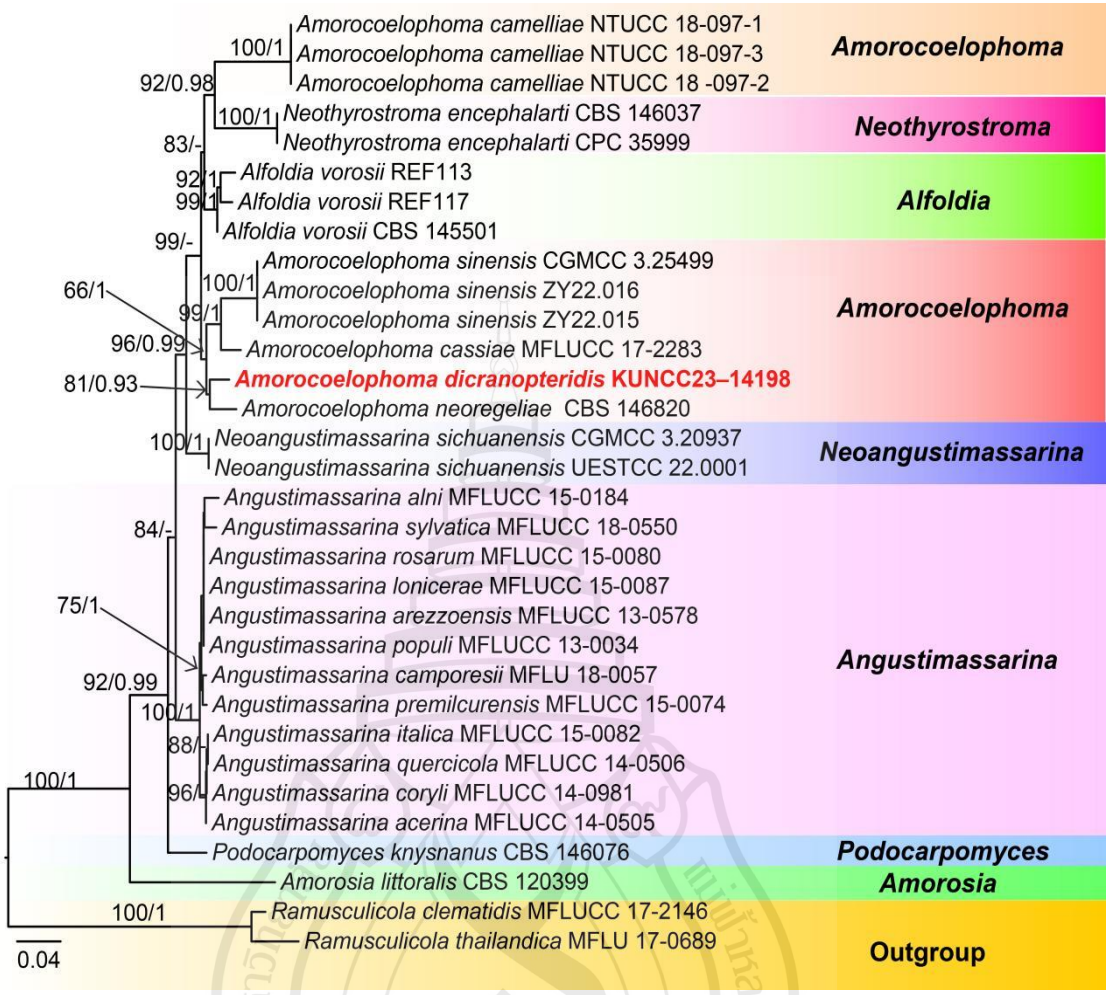
Our new isolate is similar to *A. neoregeliae* in having pycnidial, solitary to gregarious, ovoid to globose, brown conidiomata, hyaline, phialidic conidiogenous cells, and hyaline, aseptate conidia. However, it differs from *A. neoregeliae* in having ellipsoid,

subglobose to globose, and smaller conidia (2.5–3.5 × 1–2 vs. (3–)3.5–4.5(–5) × (1.5–)2(–2.5) µm) (Crous et al., 2022). In contrast, the conidia of *A. neoregeliae* are cylindrical. Based on, morphology and phylogeny, we introduce a new species, *A. dicranopteridis*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d Section through conidiomata. e Peridium f–j Conidiogenous cells and Conidia. k Conidia. l Mycelium. Scale bar: d = 200µm, e–l = 10µm

Figure 4.20 *Amorocoelophoma dicranopteridis* (KUN-HKAS 129908, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, SSU, *rpb*2, and *tef*1-*α* sequence data. A total of 32 taxa were included in the combined analyses, which comprised 4051 characters after alignment. The best scoring RAxML tree with a final likelihood value of -13214.885791 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Ramusculicola clematidis* (MFLUCC 17–2146) and *R. thailandica* (MFLU 17–0689); the newly obtained strains are in red and bold.

Figure 4.21 Phylogenetic tree of *Amorocoelophoma*

Venturiales Y. Zhang ter, C.L. Schoch & K.D. Hyde

Venturiales was introduced by Zhang et al. (2011), and it comprises two families *viz. Sympoventuriaceae* and *Venturiaceae* (Shen et al., 2020' Hongsanan et al., 2020a; Wijayawardene et al., 2022). We followed the latest updated accounts of this order provided by Wijayawardene et al. (2022).

Sympoventuriaceae Y. Zhang ter, C.L. Schoch & K.D. Hyde

Sympoventuriaceae, a highly diverse family in *Venturiales* (*Dothideomycetes*, *Ascomycota*), was erected by Zhang et al. (2011) with *Sympoventuria* as the type genus. The classification of *Sympoventuriaceae* has long been controversial and the generic boundaries remain many unresolved questions due to the lack of molecular data and a high level of morphological plasticity. Wei et al. (2022) redefined the generic boundaries of *Sympoventuriaceae* and accepted 22 genera based on seven loci (SSU, ITS, LSU, *act*, *tub*2, *tef*1-α and *rpb*2) phylogenetic analysis and morphological characteristics. Members of this family are saprobes, endophytes, plant pathogens, and opportunistic pathogens in humans and animals (e.g., *Neofusicladium cameroonensis* and *Verruconis gallopava*) with a wide geographical distribution (Zhang et al., 2011; Seyedmousavi et al., 2013; Liu et al., 2017a; Wijayawardene et al., 2018; Wei et al., 2022).

Verruconis Samerp., H.J. Choi, van den Ende, Horré & de Hoog

Verruconis, a well-studied genus, was introduced by Samerpitak et al. (2014) to accommodate *V. gallopava* and *V. verruculosa* which were transferred from *Ochroconis* and *Scolecobasidium,* respectively. *Verruconis gallopava* was designated as the type. Since then, several new species have been introduced to the genus; currently, 15 species are accepted in the genus, and all of them have sequence data available in the GenBank (Qiao et al., 2019; Shen et al., 2020; Shao et al., 2022; Wei et al., 2022).

Most *Verruconis* species are only known as the asexual morphs, characterized by micronematous, mononematous, septate conidiophores, holoblastic, determinate, conidiogenous cells and clavate to cylindrical, verrucose to smooth-walled conidia (Samerpitak et al., 2014; Shen et al., 2020; Shao et al., 2022). Only *Verruconis mangrovei* has been reported by the sexual morph, characterized by superficial to semi-immersed, clustered, or solitary, globose to subglobose, coriaceous, pale brown to dark brown, setae ascomata, bitunicate, broadly clavate, asci with an ocular chamber and

dictyosporous, ellipsoidal to oblong, hyaline to pale brown ascospores (Hyde et al., 2020). Species of *Verruconis* have been found in a variety of habitats, including soil, roots, and leaves of plants, hot spring water, and decaying wood and industrial effluents (Qiao et al., 2019; Shen et al., 2020; Shao et al., 2022). While *V. gallopava* is a human and animal pathogen, which is the primary agent of human brain infections and causes encephalitis in poultry and wild birds, dogs, and cats (Geltner et al., 2015). This study introduces a novel endophytic species, *V. hyalinus* isolated from *Dicranopteris pedata* based on phylogeny and morphology.

Verruconis hyalina J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov*, **Figure 4.22**

Etymology: The name refers to its hyaline conidia

Holotype: KUN-HKAS 129902

Endophytic in the healthy rhizome of *Dicranopteris pedate*. Sexual morph: Undetermined. Asexual morph: *Mycelium* hyaline, branched, septate, 1–4 µm wide. *Conidiophores* arising from vegetative hyphae, micronematous, mononematous, solitary, cylindrical, hyaline, simple or branched, septate, slightly constricted at the septa, thin-walled. *Conidiogenous cells* 5–18 × 2–3.5 µm ($\bar{x}$ = 10 × 3 µm, n = 25), monoblastic, integrated, terminal, hyaline. *Conidia* 9–16.5 × 4.5–9.5 µm ($\bar{x}$ = 11.5 × 6 µm, n = 25), acrogenous, solitary, subglobose, ellipsoidal, obovoid, oblong, or irregular, hyaline, aseptate or 1–3-septate, strongly constricted at the septa, smooth.

Culture characteristics: C*olonies* on MEA medium under natural light, reaching 18 mm diam. in 20 days at 26°C, circular with entire margin, umbonate with a knobby protuberance in the center, cottony to fluffy, without veined and wrinkle, taupe with pale edge from above; black or dark brown in reverse side, and does not produce pigmentation in culture.

Material examined: China, Guizhou Province, Southwest Guizhou Buyi, and Miao Autonomous Prefecture, Chengheng County, isolated from the healthy rhizome of *D. pedata*, 16 March 2022, J.Y. Zhang, NS267–6 (KUN-HKAS 129902, holotype), ex-type living culture KUNCC 23–14194.

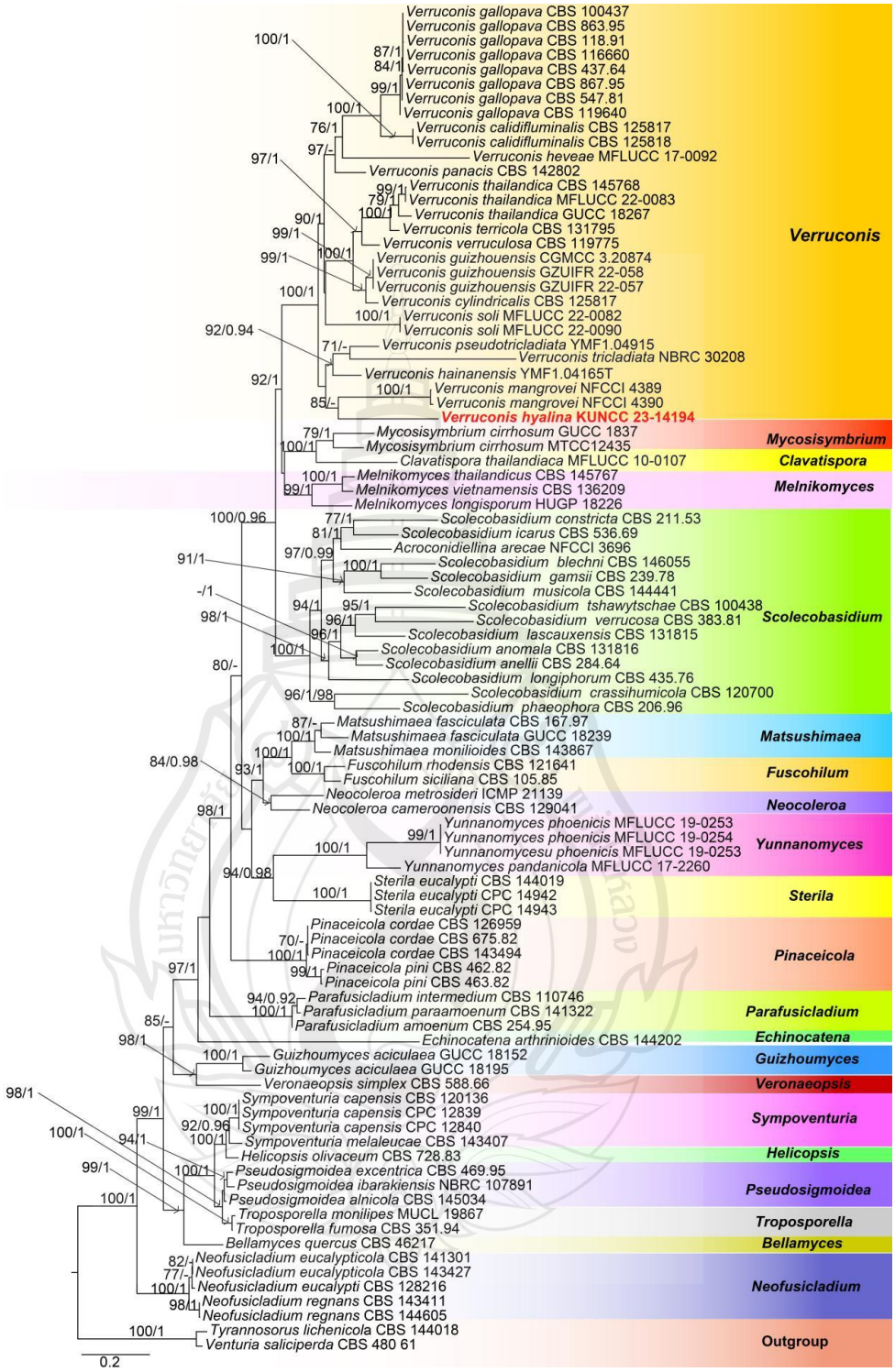
Notes: Phylogenetic analysis showed that our new collection shares a sister relationship with *V. mangrovei* with 100% ML/1.00 PP support (Figure 4.23). *Verruconis mangrovei* is the only sexual species in *Verruconis*, which was introduced

by Hyde et al. (2020), and it is a saprobe found on dead mangrove wood from marine habitats. Our collection is an endophyte isolated from *Dicranopteris pedata* and only an asexual morph was reported for this species; thus, we were unable to compare the morphology of our new collection and *V. mangrovei*, but phylogenetically they are distinct. Comparisons of the ITS and LSU sequences of our new collection and the ex-type of *V. mangrovei* revealed 99bp and 58bp differences, respectively, which strongly support our new collection as a new species. In addition, our collection is distinct from other asexual *Verruconis* species by its hyaline, smooth-walled conidia, and diverse conidial shape. Thus *V. hyalina* is introduced as a new species.

In this study, we found significant differences in the ITS and LSU regions between our new species and the closely related *V. mangrovei*. However, despite these differences, our new species clusters within the same genus. This raises questions about the standardization of evaluating new species solely based on nucleotide variations within the genus.

Note a, b Cultures on MEA from above and below. c Colonies on MEA. c Colonies on MEA. d–k Conidiophores, conidiogenous cells, and conidia. l–s Conidia. Scale bars: d–g = 20 µm, h–s = 10 µm

Figure 4.22 *Verruconis hyalina* (KUN-HKAS 129902, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. The newly obtained strains are in red and bold.

Figure 4.23 Phylogenetic tree of *Verruconis*

Eurotiomycetes O.E. Erikss. & Winka

Chaetothyriales M.E. Barr

Barr (1987) introduced *Chaetothyriale*s. Tian et al. (2021) provided phylogenetic analysis and morphological reappraisal of *Chaetothyriale*s and accepted ten families: *Chaetothyriaceae*, *Coccodiniaceae*, *Cyphellophoraceae*, *Epibryaceae*, *Herpotrichiellaceae*, *Lyrommataceae*, *Microtheliopsidaceae*, *Paracladophialophoraceae*, *Pyrenotrichaceae* and *Trichomeriaceae*, with 55 genera.

Herpotrichiellaceae Munk

Herpotrichiellaceae was established by Munk (1953) and placed in *Chaetothyriales* (*Eurotiomycetes*), with *Herpotrichiella* as the type genus. *Herpotrichiellaceae* species are distributed all over the world and can be found in a wide range of environments, such as air, insects, plants, rocks, and soil (Feng et al., 2014; Sun et al., 2020; Tian et al., 2021; Thitla et al., 2023). *Herpotrichiellaceae* is characterized by setose, ostiolate ascomata, bitunicate asci with a thickened endotunica and greenish-grey to brown, 1-multi transversely septate ascospores, rarely with longitudinal septa (Munk, 1953; Untereiner et al., 1995; Tian et al., 2021). The asexual morph of *Herpotrichiellaceae* is dematiaceous hyphomycetes, commonly referred to as black yeast, including *Capronia*, cladophialaphora-like species, *Exophiala*, *Fonsecaea*, and *Philaphora*. (Gueidan et al., 2014). Currently, 20 genera are accepted in the family (Tian et al., 2021; Thitla et al., 2023).

Cladophialophora Borelli

Cladophialophora is an asexual genus of simple hyphomycetes, characterized by branched or unbranched chains of conidia with hyaline conidial scars produced through blastic conidiogenesis (Sutton et al., 2009; Obase et al., 2016; Chang et al., 2023). *Cladophialophora* species are regularly reported as human pathogens, causing a range of illnesses from moderate cutaneous lesions to deadly encephalitis (Badali et al., 2008, 2009, 2010). Some are also endophytes, plant or human pathogens (de Hoog et al., 2007; Crous et al., 2007b; Obase et al., 2016; Nascimento, 2021), lichenicolous fungi (Diederich, 2010; Diederich et al., 2013, 2018; Chang et al., 2023) and rock-inhabiting fungi (Fu et al., 2023). Currently, over 45 species are accepted in the genus with diverse ecological habitats from various substrates, such as plants, soil, rock, sports drinks, humans, and lichens (Badali et al., 2008; Obase et al., 2016; Tang et al.,

2017; Chang et al., 2023; Fu et al. 2023). This study introduces a novel endophytic species, *C. globosa* based on phylogenetic analysis and morphological characteristics.

Cladophialophora globosa J.Y. Zhang, D.F. Bao, & J.C. Kang, *sp. nov.*, Figure 4.24

Etymology: The name refers to its globose conidia.

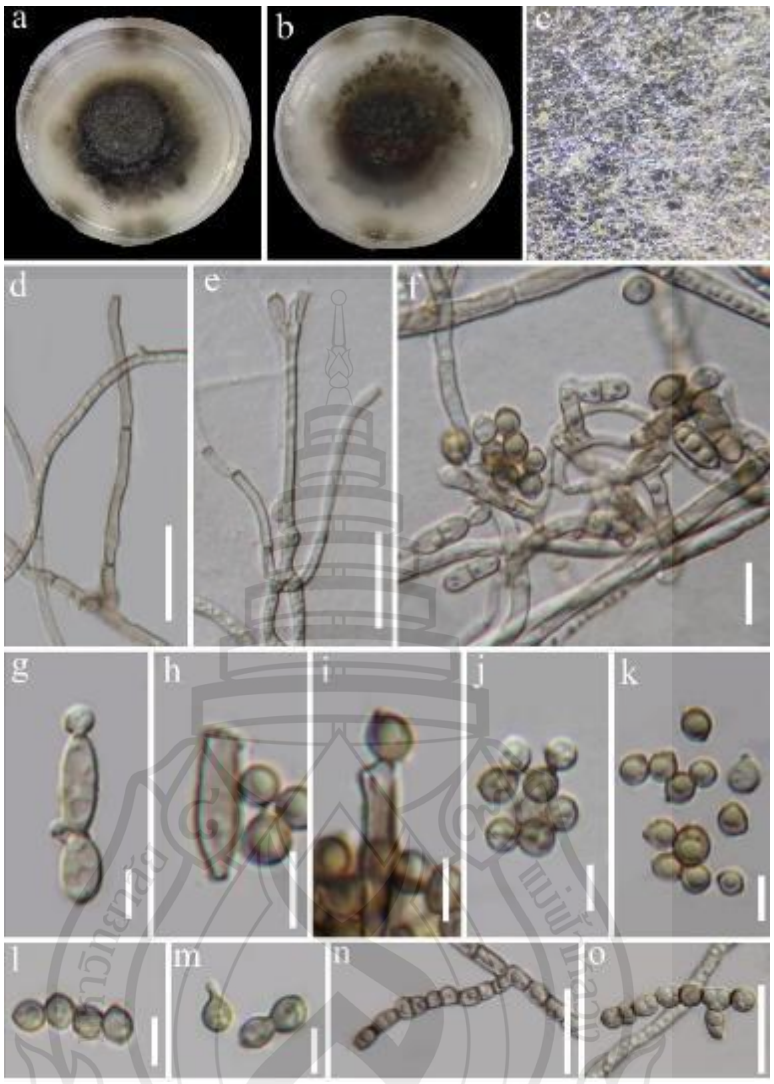
Holotype: KUN-HKAS 129911

Endophytic in the rhizome of *Dicranopteris ampla*. Sexual morph: Undetermined. Asexual morph: *Mycelium* hyaline to pale brown, branched, septate, smooth-walled. *Conidiophores* 1.5–4 µm wide, micronematous, reduced to conidiogenous cells, terminal or lateral on undifferentiated hyphae, pale to brown, branched, septate, think-walled. *Conidiogenous cells* 7.5–10 × 2–3.5 µm ($\bar{x}$ = 8.5 × 2.8 µm, n = 15), blastic, integrated, terminal, and intercalary, subcylindrical, denticulate. *Conidia* 3.5–6 × 2.5–4.5 µm ($\bar{x}$ = 4.5 × 3.5 µm, n = 30), solitary or catenate, globose to ovoid, subhyaline to brown, aseptate, smooth to verrucous, guttulate.

Culture characteristics: Colonies on medium of WA-carrot mixture under alternating natural and ultraviolet light, reaching ca. 52 mm diam. in 15 days at 26°C, circular with filamentous margin, flat, without veined and wrinkle, dark brown to black, and does not produce pigmentation in culture.

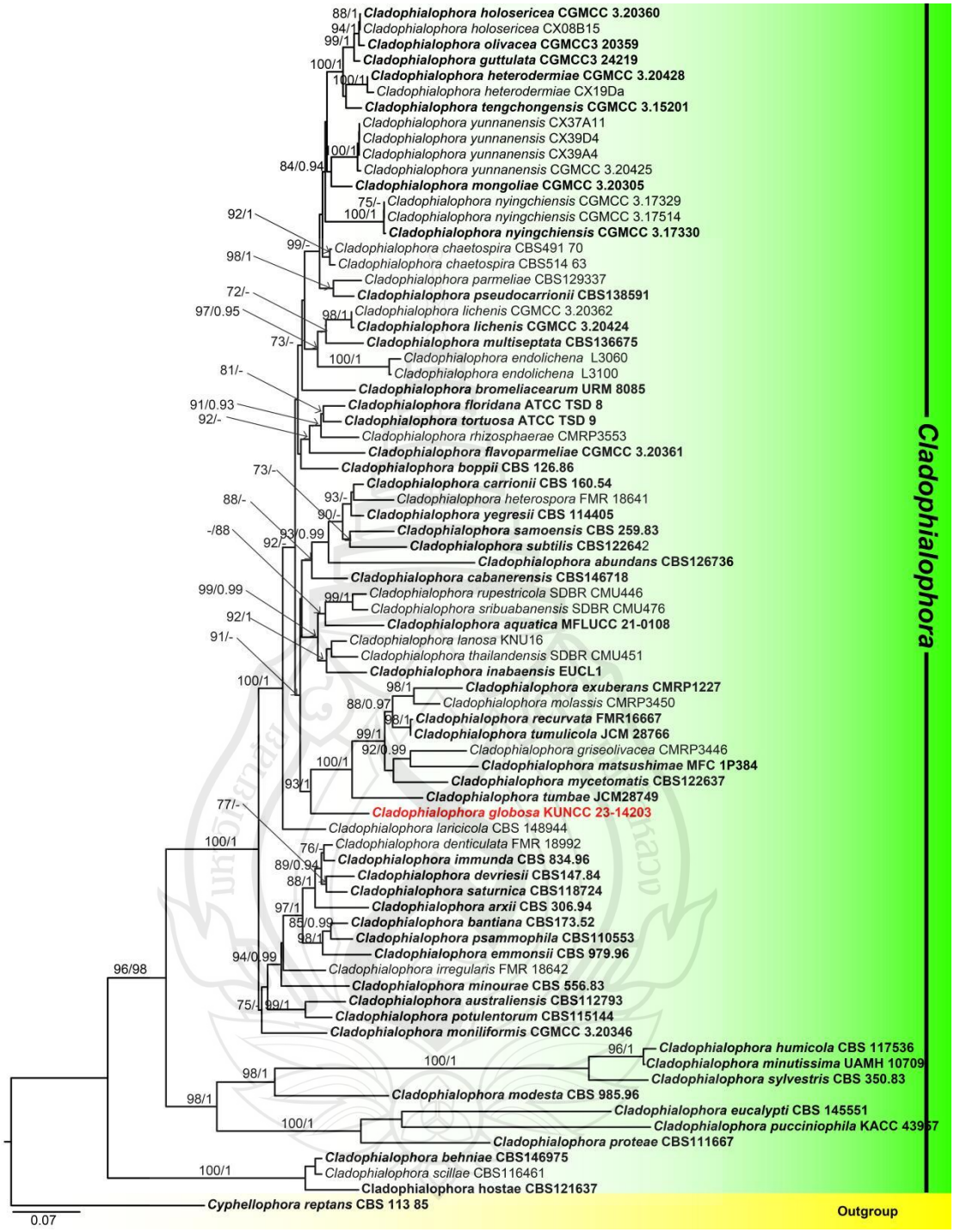
Material examined: CHINA, Guizhou Province, Southwest Guizhou Buyi and Miao Autonomous Prefecture, Zhenfeng County, isolated from the healthy rhizome of *Dicranopteris ampla*, 17 March 2022, J.Y Zhang, 317–4 (KUN-HKAS 129911, holotype), ex-type living culture KUNCC 23–14203.

Notes: In the phylogenetic analyses, our strain 317–4 grouped with *C. exuberans*, *C. griseolivacea*, *C. matsushimae*, *C. molassis*, *C. mycetomatis*, *C. recurvata*, *C. tumbae*, and *C. tumulicola*, but in a distinct basal clade (Figure 4.25). Morphologically, our new isolate has sub-hyaline to pale olivaceous, globose to ovoid, guttulate conidia. In contrast, conidia of the eight species are fusiform. Therefore, based on both phylogeny and morphology, we introduce our new isolate as a new species, namely *C. globosa*.



Note a, b Cultures on WA-carrot mixture from above and below. c Colonies on the WA-carrot mixture. d, e Conidiophores f Hyphae and conidia. g–i Conidiogenous cells and conidia. j–m Conidia. n, o Chlamydospore. Scale bars: d–f, n, o = 20 µm, g–m = 5 µm

Figure 4.24 *Cladophialophora globosa* (KUN-HKAS 129911, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, SSU, *tef*1-*α*, and *tub*2 sequence data. The tree is rooted to *Cyphellophora reptans* (CBS 113.85); the newly obtained strains are in red and bold.

Figure 4.25 Phylogenetic tree of *Cladophialophora*

Leotiomycetes O.E. Erikss. & Winka

Helotiales Nannf.

Helotiales is a highly diverse order, containing over half of the described species within the class *Leotiomycetes*. It also has the largest number of genera classified as *incertae sedis* at the familial level, indicating the need for further research to clarify their taxonomic placement (Baral et al., 2016; Quijada, 2018; Johnston et al., 2019; Wijayawardene et al., 2022). The most recent list of *Helotiales*, was by Wijayawardene et al. (2022) recognized 36 families in *Helotiales*.

Massicellisporaceae D.F. Bao, J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *fam. nov.*

Type genus: *Neocoadophora* D.F. Bao, J.Y. Zhang, Y.Z. Lu & J.C. Kang

Endophytic in dead plant tissues. Sexual morphs: Undetermined. Asexual morphs: *Colonies* on PDA media circular, flat, with an entire edge, pale grey to dark grey from above, reddish brown from below. *Mycelium* brown, branched, septate, wide. *Conidiophores* micronematous, reduced to conidiogenous cells, cylindrical, hyaline to pale brown, smooth-walled. *Conidiogenous cells* monophialidic, integrated, intercalary, doliiform, subhyaline to brown. *Conidia* solitary or catenate and quickly become mass of cells, hyaline when young, becoming pale brown to dark-brown when mature, generally similar in shape, globose, subglobose, ellipsoidal to obovoid, rounded or with truncate base, smooth-walled.

Type genus: *Massicellispora* D.F. Bao, J.Y. Zhang, K.D. Hyde & Y.Z. Lu

Notes: Phylogenetic analysis showed that our two new isolates *Massicellispora globosa* (KUNCC23–14165) and *M. dicranopteris* (KUNCC23–14190) grouped with three strains of *Rhexocercosporidium* sp. (Dzf14, P5Es5, and TRXY 46) in a well-supported clade within *Helotiales*, but did not belong to any family. (Figure 4.26). Thus, *Massicellisporaceae* is introduced to accommodate a single genus *Massicellispora* with two new endophytic species (*N. globosa* and *N. dicranopteris*) and three strains (Dzf14, P5Es5, and TRXY 46) based on phylogenetic analysis.

Massicellispora D.F. Bao, J.Y. Zhang, K.D. Hyde & Y.Z. Lu, *gen. nov.*

Etymology: Refers to the conidia quickly becoming a mass of cells

Endophytic in plant tissues. Sexual morphs: Undetermined. Asexual morphs: *Colonies* on PDA media circular, flat, with entire edge, pale grey to dark grey from above, reddish brown from below. *Mycelium* brown, branched, septate, wide.

Conidiophores micronematous, reduced to conidiogenous cells, cylindrical, hyaline to pale brown, smooth-walled. *Conidiogenous cells*, monoblastic, integrated, intercalary, doliiform, subhyaline to brown. *Conidia*, solitary or catenate and quickly become mass of cells, hyaline when young, becoming pale brown to dark-brown when mature, generally similar in shape, globose, subglobose, ellipsoidal to obovoid, rounded or with truncate base, smooth-walled.

Type species: *Massicellispora dicranopteridis* J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu

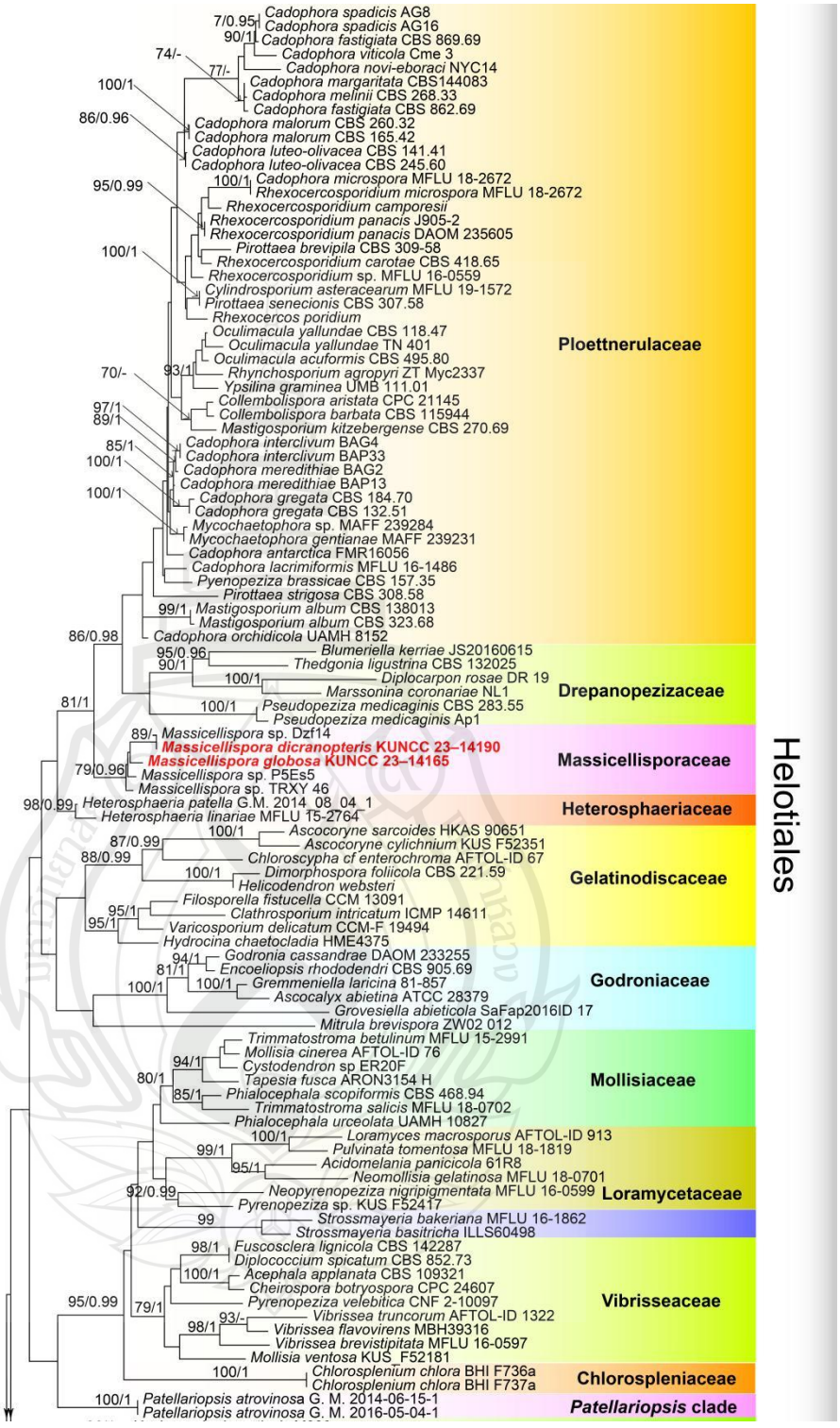
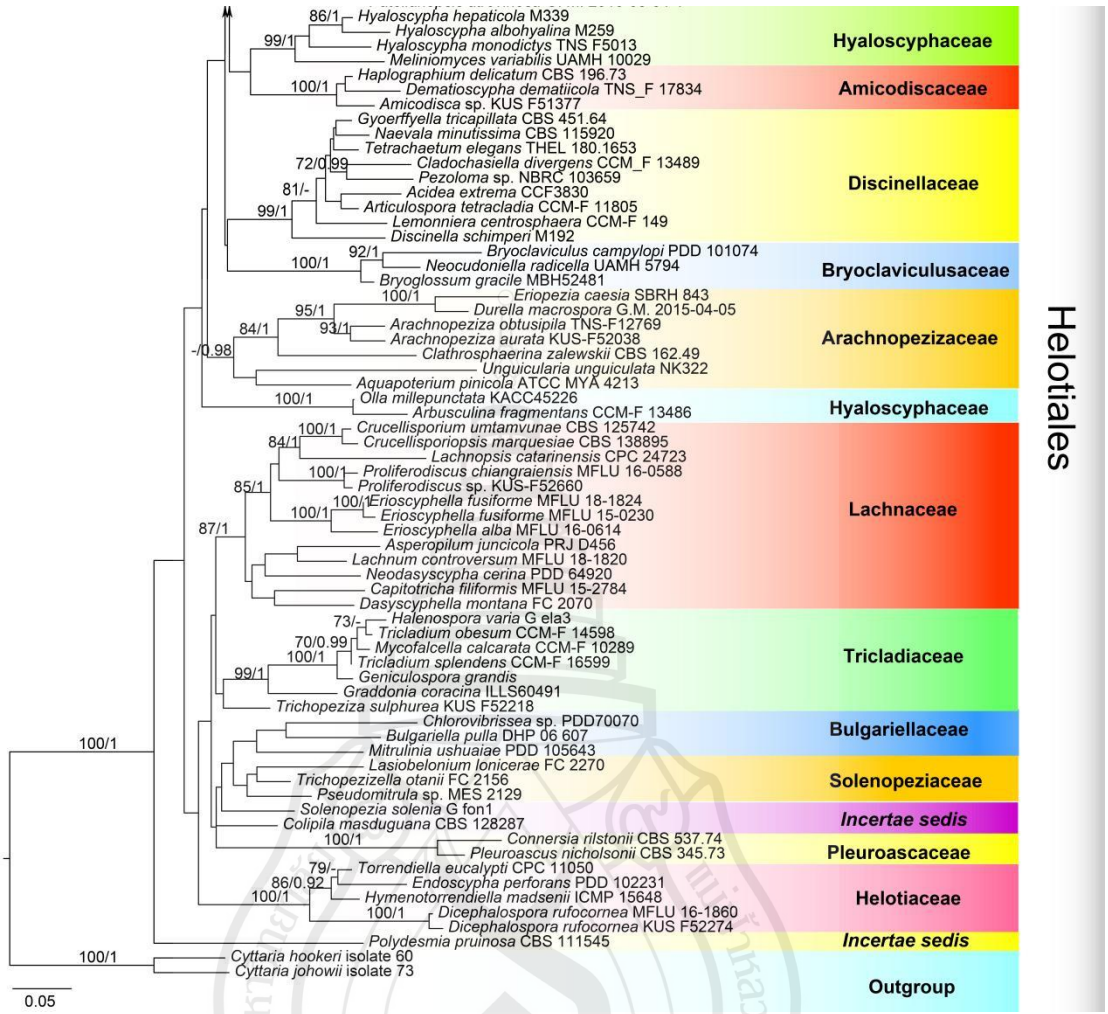


Figure 4.26 Phylogenetic tree of Massicellisporaceae



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. 168 taxa were included in the combined analyses, which comprised 1516 characters after alignment. The best scoring RAxML tree with a final likelihood value of -31039.487192 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree is rooted to *Cyttaria hookeri* (isolate 60) and *C. johowii* (isolate 73); the newly obtained strains are in red and bold.

Figure 4.26 (continued)

Massicellispora dicranopteris J. Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, sp. nov., Figure 4.27

Etymology: The specific epithet dicranopterisis refers the fern genus *Dicranopteris*, from which the type strain was isolated.

Holotype: KUN-HKAS 129894

Endophytic in the fresh root of *Dicranopteris linearis*. Sexual morph: Not observed. Asexual morph: *Mycelium* partly immersed, partly superficial, composed of hyaline to dark brown, smooth, thick-walled, septate, branched hyphae. *Conidiophores* not well-differentiated, micronematous, septate, hyaline to grayish brown, cylindrical to clavate. *Conidiogenous cells* 7–18(–27) × 3–4 µm ($\bar{x}$ = 12.3 × 3.5 µm, n = 20), monoblastic, integrated, pale brown, guttulate, smooth-walled. *Conidia* solitary, dry, septate, filamentous, helicoid; conidial filament indeterminate, with basipetal growth, pale to dark-brown, quickly becoming a coiled ball of cells; *Conidial cells* 5–7 × 4–5.5 µm ($\bar{x}$ = 6.1 × 4.9 µm, n = 30), similar in shape, globose to subglobose, subhyaline when young, becoming brown to dark brown at maturity, guttulate, smooth-walled.

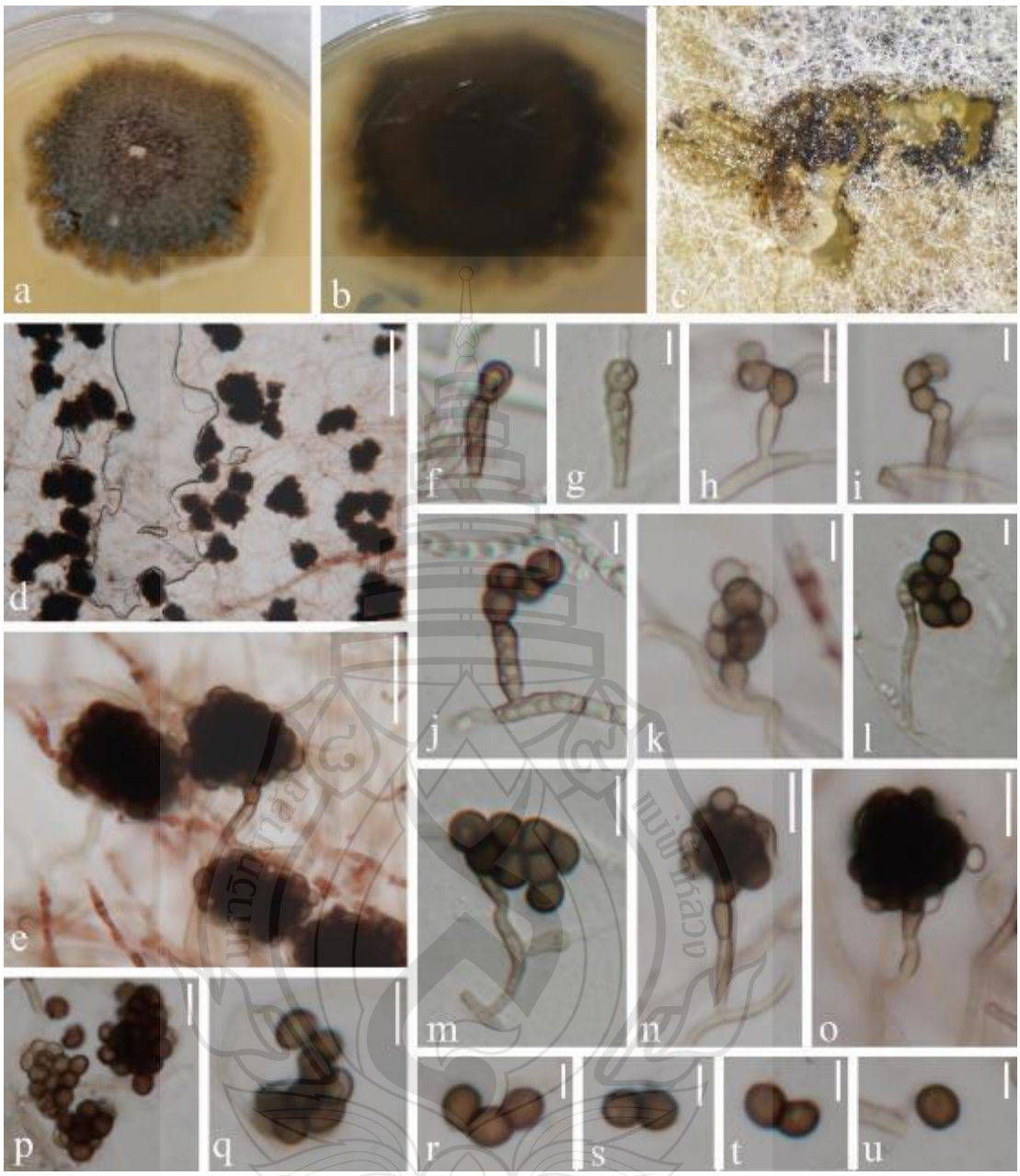
Culture characteristics: Colonies on MEA attaining 15–20 mm diam after 14 d at 25°C, with smooth edge, circular, with fluffy, dense, brown to dark brown mycelium on the surface; in reverse dark brown with entire margin.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the root of *Dicranopteris linearis*, 16 March 2022, J.Y. Zhang, 212–2 (KUN-HKAS 129894, holotype), ex-type living culture KUNCC 23–14190.

Notes: Phylogenetic analysis showed that *Massicellispora globosa*, *M. dicranopteridis* and three unidentified strains (Dzf14, P5Es5, and TRXY-46) formed a distinct clade within *Helotiales* (Figure 4.26). To accommodate the two novel isolates and the three unidentified strains, a new genus, *Massicellispora* is introduced. Morphologically, both novel isolates have micronematous cylindrical, hyaline to pale brown, septate, smooth-walled conidiophores, monoblastic, subhyaline to brown conidiogenous cells and septate, filamentous, helicoid, subhyaline to brown, smooth-walled, globose, subglobose, ellipsoidal to obovoid, smooth-walled, subhyaline to brown conidia. However, the conidia of *M. dicranopteris* are catenate and quickly become a mass of cells, which is different from those of *M. globosa*. In contrast, the

conidia of *M. globosa* are solitary. Phylogenetically, *M. globosa* and *M. dicranopteridis* are sister taxa. As a result, we assigned the two species to the same genus, *Massicellispora*. Nevertheless, whether the two species should be placed in the same or distinct genus requires further investigation with more taxonomic sampling and morphological characteristics.

Additionally, phylogenetic analysis showed that *Massicellispora dicranopteris* (KUNCC23–14190) clustered with an unidentified strain, *Rhexocercosporidium* sp. (Dzf14). This strain lacks morphological data, and only ITS sequence data is available for it, which is insufficient to identify it. Thus, additional phylogenetic and morphological data are required to rectify this strain.



Note a, b Culture on MEA from above and below. c Colonies on MEA.d Conidial mass and mycelium. e–o Conidiophores, conidiogenous cells, and conidia. p–q Conidia. r–u Conidial cells. Scale bar: d = 100 µm, e = 20 µm, f–l, r–u =5 µm, m–q = 10 um

Figure 4.27 *Massicellispora dicranopteris* (KUN-HKAS 129894, holotype)

Massicellispora globosa J. Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov*., Figure 4.28

Etymology: The name refers to its globose conidia

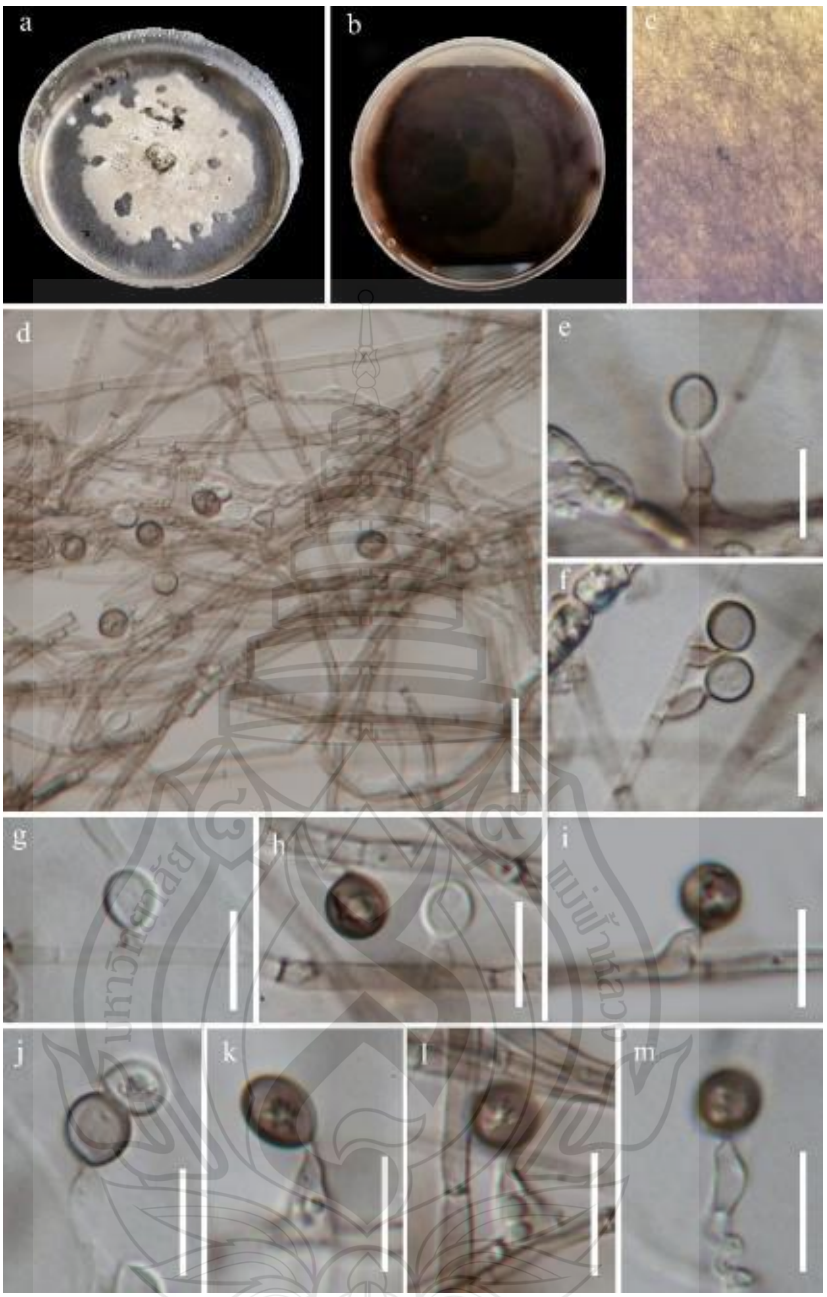
Holotype: GZAAS 23-0792

Endophytic in the roots of *Dicranopteris ampla.* Sexual morph: Undetermined. Asexual morph: *Colonies* on PDA media circular, flat, with entire edge, pale grey to dark grey from above, reddish brown from below. *Mycelium* 1–3.5 µm wide, brown, branched, septate, smooth-walled. *Conidiophores* reduce to conidiogenous cells, cylindrical, hyaline to pale brown, smooth-walled. *Conidiogenous cells* 2.5–9.5 × 2–4 µm ($\bar{x}$ = 6 × 3 µm, n = 20), monoblastic, integrated, intercalary, doliiform, subhyaline to brown. *Conidia* 5.5–7.5 × 4.5–6 µm ($\bar{x}$ = 6.5 × 5.5 µm, n = 25), solitary, globose, ellipsoidal to obovoid, hyaline when young, brown when mature, aseptate, smooth.

Culture characteristics: Colonies on PDA medium under natural light, reaching 55 mm diam. in 14 days at 26°C, circular with entire margin, flat with smooth surface, spread, with immersed mostly mycelia, without veined and wrinkle, gray to taupe towards edge from above; dark brown to brown from inside to the margin in reverse.

Material examined: CHINA, Guizhou Province, Southwest Guizhou Buyi and Miao Autonomous Prefecture, Zhenfeng County, isolated from the healthy roots of *Dicranopteris ampla*, 17 March 2022, J.Y Zhang, 119-1 (GZAAS 23–0792, holotype), ex-type living culture KUNCC 23–14165.

Note Massicellispora globosa is introduced as a new species based on its distinct morphology and phylogeny. *Massicellispora globosa* has solitary, globose, ellipsoidal to obovoid, aseptate, and hyaline to brown conidia which is distinct from *M. dicranopteridis*. While, *M. globosa* has guttulate and catenate conidia, which quickly become a mass of cells. Furthermore, we noticed that LSU sequence data is more valuable in discriminating between *M. dicranopteris* and *M. globosa* than ITS. The ITS of these two species is almost identical, but the LSU sequence data differs by 26bp. Based on both phylogeny and morphology, we introduce *M. dicranopteris* as a new species. However, because of the limited taxonomic sampling and morphological information available for this genus, further morphological and phylogenetic research based on more recent collections are required to better comprehend it.



Note a, b Cultures on PDA from above and below. c Colonies on PDA. d–m Conidiogenous cells with conidia. Scale bars: d = 20 μm, e–m = 10 μm

Figure 4.28 *Massicellispora globosa* (GZAAS 23–0792, holotype)

Medeolariales Korf

Medeolariales was introduced by Eriksson (1982) with a single family *Medeolariaceae*. Ekanayaka et al. (2019) showed that *Medeolariaceae* formed a monophyletic clade with *Ascodichaenaceae*, *Dermateaceae*, and a clade of *Coleophoma-Parafabraea*. Although *Ascocorticiaceae* do not have available sequence data in GenBank, species of this family have a similar morphology to *Medeolariales* taxa. Therefore, Ekanayaka et al. (2019) accepted *Ascodichaenaceae*, *Ascocorticiaceae*, *Dermateaceae*, and *Coleophoma-Parafabraea* clade in this order.

Dermateaceae Fr.

Dermateaceae typified by *Dermea*, and members of this family can cause stem and fruit rots on vascular plants (Yuan & Verkley, 2015; Chen et al., 2016; Michalecka et al., 2016; Cameldi et al., 2017; Pešicová et al., 2017; Romero et al., 2017; Lin et al., 2018a). *Dermateaceae* species have also been reported as endophytes and saprobes from various hosts (Chen et al., 2016). The family was initially placed in *Helotiales*; however, Ekanayaka et al. (2019) showed that *Dermateaceae* shares a close relationship with *Medeolariales*, placing this family in *Medeolariales*. The placement of this family remains problematic, as different authors treat it under different orders. Li et al. (2020a), following Ekanayaka et al. (2019), place this family in *Medeolariales.* However, more recently, Wijayawardene et al. (2022) and Iliushin et al. (2023) placed the family back in *Helotiales*. In this study, we follow the treatment of Ekanayaka et al. (2019) and Li et al. (2020a), placing the family in *Medeolariales*, as phylogenetic analyses have shown that this family groups within *Medeolariales.*

The most recent list of *Dermateaceae* genera was provided by Hyde et al. (2024), which comprises 15 genera: *Chaetophiophoma*, *Coleophoma*, *Cornicullariella*, *Davidhawksworthia*, *Dermea*, *Gelatinoamylaria*, *Neodermea*, *Neofabraea*, *Neogloeosporidina*, *Pezicula*, *Phlyctema*, *Pseudofabraea*, *Rhizodermea*, *Schizothyrioma* and *Verkleyomyces*. However, several genera within this family require further revisions due to the lack of sequence data and problematic phylogenetic affinities. For example, studies have shown that *Dermea* is polyphyletic within the family, and our phylogenetic analysis obtained a similar result (Jiang & Tian, 2019). During our study on the diversity of endophytic fungi associated with *Dicranopteris*, we isolated a fungus, which we introduced as a new species placed in *Pezicula* based

on phylogenetic and morphological analysis. Additionally, *Neofabraea actinidiae* was isolated from *Dicranopteris* for the first time.

Neofabraea H.S. Jacks.

Neofabraea was introduced by Jackson (1913) with *N. malicorticis* as the type species (Jackson, 1913). The genus was treated as a synonym of *Pezicula* by Nannfeldt (1932). However, Verkley (1999) accepted *Neofabraea* as a distinct genus based on phylogeny and morphology. Johnston et al. (2014) transferred related *Cryptosporiopsis* species to *Neofabraea*, and advocated for the use of *Neofabraea* over *Phlyctema. Neofabraea vagabunda* was introduced to accommodate *N. alba*. Chen et al. (2016) redefined the common endophytes and plant pathogens in *Neofabraea*, *Pezicula*, and related genera, emending the generic concept of *Neofabraea*. They accepted six species: *N. actinidiae*, *N. inaequalis*, *N. kienholzii*, *N. krawtzewii*, *N. malicorticis*, and *N. perennans* in the genus and all of which appear to be phytopathogenic. Five additional species, *N. brasiliensis*, *N. brunneipila*, *N. eucalyptorum*, *N. illicii*, and *N. salicina* were subsequently introduced to *Neofabraea* (Crous et al., 2015a, 2020, 2021b; Chen et al., 2016; Ekanayaka et al., 2019). Currently, 11 species are accepted in *Neofabraea*.

Neofabraea actinidiae (P.R. Johnst., M.A. Manning & X. Meier) P.R. Johnst., in Johnston, Seifert, Stone, Rossman & Marvanová, IMA Fungus 5(1): 102 (2014)

Fungal Names number: FN 808962; Figure 4.29

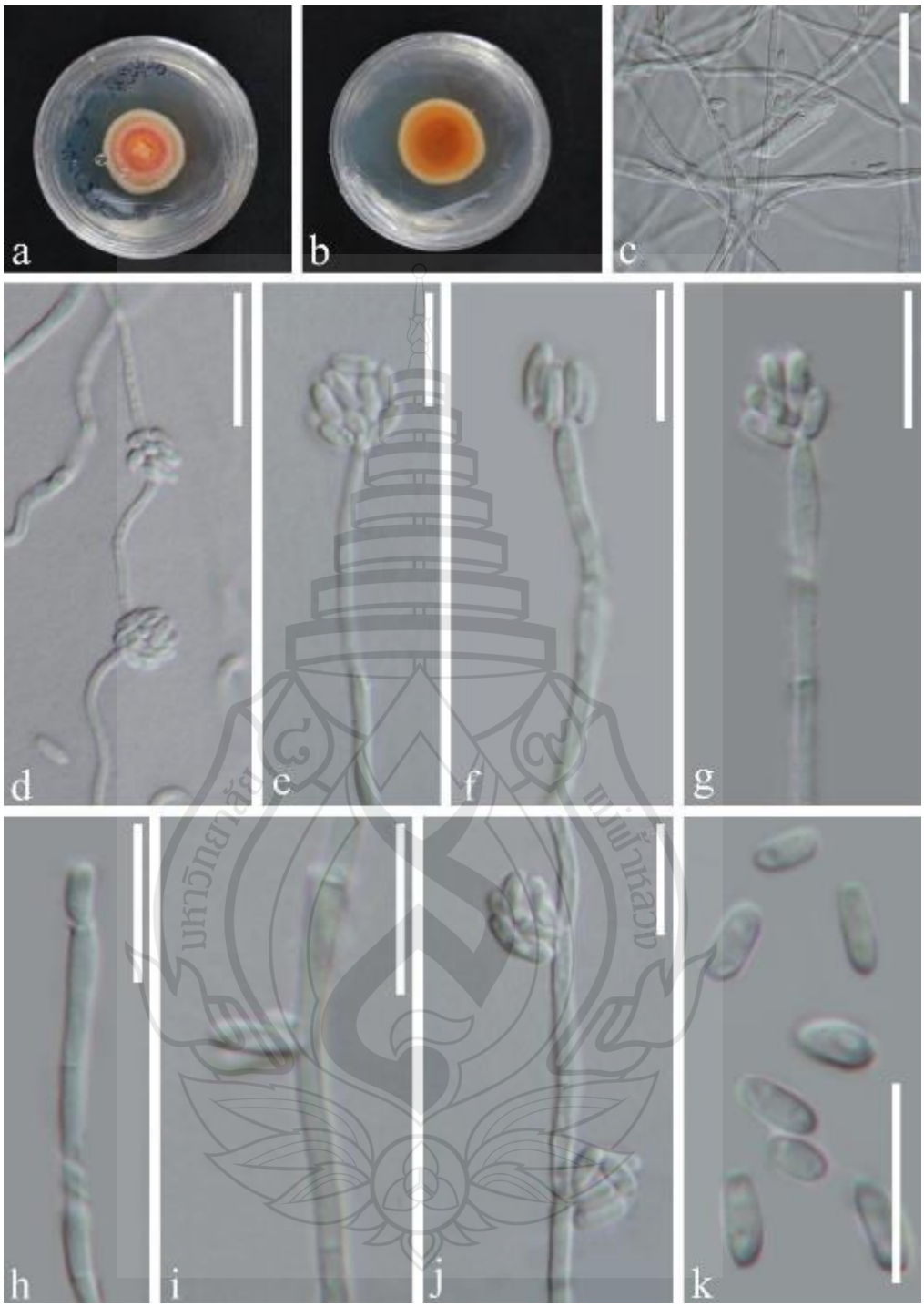
Endophytic in stems of *Dicranopteris ampla*. Sexual morph: Undetermined. Asexual morph: *Mycelium* mostly immersed, composed of hyaline, septate, smooth-walled. *Conidiophores* arising from single or slightly fasciculate aerial hyphae, hyaline, septate, smooth-walled. *Conidiogenous cells* 9–25 × 1.5–2.5 µm ($\bar{x}$ = 17 × 2 µm, n = 30), usually held on irregularly branched conidiophores, sometimes arising directly from hypha, sometimes with a conidiogenous loci, smooth walled. *Conidia* 3.2–6.8 × 1.2–2.5 µm ($\bar{x}$ = 5 × 1.9 µm, n = 30), aseptate, elliptic to clavate, smooth-walled, ends widely rounded, with an indistinct scar at the base.

Culture characteristics: Colonies on PDA medium circular, aerial mycelium more or less, growly slowly, reaching 20 mm diam after 10 days at 25°C in natural light, circular, orange mycelium in the middle, pale orange to pink in the inner ring and white at the edge; orange in reverse, pale orange in narrow zone near margin, margin itself colorless similar variation in color from below.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Chengheng County, isolated from healthy stems of *Dicranopteris ampla* (*Gleicheniaceae*) collected from the rock crevices, 16 March 2022, J.Y. Zhang, NS224-6 (KUN-HKAS 129897), living culture KUNCC23–14192.

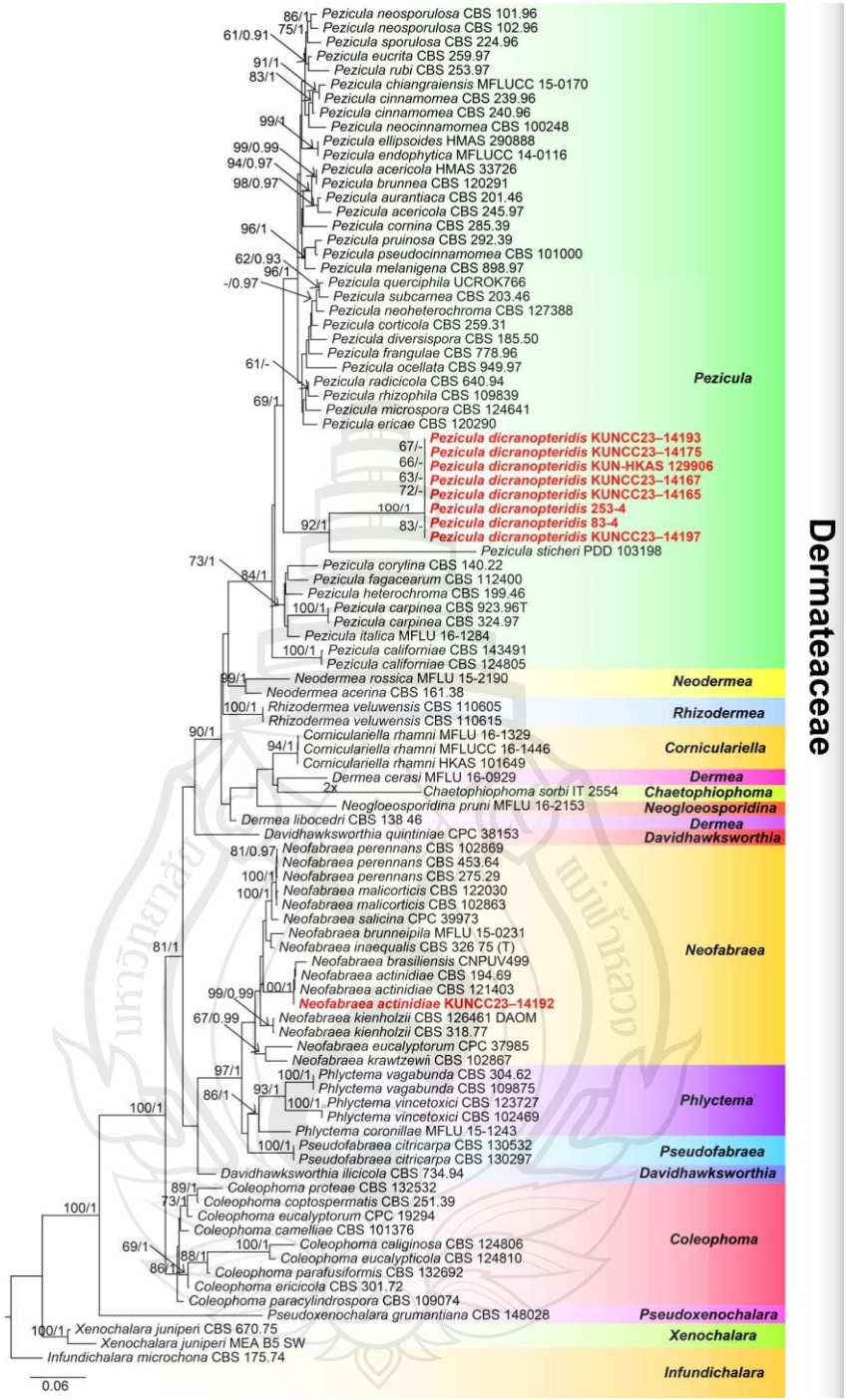
Notes: Based on the phylogenetic tree, our new isolate clusters with two strains of *Neofabraea actinidiae* (CBS 121403 and CBS 194.69) (Figure 4.30). There are no significant differences in ITS, LSU, and *rpb*2 sequencing data between our new strain and *N. actinidiae* (CBS 121403 and CBS 194.69). In addition, the morphology of our new isolate is almost identical to the Holotype: of *N. actinidiae*, except for the size of conidiogenous cells and conidia. Our isolate has larger conidiogenous cells (9–25 ×1.5–2.5 vs. 8.5–14.5 × 8–4 um) and smaller conidia (3.2–6.8 × 1.2–2.5 vs. 9–14 × 3–5.5 um) than the Holotype: (Johnston et al., 2004). Therefore, we identify our new isolate as *N. actinidiae* based on molecular data and morphological characteristics.

Neofabraea actinidiae was originally introduced by Johnston et al. (2004) as *Cryptosporiopsis actinidiae*. Subsequently, this species has been transferred to *Neofabraea* and synthesized as *N. actinidiae* based on phylogenetic analysis and morphological characteristics. *Neofabraea actinidiae* is a plant pathogenic fungus with a wide distribution, documented to cause ripe rots in the green kiwifruit cultivar, apple bull's-eye rot, and Cranberry Fruit Rot (Bogo et al., 2018; Tyson et al., 2019; Valentine et al., 2024). While, our isolate is an endophyte isolated from *Dicranopteris ampla* stems.



Note a Colonies on PDA medium. b Conidiomata on PDA. c–j Conidiogenous cells bearing developing conidia. k Conidia. Scale bars: c–d = 20 µm, e–k = 10 µm

Figure 4.29 *Neofabraea actinidiae* (KUN-HKAS 129897)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, *rpb*2, and *tub*2 sequence data. The newly obtained strains are in red and bold.

Figure 4.30 Phylogenetic tree of Dermateaceae

Pezicula Tul. & C. Tul.

Pezicula, typified by *P. carpinea* was established in 1869. The genus is characterized by brightly colored, short-stalked apothecia with circular discs that are initially concave and surrounded by slightly elevated margins, but later become convex, inoperculate, and clavate or cylindric-clavate asci and broadly ellipsoid to elongate-ellipsoid to allantoid or fusoid ascospores (Ooki et al., 2003; Verkley, 1999; Ekanayaka et al., 2016; Ma et al., 2021). The asexual morph of *Pezicula* has been linked to *Cryptosporiopsis* and Johnston et al. (2014) synonymized *Cryptosporiopsis* under *Pezicula*. Species of *Pezicula* are reported as endophytes, phytopathogens, or saprobes associated with diverse hosts from temperate regions of the world (Chen et al., 2016; Ma et al., 2021; Zheng & Zhuang, 2022). In this study, we introduce a new species, *P. dicranopteridis*, which is an endophytic fungus isolated from *Dicranopteris*. In addition, *Cashiella sticheri* was transferred to *Pezicula* as *P. sticheri* based on phylogenetic analysis and morphological characters.

Pezicula dicranopteridis J. Y. Zhang, D.F. Bao & Y.Z. Lu, *sp. nov*., Figure 4.31

Etymology: Etymology: the specific epithet dicranopterisis refers to the fern genus *Dicranopteris*, from which the type strain was isolated.

Holotype: KUN-HKAS 129880

Endophytic in the healthy leaf of *Dicranopteris pedata*. Sexual morph: Undetermined. Asexual morph: *Hyphae* 3.5–4.5 µm, hyaline to pale brown, septate, branched, thin wall, smooth. *Conidiophores* 6–8.5 × 3.5–4.5 µm ($\bar{x}$ = 7 × 4 µm, n = 10), micronematous, reduced to conidiogenous cells, hyaline, septate, thin-walled, unbranched, straight or flexuous. *Conidiogenous cells* holoblastic, hyaline to brown, terminal, cylindrical, flexuous, or coiled, bear a brown sheath at maturity. *Conidia* 12–15 × 6–7 µm ($\bar{x}$ = 13.3 × 6.8 µm, n = 30), aseptate, acropleuroacrogenous, oval to obovoid, fusiform,top-shaped, rounded at the base, tapering to a point at the apex, smooth-walled, guttulate, hyaline, differentiated within the conidiogenous cell.

Culture characteristics: C*olonies* on PDA medium irregulate, effuse, effuse, with little dark spots, flat with undulate edge, hyaline to pale brown.

Material examined: China, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Chengheng County, isolated from the stem of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS152–3 (KUN-HKAS 129880, holotype),

ex-type living culture KUNCC23–14175. *ibid.* NS253–2 (KUN-HKAS 129899, paratype), living culture KUNCC23–14193. *ibid.* isolated from the leaf of *D. linearis* near the roadside, 16 March 2022, J.Y. Zhang, NS275–3 (KUN-HKAS 129905), living culture, KUNCC23–14197. *ibid.* NS275–7 (KUN-HKAS 129906, paratype); isolated from the stem of *D. pedata* near the roadside, 16 March 2022, J.Y. Zhang, NS141–3 (GZAAS 23-0792, paratype), living culture KUNCC23–14165. *ibid.* NS253–4. *ibid.* NS127–1, living cultures KUNCC23–14167.

Notes: In the phylogenetic analysis, our new isolates clustered with *Cashiella sticheri* (PDD 103198) in a well-supported clade basal to *Pezicula* (Figure 4.30). *Cashiella sticheri* was introduced by Gadgil and Dick (1999), with only its sexual morph was known. Our isolates represent the asexual morphs, and the sexual morph was not observed in this study. Phylogenetically, however, our isolates are distinct from *C. sticheri* (Figure 4.30). Morphologically, *P. dicranopteridis* differs significantly from other *Pezicula* species, particularly in its formation and shape. *Pezicula dicranopteridis* produces oval to obovoid conidia, rounded at the base, tapering to a point at the apex, and formed within a brown sheath over time, a feature that was not observed in other *Pezicula* species. All other *Pezicula* species have cylindrical, ellipsoid, pyriform, claviform, or fusoid conidia (Verkley, 1999; Chen et al., 2016; Zheng & Zhuang, 2022). Notably, the endogenous conidial formation within a brown sheath in *P. dicranopteridis* is a unique feature.

Despite these morphological differences, our isolates and *Cashiella sticheri* are not significantly separated from *Pezicula* in the phylogenetic analyses. Therefore, based on both morphological and molecular evidence, we identify the eight newly obtained strains as a new species, *P. dicranopteridis* within *Pezicula*.

Note a–b Cultures on WA from above and below. c Colonies on WA. d–i mycelium with a brown to dark brown sheath. j–n Conidiogenous cells and conidia. o–s Conidia. Scale bars: d = 30 μm, e, f, h, i =20 um, g = 40 um, j, k = 5 um, l–s = 10 um

Figure 4.31 *Pezicula dicranopteridis* (KUN-HKAS 129880, holotype)

Pezicula sticheri (Gadgil & M.A. Dick) D.F. Bao, Y.Z. Lu and J.C Kang, *comb. nov*.

≡ *Cashiella sticheri* Gadgil & M.A. Dick, N.Z. Jl For. Sci. 29(3): 447 (1999)

Notes: *Cashiella sticheri* was introduced by Gadgil and Dick (2000) after being collected from *Sticheri cunninghamii* in New Zealand. It is characterized by black, cup-shaped apothecia that are sessile but narrowed at the base, gregarious, circular in outline, and glabrous, with clavate asci and uniseriate, ellipsoid, hyaline to pale brown, aseptate ascospores. These morphological characteristics align with the generic concept of *Pezicula*. Ekanayaka et al. (2019) demonstrated that *Cashiella sticheri* grouped within *Dermateaceae*, a placement further supported by Wijayawardene et al. (2022).

Our phylogenetic analysis showed that *Cashiella sticheri* clustered with our new isolates (*P. dicranopteridis*), forming a clade basal to *Pezicula*, and could not be significantly separated from *Pezicula* (Figure 4.30). Thus, based on both phylogenetic and morphological analyses, we transfer *Cashiella sticheri* to *Pezicula*, synonymizing *P. sticheri* with *C. sticheri*. Currently, four species are accepted in *Cashiella*, but only *Cashiella sticheri* has sequence data available in GenBank. Therefore, further studies are needed to confirm whether the remaining *Cashiella* species should also be transferred to *Pezicula*.

Rhytismatales M.E. Barr ex Minter

Based on the phylogenetic analyses, Ekanayaka et al. (2019) accepted three families *Calloriaceae*, *Pezizellaceae*, and *Rhytismataceae*, in this order.

Calloriaceae Marchand

Ekanayaka et al. (2019) updated the classification of *Calloriaceae*, accepting 28 genera based on phylogenetic analysis and previous literature. Subsequently, Crous et al. (2021c) added a new genus, *Populomyces*. However, the majority of taxa in this family lack sequencing data accessible in GenBank. Therefore, the classification of this family needs further studies to better understand its taxonomy.

Populomyces Hern. -Restr.

The monotypic genus *Populomyces* was introduced by Crous et al. (2021c) to accommodate *P. zwinianu* based on phylogenetic analysis and morphological characteristics. Tan et al. (2021) introduced the second species, *P. barnardiae* based solely on phylogenetic analysis, with no morphological description and illustration

provided for this species. Currently, only these two species are included in the genus, both of which have been isolated from soil (Crous et al., 2021c; Tan et al., 2021). *Populomyces* is characterized by micronematous conidiophores or mostly reduced to conidiogenous, monophialidic, hyaline, smooth, cylindrical to lageniform conidiogenous cells with a cylindrical collarette, and aseptate, cylindrical, solitary, hyaline, guttulate conidia (Crous et al., 2021c). In this study, *P. barnardiae* was isolated from the roots of *Dicranopteris pedata*, and detailed morphological descriptions, illustrations, and phylogenetic analysis results are provided for this species.

Populomyces barnardiae Y.P. Tan, Bishop-Hurley, Marney, R.G. Shivas, in Tan & Shivas, Index of Australian Fungi 3: 16 (2022)

Fungal Names number: FN 900147; Figure 4.32

Endophytic in the healthy roots of *Dicranopteris pedata*. Sexual morph: Undetermined. Asexual morph: *Hyphae* in medium, septate, hyaline, smooth-walled. *Conidiophores* micronematous, mostly reduced to conidiogenous cells. *Conidiogenous cells* 10–17 × 2.5–4.5 µm ($\bar{x}$ = 13.5 × 3.5 µm, n = 30), monophialidic, simple, ampuliform with swollen basal cell, smooth-walled, hyaline. *Conidia* 3.5–7 × 1.8–3.0 µm ($\bar{x}$ = 5.2 × 2.4 µm, n = 30), ellipsoidal with round ends, aseptate, hyaline, smooth-walled.

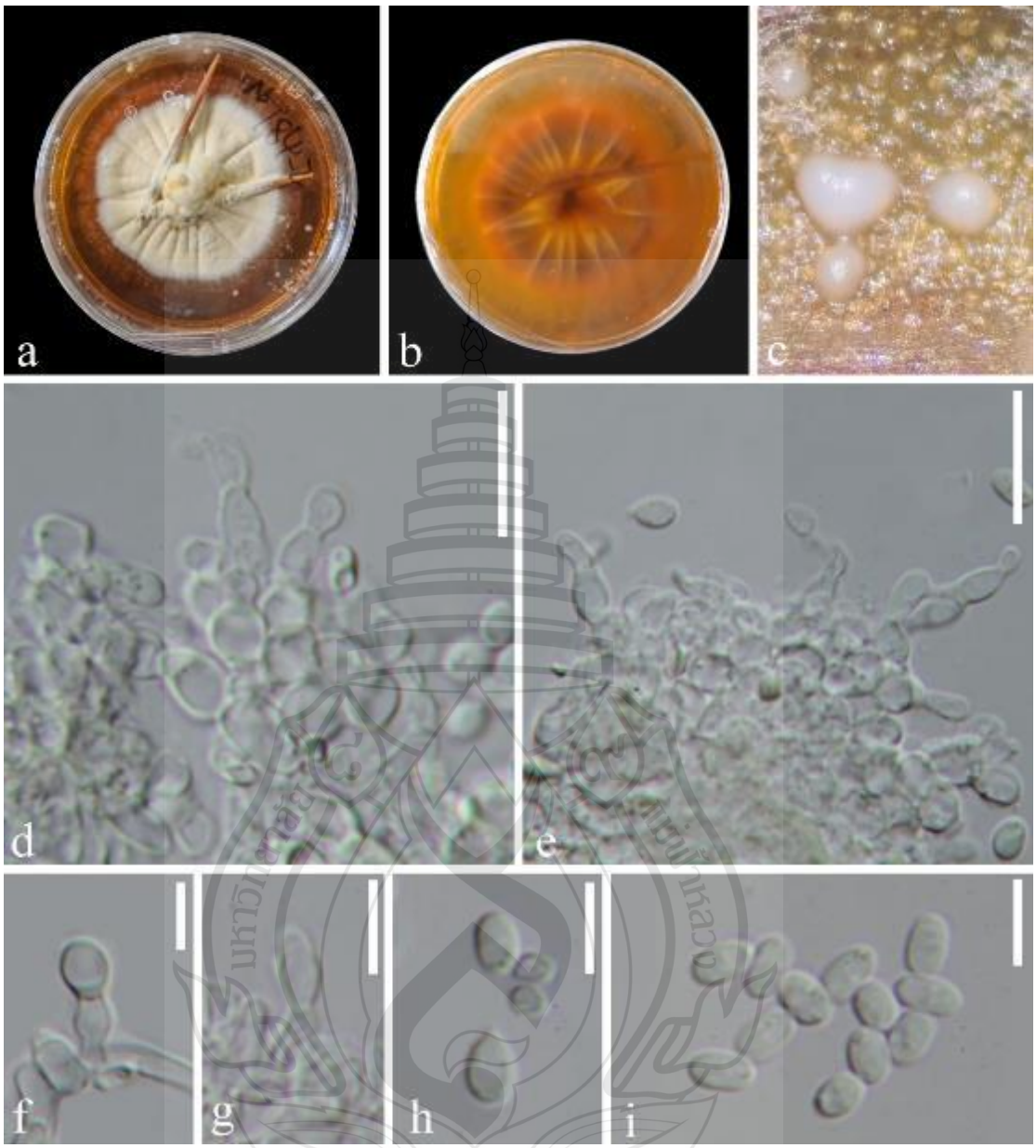
Culture characteristics: Colonies on PDA medium circular, entirely to slightly filamentous, growly fast, reaching 40 mm diam after 7 d at 25°C in natural light, cottony, velvety, dense, with creases, glutinous, pale yellow to bright orange from above; light orange red in reverse, put in toothpicks to promote sporulation, spore production after two weeks.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Chengheng County, isolated from healthy roots of *Dicranopteris pedata* (*Gleicheniaceae*) collected from the rock crevices, 16 March 2022, J.Y. Zhang, NS184–2 (KUN-HKAS 129886), living culture KUNCC23–14184.

Notes: Phylogenetic analysis showed that our new isolate (KUNCC23–14184) was placed sister to *Populomyces barnardiae* (BRIP 74917a) which was isolated from soil in Australia by Tan et al. (2022). However, this species was introduced based on molecular analysis; there were no morphological descriptions or illustrations provided for this species. The nucleotide comparison of ITS and LSU sequence data from our

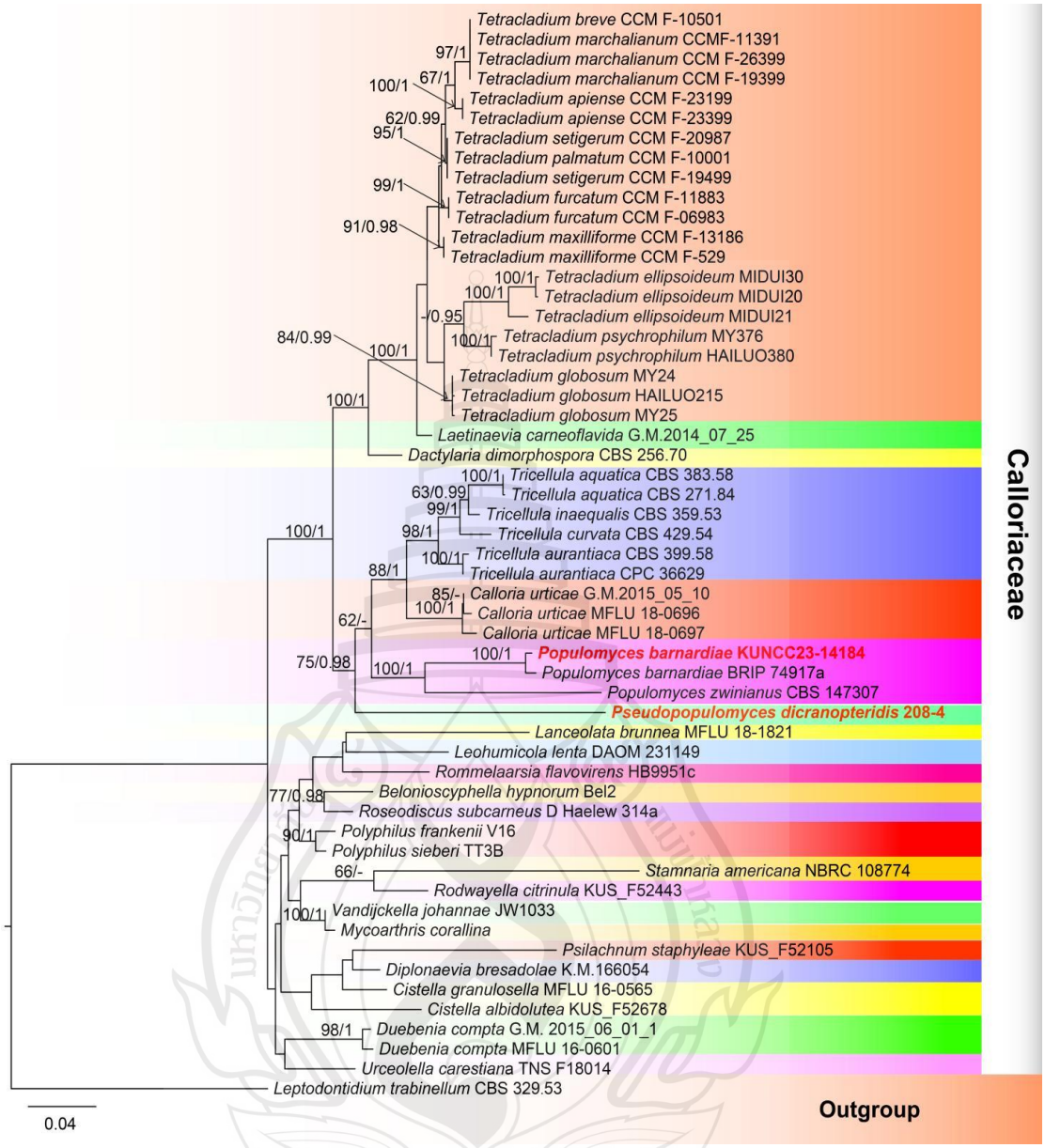
new isolate and *P. barnardiae* (BRIP 74917a) revealed 5bp and 1bp differences, respectively. Which were not significantly different between the two species. Thus, we identified our new isolate as *P. barnardiae* and provided morphological descriptions, illustrations, and phylogenetic analysis results for this species.

Populomyces barnardiae is similar to the type species, *P. zwinianus* in having micronematous conidiophores, which are mostly reduced to conidiogenous cells, monophialidic, ampuliform smooth-walled, hyaline conidiogenous cells and aseptate, solitary, hyaline conidia. However, *P. barnardiae* is different from *P. zwinianus* by the shape and size of conidia (ellipsoidal with round ends vs. cylindrical, 3.5–7 × 1.8–3 vs. 9–12 × 2–2.5 μm) (Crous et al., 2021c). Furthermore, the phylogenetic analysis also strongly supports they are different species (Figure 4.33).



Note a, b Colonies on PDA medium. c Colonies on PDA. d, e Conidiogenous cells and Conidia. f–g Conidiogenous cells. h–i Conidia. Scale bars: d–e = 10 µm, f–i = 5 µm

Figure 4.32 *Populomyces barnardiae* (KUN-HKAS 129886)



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. Bootstrap support values for maximum likelihood (ML) equal to or greater than 60% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated near branches as ML/PP. The tree is rooted with *Leptodontidium trabinellum* (CBS 329.53). The new taxa are red and bold.

Figure 4.33 Phylogenetic tree of *Pseudopopulomyce*

Pseudopopulomyces D.F. Bao, K.D. Hyde & Y.Z. Lu, *gen*. *nov*.

Etymology: Referring to its similar ity with *Populomyces*.

Endophytic in the health plant tissue. Sexual morph: Undetermined. Asexual morph: Conidiomata sporodochial, hyaline. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* monoblastic, terminal, cylindrical, hyaline, smooth. Conidia globose to suglobose, ellipsoidal with round ends, aseptate, hyaline, smooth-walled.

Pseudopopulomyces dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, sp. nov., Figure 4.34

Etymology: The specific epithet dicranopterisis refers to the fern genus *Dicranopteris*, from which the type strain was isolated.

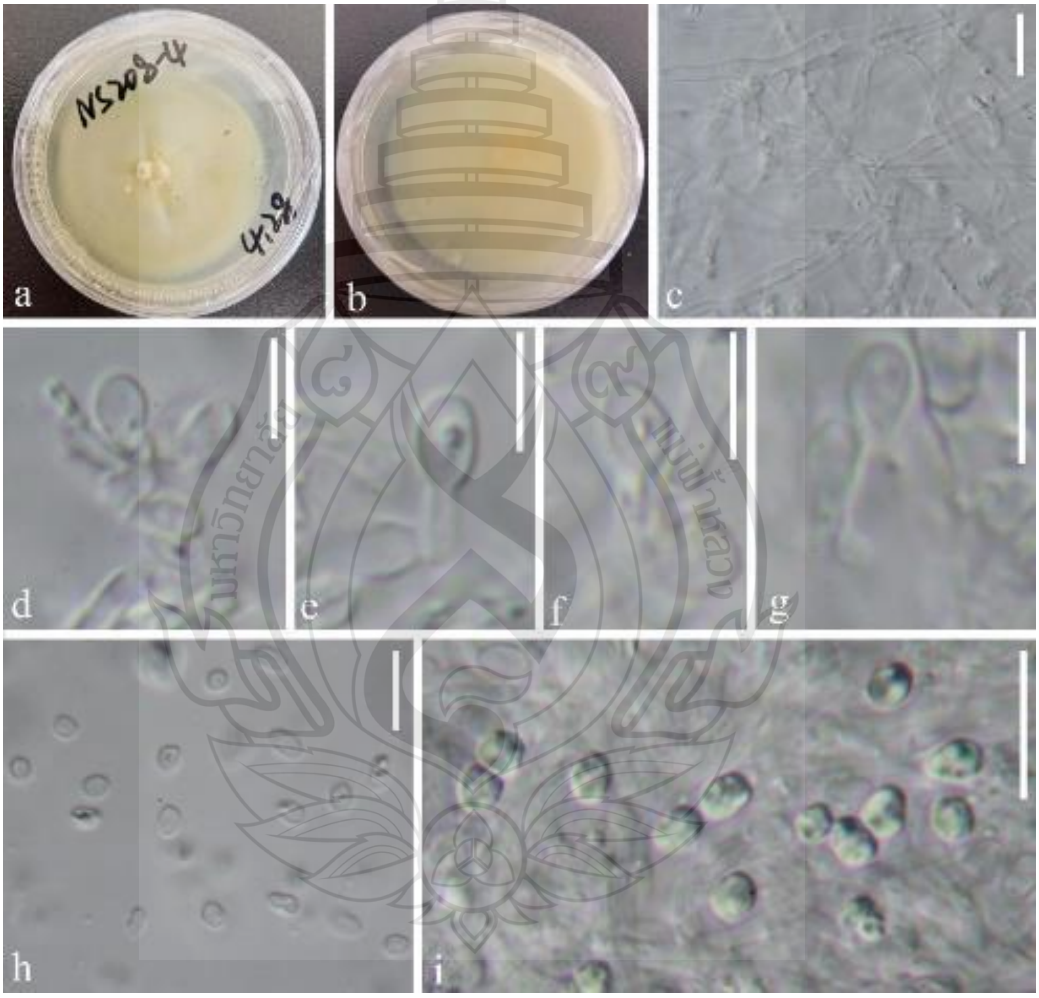
Endophytic in the root of *Dicranopteris pedata*. *Mycelium* mostly immersed composed of septate, branched, hyaline smooth hyphae. Sexual morph: Undetermined. Asexual morph: Conidiomata sporodochial, hyaline. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 3.5–7 × 1.5–2.5 µm (n = 10), monoblastic, terminal, cylindrical, hyaline, smooth. Conidia 3–4 × 2–3 µm (n = 30), globose to suglobose, ellipsoidal with round ends, aseptate, hyaline, smooth-walled.

Culture characteristics: Colonies on PDA medium circular with entire margin, pale to bright yellow, reverse pure white, stenopsychrophile; aerial hyphae absent or sparse hyaline to white, and does not produce pigmentation in culture.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the root of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS208–4.

Notes: In a BLASTn search of NCBI GenBank, the closest match of the ITS and LSU sequences of *Pseudopopulomyces dicranopteridis* with 83.93% and 95.22% similarities were *Tetracladium* sp. (B103) and *T. breve* (CCM F-12505), respectively. In our phylgenetic analysis, *P. dicranopteridis* grouped with *Calloria*, *Populomyces* and *Tricellula*, but in a distinct basal clade (Figure 4.33). *Pseudopopulomyces dicranopteridis* is similar to *Tetracladium* in having 1-celled, hyaline, globose, ellipsoid, smooth-walled conidia (Wang et al., 2015). However, the conidia of *Tetracladium* drectly borne on short, undifferentiated or sessile pedicels, or attaching to the hyphae with very short conidiophores. In contrast, *P. dicranopteridis* has sporodochial conidiomata, reduced conidiophores and monoblastic, terminal, cylindrical, hyaline, smooth conidiogenous cells.

Morphlogically, *Pseudopopulomyces dicranopteridis* is similar to *Populomyces* in having reduced conidiophores, monophialidic, simple, ampuliform with swollen basal cell, smooth-walled, hyaline conidiogenous cells and ellipsoidal, aseptate, hyaline, smooth-walled conidia. It is difficult to distinguish them from morphology. But phylogenetically they are distinct, *Pseudopopulomyces dicranopteridis* formed a distinct lineage basal to *Tricellula*, *Calloria* and *Populomyces*. Thus, based on phylogenetic analysis and morphological differences, we introduce a new genus *Pseudopopulomyces* to accommodate our new isolate *Pseudopopulomyces* dicranopteridis.



Note a, b Cultures on PDA from above and below. c Mycelium. d–g Conidiogenous cells and conidia. h–i Conidia. Scale bars: c, h, i = 10 µm, d–g = 5 µm

Figure 4.34 *Pseudopopulomyces dicranopteridis* (NS208-4, holotype)

Thelebolales Haeckel

Haeckel (1894) proposed the order *Thelebolales*, nevertheless, the classification of this order has long been disputed. Some studies mentioned that the order comprises two families *Pseudeurotiaceae* and *Thelebolaceae* (Johnston et al., 2019; Batista et al., 2020). Ekanayaka et al. (2019) treated *Pseudeurotiaceae* as a synonym of *Thelebolaceae*, as their phylogenetic analysis showed that *Pseudeurotiaceae* is nested within *Thelebolaceae*. Recently, Quijada et al. (2022) showed that *Thelebolaceae* is monophyletic, whereas *Pseudeurotiaceae* is polyphyletic and they introduced the third family, *Holwayaceae*, constituting three genera (*Holwaya*, *Patinella*, and *Ramgea*) previously placed in *Tympanidaceae*, *Thelebolaceae*, or *incertae sedis* in *Helotiales* or *Leotiomycetes*.

Miniglobosispora D.F. Bao, Y.Z. Lu, K.D. Hyde & J.C. Kang, *gen*. *nov*.

Etymology: The generic epithet refers to the small globose conidia

Endophytic in the rhizome of *Dicranopteris linearis*. Sexual morph: Not observed. Asexual morph: *Hyphae* hyaline to brown, septate, branched, aerial mycelium, thin-walled. *Conidiophores* hyaline to pale brown, septate, branched, slightly flexuous, with conidiogenous cell arising terminally or laterally. *Conidiogenous cells* polyblastic, integrated, hyaline, smooth-walled, cylindrical to oblong. *Conidia* single or catenate, hyaline, aseptate, thin-walled, smooth, obovoid to clavate, globose, subglobose, sometimes truncate at both ends or truncate at base and rounded at the apex, sometimes with one or more hilum at one end.

Type species Miniglobosispora guizhounises J.Y. Zhang, D.F. Bao, Y.Z. Lu & J.C. Kang

Miniglobosispora guizhounises J. Y. Zhang, D.F. Bao, K.D. Hyde & J.C. Kang, sp. nov., Figure 4.35

Etymology: Refers to the Guizhou Province where the Holotype: was collected

Holotype: KUN-HKAS 129872

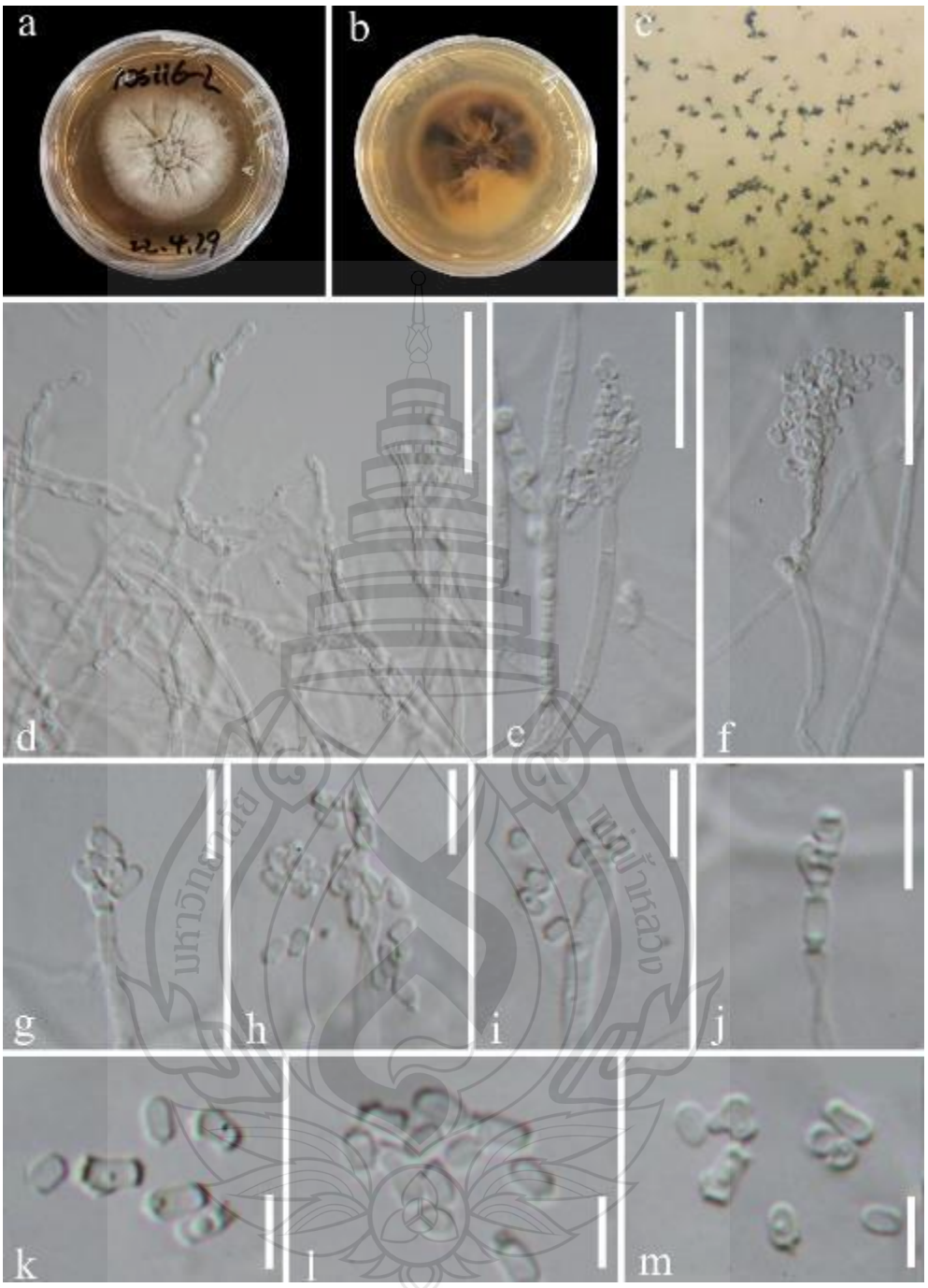
Endophytic in the root of *Dicranopteris ampla*. **S**exual morph: not observed. Asexual morph: *Mycelium* in culture partly immersed, partly aerial, composed of hyaline to brown, septate, branched, aerial mycelium, thin-walled, hyphae *Conidiophores* hyaline to pale brown, septate, branched, slightly flexuous, with conidiogenous cells arising terminally or laterally. *Conidiogenous cells* monoblastic,

polyblastic, integrated, hyaline, smooth-walled, cylindrical to oblong. *Conidia* 3.6–6.2 × 1.8–2.7 µm ($\bar{x}$ = 4.2 ×2.4 µm, n = 30), single or catenate, hyaline, aseptate, thin-walled, smooth, globose to subglobose, obovoid to clavate, or irregular, sometimes truncate at both ends or truncate at the base and rounded at the apex, sometimes with 1-3 hilum at the base, guttulate.

Culture characters: Colonies on PDA medium, growing fast, dense, covered with abundant, white, cottony to woolly aerial mycelia, reverse brown to dark brown.

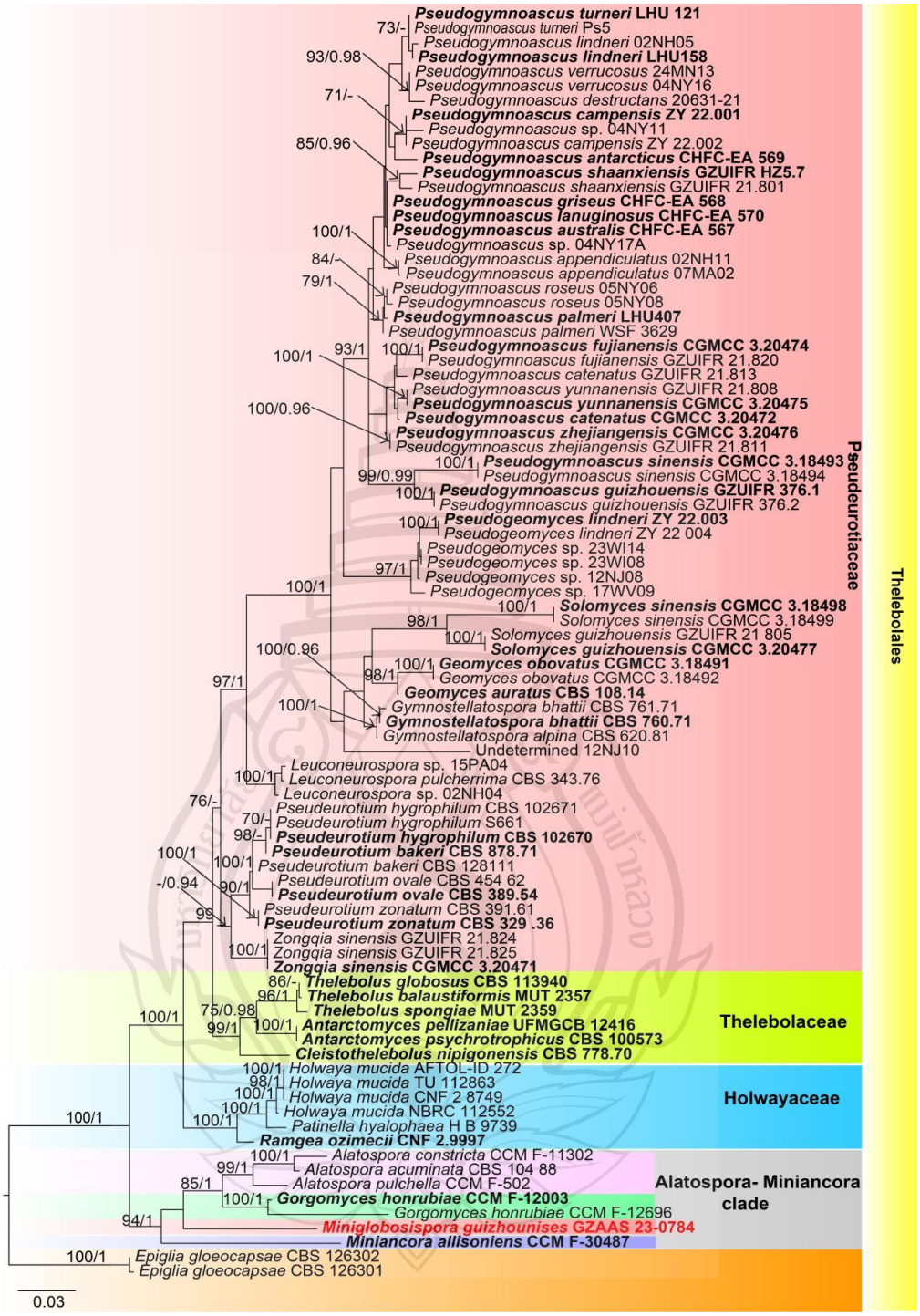
Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi and Miao Autonomous County, from the root of *Dicranopteris ampla*, 2 August 2022, J.Y. Zhang, 116–2 (KUN-HKAS 129872, holotype).

Notes: In our phylogenetic analysis, the new strain (116–2) grouped with *Alatospora*, *Gorgomyces*, and *Miniancora* as a monophyletic clade distinct from *Thelebolaceae*. However, our new isolate formed an independent clade that is distinct from the three genera (Figure 4.36). Morphologically, our new strain is quite different from *Alatospora*, *Gorgomyces*, and *Miniancora* in having holoblastic to polyblastic and phialidic conidiogenous cells and single or catenate, hyaline, aseptate, clavate to short cylindrical, globose to subglobose conidia. Species in *Alatospora* and *Miniancora* have long conidiophores, phialidic conidiogenesis, and conidia that are tetraradiate, T-shaped or flail-shaped conidia, with filiform, septate, main axis and 0–4 branches (Ekanayaka et al., 2019). *Gorgomyces* has solitary, filiform conidia with an apical appendage and a stalk cell (Roldán, 1989). Hence, based on its distinct morphology and phylogenetic analysis, we introduce a new genus, *Miniglobosispora*, to accommodate our new strain as *Miniglobosispora guizhounises*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d Mycelium. e, f Conidiophores, conidiogenous cells, and conidia. g–j Conidiogenous cells, and conidia. k–m Conidia. Scale bar: e, d = 50μm, f = 100 μm, g–j = 20 μm, k–m = 10 um

Figure 4.35 *Miniglobosispora guizhounises* (KUN-HKAS 129872, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. The tree is rooted with *Epiglia gloeocapsae* (CBS 126302 and CBS 126301). The new taxon is in red and bold.

Figure 4.36 Phylogenetic tree of Phylogenetic tree of *Miniglobosispora*

Sordariomycetes O.E. Erikss. & Winka

Diaporthomycetidae Senan., Maharachch. & K.D. Hyde

Diaporthales Nannf., Nova Acta R.

Nannfeldt (1932) established *Diaporthales.* The order comprises saprobes, endophytes, and pathogens on plants, animals, or soil (Alvarez et al., 2016; Senanayake et al., 2017, 2018; Braun et al., 2018; Fan et al., 2018; Pádua et al., 2019; Hyde et al., 2020). We followed the latest treatment of *Diaporthales* by Wijayawardene et al. (2022), which accepted 32 families.

Diaporthaceae Höhn.

Diaporthaceae was introduced by Höhnel (1917) and placed in *Diaporthales.* Wehmeyer (1975) included *Diaporthe* and *Mazzantia* in this family, which was later confirmed by Castlebury et al. (2002) based on a phylogenetic analysis of LSU sequence data. Afterward, several new genera and previously introduced genera have been confirmed in the family based on phylogenetic analysis (Lumbsch & Huhndorf, 2010; Lamprecht et al., 2011; Dai et al., 2014; Voglmayr & Jaklitsch, 2014; Maharachchikumbura et al., 2015). Maharachchikumbura et al. (2015) accepted 11 genera viz. *Allantoporthe*, *Apioporthella*, *Clypeoporthella*, *Diaporthe*, *Diaporthella*, *Diaporthopsis*, *Leucodiaporthe*, *Mazzantia*, *Mazzantiella*, *Ophiodiaporthe* and *Pustulomyces* in *Diaporthaceae* based on phylogenetic analysis. However, *Mazzantiella* and *Clypeoporthella* have been synonymized under *Mazzantia* and *Diaporthe*, respectively. *Diaporthella* was excluded from the family by Senanayake et al. (2017, 2018) as the genus clustered out of *Diaporthaceae*. The latest treatment of *Diaporthaceae* was provided by Hyde et al. (2024) who accepted 15 genera: *Apioporthella*, *Apiosphaeria*, *Chaetoconis*, *Chiangraiomyces*, *Diaporthe*, *Hyaliappendispora*, *Leucodiaporthe*, *Massariothea*, *Mazzantia*, *Ophiodiaporthe*, *Paradiaporthe*, *Phaeocytostroma*, *Phaeodiaporthe*, *Pseudophaeocytostroma*, *Pustulomyces*, *Pulvinaticonidioma*, *Stenocarpella* and *Subellipsoidispora*.

Diaporthe Nitschke

Diaporthe is a large and diverse genus, introduced by Nitschke (1870) and typified by *D. eres*. Initially, *Diaporthe* species were believed to be host-specific, leading to the identification of numerous species based on morphological characteristics and host association (Gomes et al., 2013; Gao et al., 2016). However, it

is now understood that *Diaporthe* species exhibit significant inter- and intra-species diversity and are not host-specific, with many species occurring on multiple hosts. Consequently, morphological features and host association alone are insufficient for accurate species identification (Rehner & Uecker, 1994; Wehmeyer, 1933; Mostert et al. 2001; Gomes et al., 2013). Currently, multigene phylogenetic analyses (ITS, *tub*2, *tef*1-α, *cal* and *his*3), combined with morphological characteristics and ecological data, are employed to delimit *Diaporthe* species (Gao et al., 2017; Yang et al., 2020; Norphanphoun et al., 2022; Hongsanan et al., 2023; Liu et al., 2024; Dissanayake et al., 2024). Members of the genus *Diaporthe* function as endophytes, saprobes, or pathogens and are known to cause severe plant diseases, such as dieback, cankers, leaf spots, blights, rot, and wilt, affecting a variety of economically important agricultural crops (Gomes et al., 2013; Dissanayake et al., 2017; Bai et al., 2022; Hongsanan et al., 2023; Zhou et al., 2024).

There are currently 1,299 *Diaporthe* species listed in Index Fungorum (2024) (accessed 1 November 2024), though only about one-fifth of these species have been linked to molecular data (Zhou et al., 2024). Recently, Dissanayake et al. (2024) re-evaluated the genus, refining species boundaries and dividing *Diaporthe* into seven sections (*Crotalariae*, *Eres*, *Foeniculina*, *Psoraleaepinnatae*, *Rudis*, and *Sojae*) and proposing 15 species complexes. In this study, following the treatment of Dissanayake et al. (2024), four *Diaporthe* species belonging to two sections (Foeniculina and Sojae) were identified based on phylogenetic and morphological analyses. In addition, two new recently published species *D. hainanensis* and *D. harriottiae* are synonymized under *D. arecae* based on phylogenetic analysis and morphological characteristics. Interestingly, *D. xishuangbanica* was reported for the first time as a hyphomycete with brown conidia in this study. In contrast, the conidia of *Diaporthe* are typically hyaline. We speculate that this difference may be due to various morphotypes; specifically, our species is a hyphomycete, while other species are coelomycetes. Additionally, the same species may exhibit different characteristics depending on the conditions.

Diaporthe arecae (H.C. Srivast., Zakia & Govindar.) R.R. Gomes, Glienke & Crous, Persoonia 31: 16 (2013)

= *Diaporthe hainanensis* Qin Yang, in Liu, Luo, Huang & Yang, MycoKeys 102: 235 (2024)

= *Diaporthe harriottiae* Y.P. Tan, in Tan & Shivas, Index of Australian Fungi 44: 1 (2024)

Fungal Names number: FN 802924; Figure 4.37

Endophytic in the fresh stem of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* pycnidial in culture on PDA, globose or irregular, brownish to black, solitary or in groups, embedded, erumpent, cream to pale luteous conidial droplets exuding from the central ostioles. *Conidiophores* 13–20 × 2–3 μm ($\bar{x}$ = 16.6 × 2.3 μm, n = 10) reduced to conidiogenous cells, cylindrical to subcylindrical, tracte at the apex, (0)1–2 septate, densely aggregated, hyaline, smooth-walled. *Conidiogenous cells* 9–11 × 2–3 μm ($\bar{x}$ = 10.2 × 2.4 μm, n = 10), phialidic, terminal, cylindrical to subcylindrical, hyaline. *Alpha conidia* not observed. *Beta conidia* 25–30 × 1.5–2.5 μm ($\bar{x}$ = 28 × 1.6 μm, n = 36), filiform, slightly curved, tapering towards the ends, aseptate, hyaline, not guttulate. *Gamma conidia* not observed.

Culture characters Colonies on PDA medium occupied the whole plate in 15 days at 25 ◦C. Colony at first white, becoming cream to yellowish, flat, with dense and felted mycelium, white to cream with brownish dots with age, with visible solitary or aggregated conidiomata at maturity, reverse pale brown to yellowish brown.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the fresh stem of *Dicranopteris pedata*, 16 March 2022, J.Y Zhang, 108–1 (KUN-HKAS 136229), living culture KUNCC 24–17928.

Notes: Dissanayake et al. (2024) recently re-evaluated the species within *Diaporthe*, combining and synonymizing many species. Approximately 50 species were merged into a single species, *D. arecae*, based on both phylogenetic and morphological analyses. Following the treatment by Dissanayake et al. (2024), our phylogenetic analysis showed that our new isolate grouped within the *D. arecae* clade (Figure 4.38). Morphologically, the new isolate also matches the characteristics of *D. arecae*. Therefore, we have identified our new isolate as *D. arecae* and report it as a new host record for *Dicranopteris pedata*.

Recently, two new species, *D. hainanensis* and *D. harriottiae*, were introduced by Liu et al. (2024) and Tan & Shivas (2024), respectively. However, these two species were not included in the phylogenetic analysis of Dissanayake et al. (2024). Our phylogenetic analysis revealed that both species clustered within the *D. arecae* clade. Following the treatment of Dissanayake et al. (2024), we synonymize these two species under *D. arecae*.

Note a, b Front and reverse colony on PDA. c Conidiomata on the PDA. d Mycelium. e, f, i Conidiophores. g, h Conidiogenous cells and conidia. j–o Conidia. Scale bars: Scale bars: d, j–o = 10 um, e–i = 5 um

Figure 4.37 *Diaporthe arecae* (KUN-HKAS 136229)

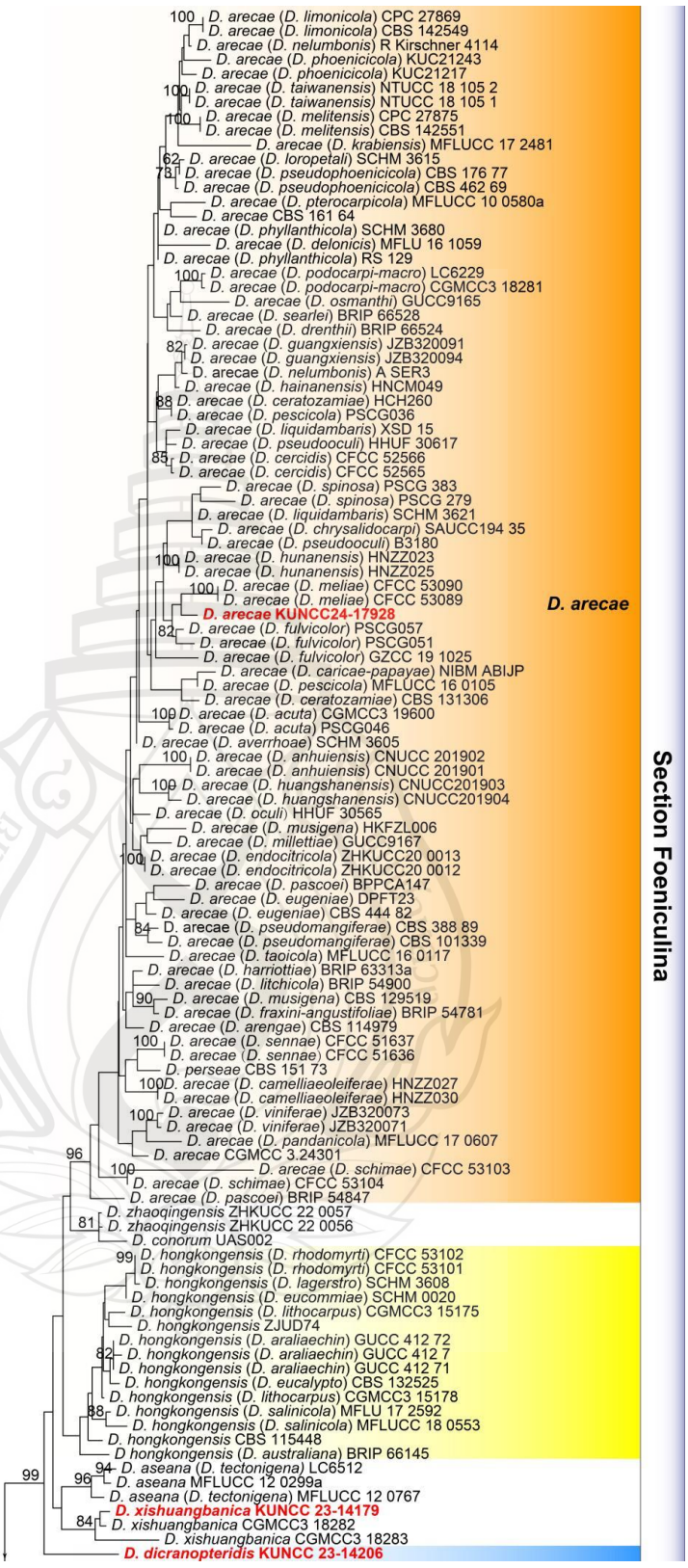
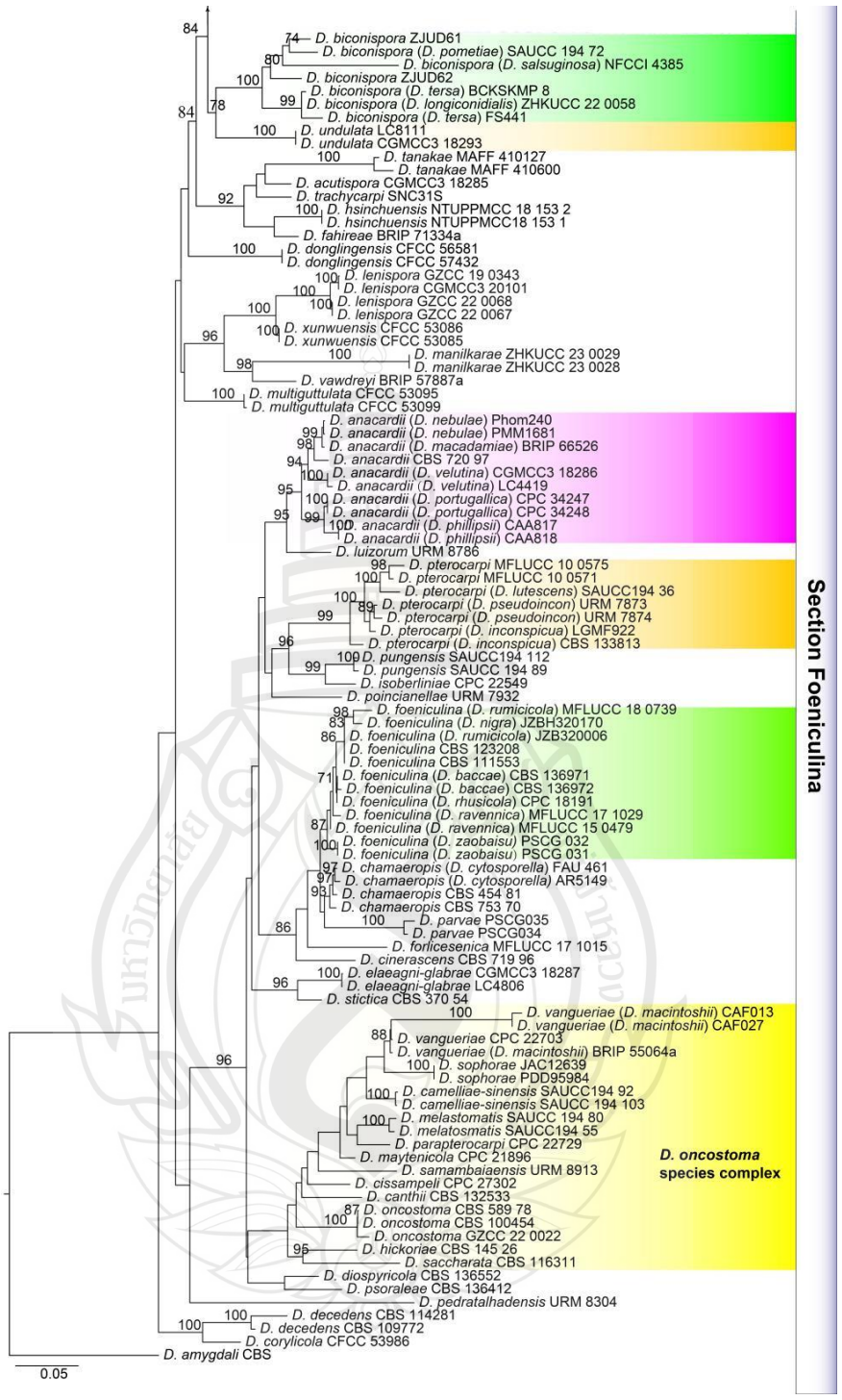


Figure 4.38 Phylogenetic tree of *Diaporthe*



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *tef*1-α, *cal*, and *tub*2 sequence data. The tree is rooted with *D. amygdali* (CBS 126679). The newly obtained strains are red and bold.

Figure 4.38 (continued)

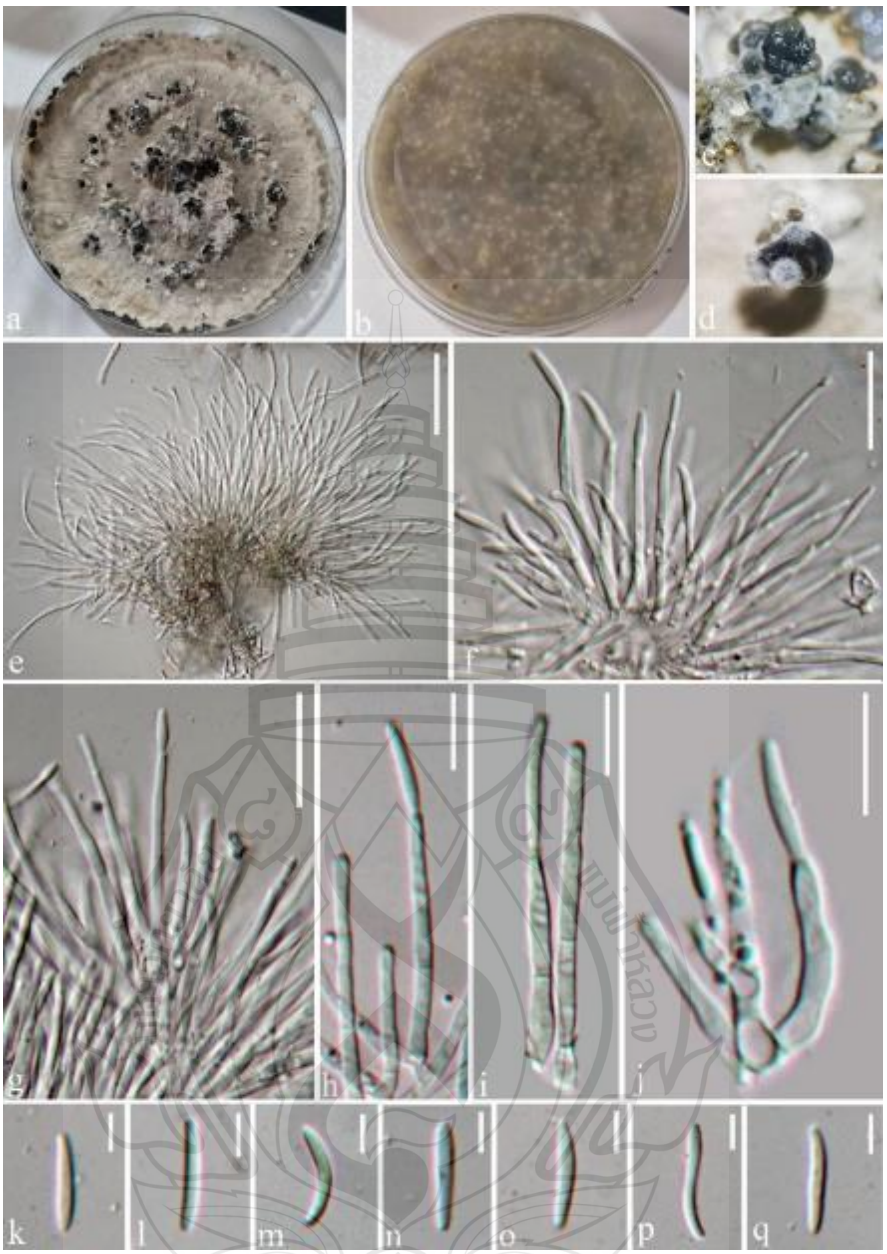
Diaporthe dicranopteridis J.Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov*., Figure 4.39

Etymology: Refers to the host fern *Dicranopteris*, on which the Holotype: was isolated.

Endophytic in fresh stem of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* pycnidial in culture on PDA, globose or irregular, dark brown to black, solitary or in groups, embedded, erumpent, white to cream conidial drops exuded from ostioles. *Conidiomatal wall* brown to dark brown, composed several layers of brown to dark brown cells of *textura angularis*. *Conidiophores* 31–53 × 2–3 µm ($\bar{x}$ = 42.4 × 2.5 µm, n = 25), cylindrical to subcylindrical, truncate at the apex, (0)1–2 septate, densely aggregated, hyaline, smooth-walled. *Conidiogenous cells* 13–24 × 1.5–2.5 µm ($\bar{x}$ = 18.8 × 2.2 µm, n = 34), phialidic, terminal, cylindrical to subcylindrical, hyaline. *Alpha conidia* not observed. *Beta conidia* 12–15 × 2–2.5 µm ($\bar{x}$ = 13.7 × 2.1 µm, n = 34), filiform, slightly curved, tapering towards the ends, aseptate, hyaline, not guttulate. *Gamma conidia* not observed.

Material examined: CHINA, Guizhou Province, Libo County, Southwest Guizhou Buyi and Miao Autonomous County, from the fresh stem of *Dicranopteris pedata*, 8 April 2022, Y Yang, 379–2 (holotype), ex-type culture KUNCC 23–14206.

Notes: In our phylogenetic analysis, *Diaporthe dicranopteridis* (KUNCC 23–14206) formed a distinct lineage within *Diaporthe* (Section Foeniculina) (Figure 4.38), which can be recognized as a new species. Morphologies of *Diaporthe* species are quite similar to each other; thus, it is difficult to identify them without multi-locus phylogenetic analysis. Our new species, *D. dicranopteridis* is phylogenetically closely related to *D. xishuangbanica*, *D. tectonigena,* and *D. aseana*. But *D. dicranopteridis* differs from *D. tectonigena* in having longer conidiophores (31–53 vs. 9–32 um) and shorter Beta conidia (12–15 vs. (16–)29–30(−34) µm) (Doilom et al., 2016). *Diaporthe dicranopteridis* is different from *D. xishuangbanica* and *D. aseana* in having longer conidiophores (31–53 um in *D. dicranopteridis*, 13–34.5 um in *D. xishuangbanica* and 8–15 um in *D. aseana*) (Hyde et al., 2016; Gao et al., 2017). Thus, *D. dicranopteridis* is introduced as a new species, based on phylogeny and morphological analyses.



Note a, b Front and reverse colony on PDA. c, d Conidiomata on the PDA. e–j Conidiophores, conidiogenous cells, and conidia. k–q Beta conidia. Scale bars: Scale bars: e = 40 μm. f, g = 20um, h–j = 10um, k–q = 5 um

Figure 4.39 *Diaporthe dicranopteridis* (379–2, holotype)

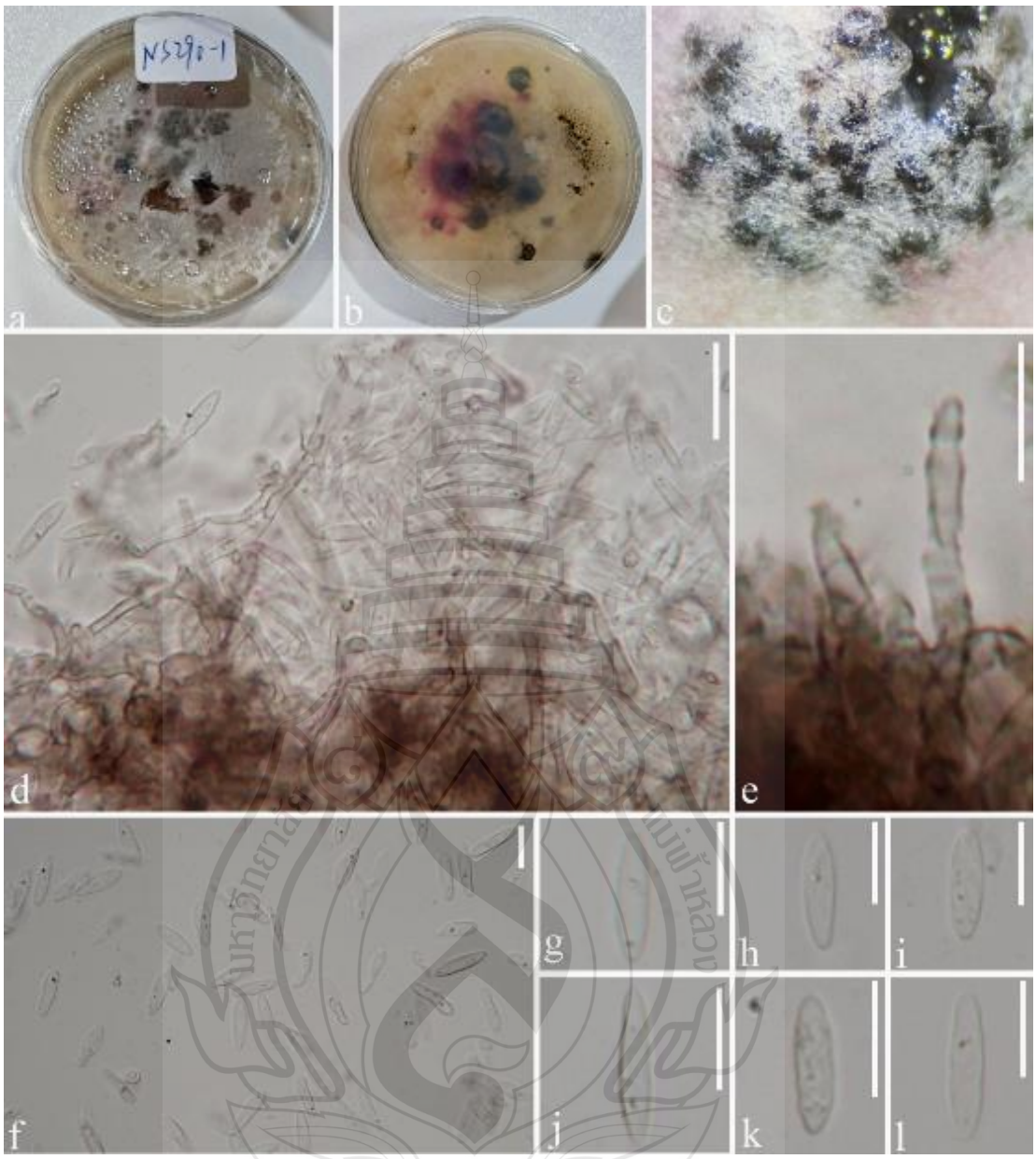
Diaporthe tulliensis R.G. Shivas, Vawdrey & Y.P. Tan, in Crous et al., Persoonia 35: 301 (2015)

Fungal Names number: FN 812896; Figure 4.40

Endophytic stem of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* pycnidial in culture on PDA, globose or irregular, dark brown to black, solitary or in groups, embedded, erumpent, white to cream conidial drops exuded from ostioles. *Conidiophores* densely aggregated, reduced to conidiogenous cells, hyaline to brown, smooth-walled. *Conidiogenous cells* phialidic, terminal, cylindrical to subcylindrical, hyaline. *Alpha conidia* 11–14× 3–4 µm ($\bar{x}$ = 12.9 × 3.6 µm, n = 30), ellipsoidal to cylindrical, acute at both ends, straight, hyaline, aseptate, smooth-walled, small-guttulate. *Beta conidia* and *Gamma conidia* not observed.

Material examined: CHINA, Guizhou Province, Zhenfeng County, Southwest Guizhou Buyi and Miao Autonomous County, the stem of *Dicranopteris pedata*, 17 March 2022, J.Y Zhang, 290–1 (KUN-HKAS 136235), living culture KUNCC 24–17933.

Notes: In our phylogenetic analysis, the new isolate KUNCC 24–17933 clustered with two strains of *Diaporthe hubeiensis* (JZB320128 and JZB320123) (Figure 4.38), which was introduced by Manawasinghe et al. (2019) from the diseased trunk of *Vitis vinifera* in China. Morphologically, the new isolate is nearly identical to *D. hubeiensis*, except for the conidia, which are small-guttulate and larger than those of the Holotype: of *D. hubeiensis*. The ITS, *tub*2, *his*3, *cal*, and *tef*1-α sequences of the new isolate (KUNCC 24–17933) show no significant differences from *D. hubeiensis* (JZB320123). However, Dissanayake et al. (2024) recently refined the species boundaries and complexes of *Diaporthe*, *D. hubeiensis* was synonymized as *D. tulliensis*. Following this treatment, we identified our new isolate as *D. tulliensis*. This is the first report of *D. tulliensis* from *Dicranopteris pedata*.



Note a, b Front and reverse colony on PDA. c Conidiomata on the PDA. d Conidial mass, conidiophores, and conidia. e Conidiophores. f–l Conidia. Scale bars: d = 20 µm. e–l = 10 um

Figure 4.40 *Diaporthe tulliensis* (KUN-HKAS 136235)

Diaporthe xishuangbanica Y.H. Gao & L. Cai, in Gao, Liu, Duan, Crous & Cai, IMA Fungus 8(1): 179 (2017)

Fungal Names number: FN 820685; Figure 4.41

Endophytic in the rhizome of *Dicranopteris linearis*. Sexual morph: Not observed. Asexual morph: *Hyphae* hyaline to brown, septate, branched, aerial mycelium, thin-walled. *Conidiophores* cylindrical, straight or slightly flexuous, hyaline to pale brown, septate, branched, with conidiogenous cell arising terminally or laterally. *Conidiogenous cells* polyblastic, terminal, integrated, hyaline, smooth-walled, cylindrical to oblong. *Conidia* 4–6 × 2–3 µm ($\bar{x}$ =4.9 × 2.8µm, n = 40), single, in a short chain, aseptate, thin-walled, smooth, obovoid to clavate, or ellipsoidal to fusiform, rounded at the apex, truncate at the base, straight, hyaline when young, becoming olive brown when mature, aseptate, smooth-walled, guttulate.

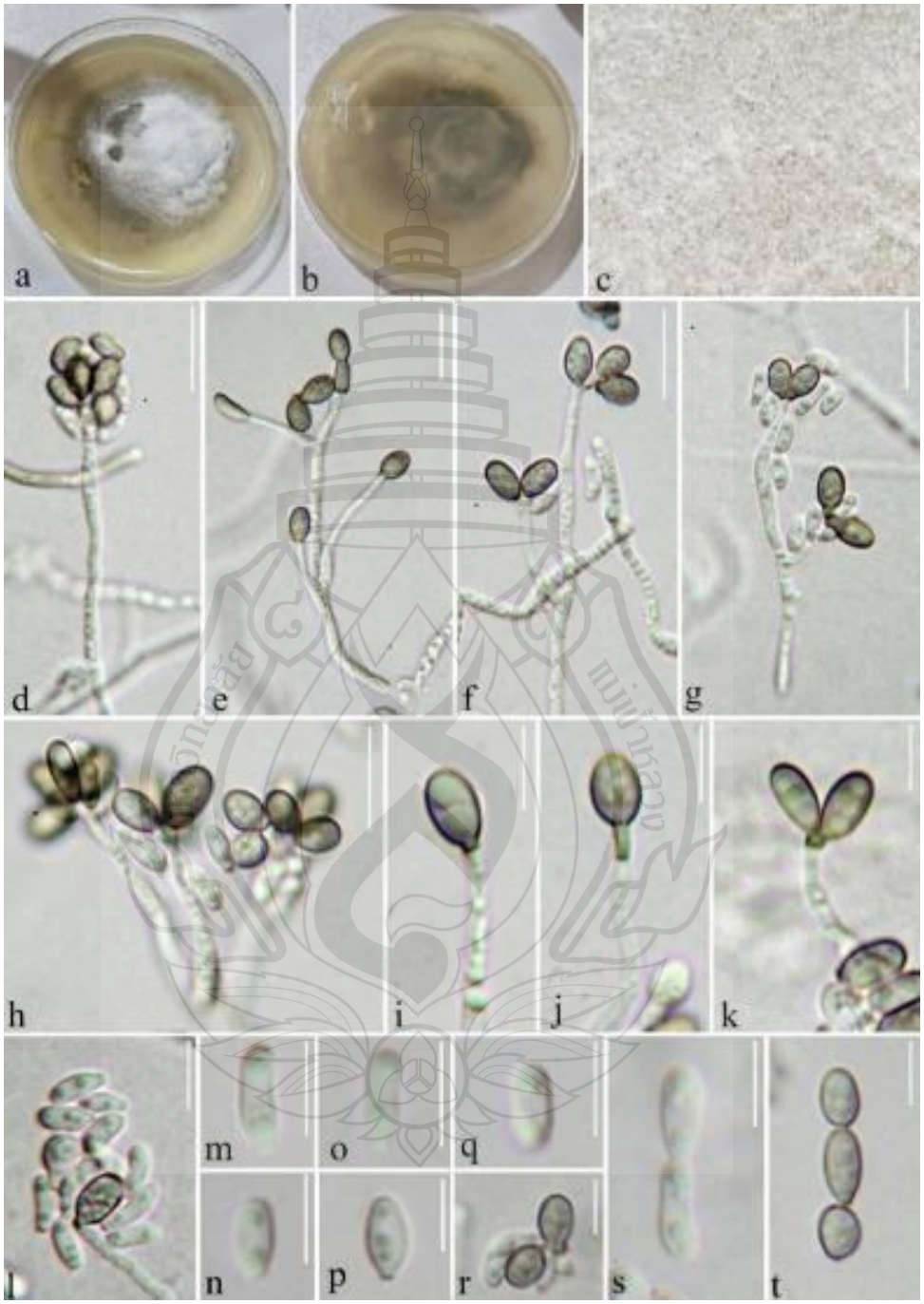
Culture characters Colonies on PDA medium, growing fast, dense, covered with abundant, white at the surface, cottony to woolly aerial mycelia; reverse darj grey.

Material examined: CHINA, Guizhou Province, Zhenfeng County, Southwest Guizhou Buyi and Miao Autonomous County, the rhizome of *Dicranopteris pedata*, 17 March 2022, J.Y Zhang, 171–1 (KUN-HKAS 129883), living culture KUNCC 23–14179.

Notes: The phylogenetic analysis showed that our new isolate UNCC 23–14179 clustered sister to the ex-type strain of *D. xishuangbanica* (CGMCC 3.18282) with 83% bootstrap support (Figure 4.42). The comparison of nucleotides of ITS, *tef*1-*α*, *tub*2 and *his*3 sequences between our new isolate and *D. xishuangbanica* (CGMCC 3.18282) revealed 8bp, 0bp, 1bp and 4bp differences, respectively, which were not significantly different from *D. xishuangbanica* (CGMCC 3.18282). Thus, we identified our new isolate as *D. xishuangbanica*.

Morphologically, our new isolate UNCC 23–14179 was found as hyphomycetes, while the Holotype: of *D. xishuangbanica* was reported as coelomycetes (Gao et al., 2017). Our new isolate is similar to the Holotype: of *D. xishuangbanica* in having fusiform, multi-guttulate conidia. However, our new isolate has single or catenate, hyaline to olive brown conidia, which are different from the holotype; the occurrence of these differences may be due to the different morphs as our new isolate is a hyphomycetes, while the Holotype: is a coelomycete. It would be fascinating to look

into the morphologies of the same fungus in different asexual morphs; there could be differences between the hyphomycetous and coelomycetous asexual morphs of the same fungus.



Note a, b Front and reverse colony on PDA. c Conidial mass on the PDA. d–h hyphae, conidiogenous cells and conidia. i–k Conidiogenous cells and conidia. l–t Conidia. Scale bars: Scale bars: d–h = 10 um, i–t = 5 um

Figure 4.41 *Diaporthe xishuangbanica* (KUN-HKAS 129883)

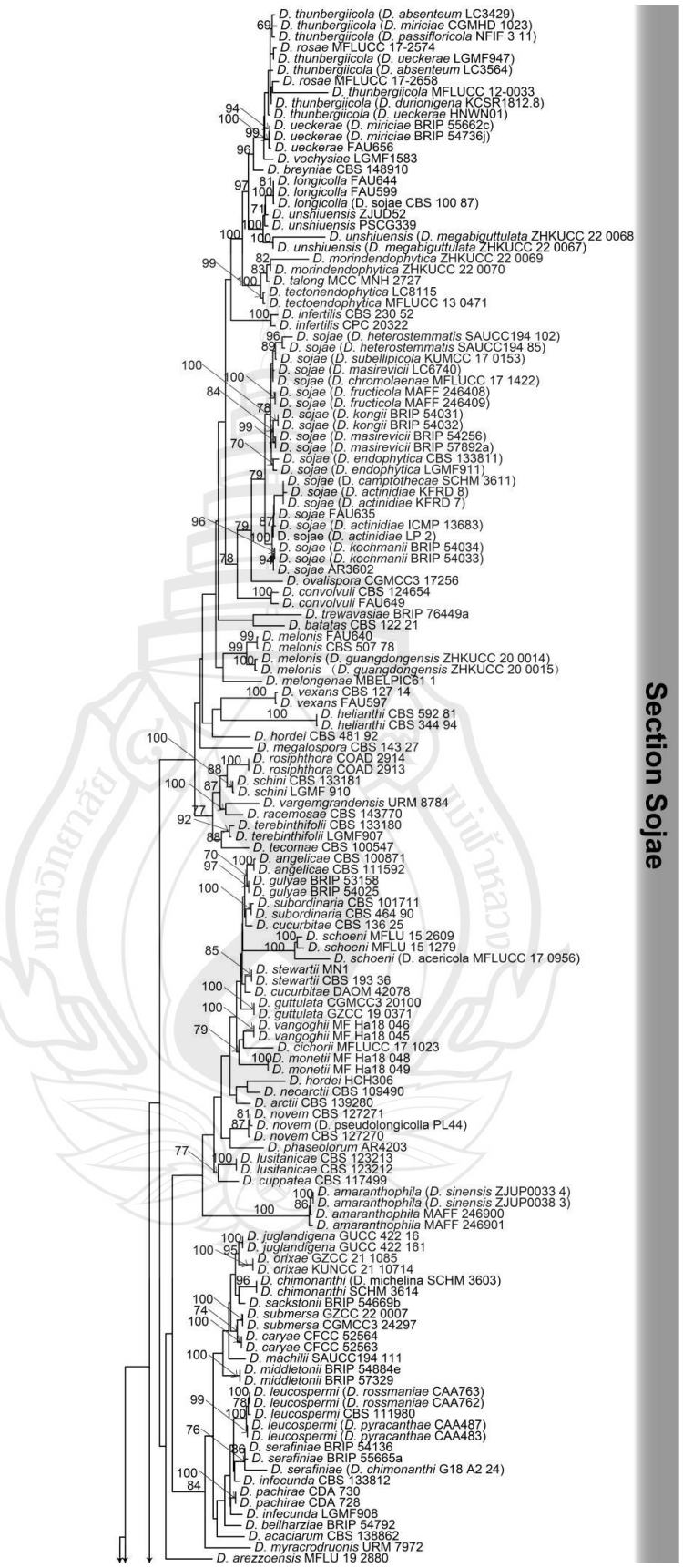
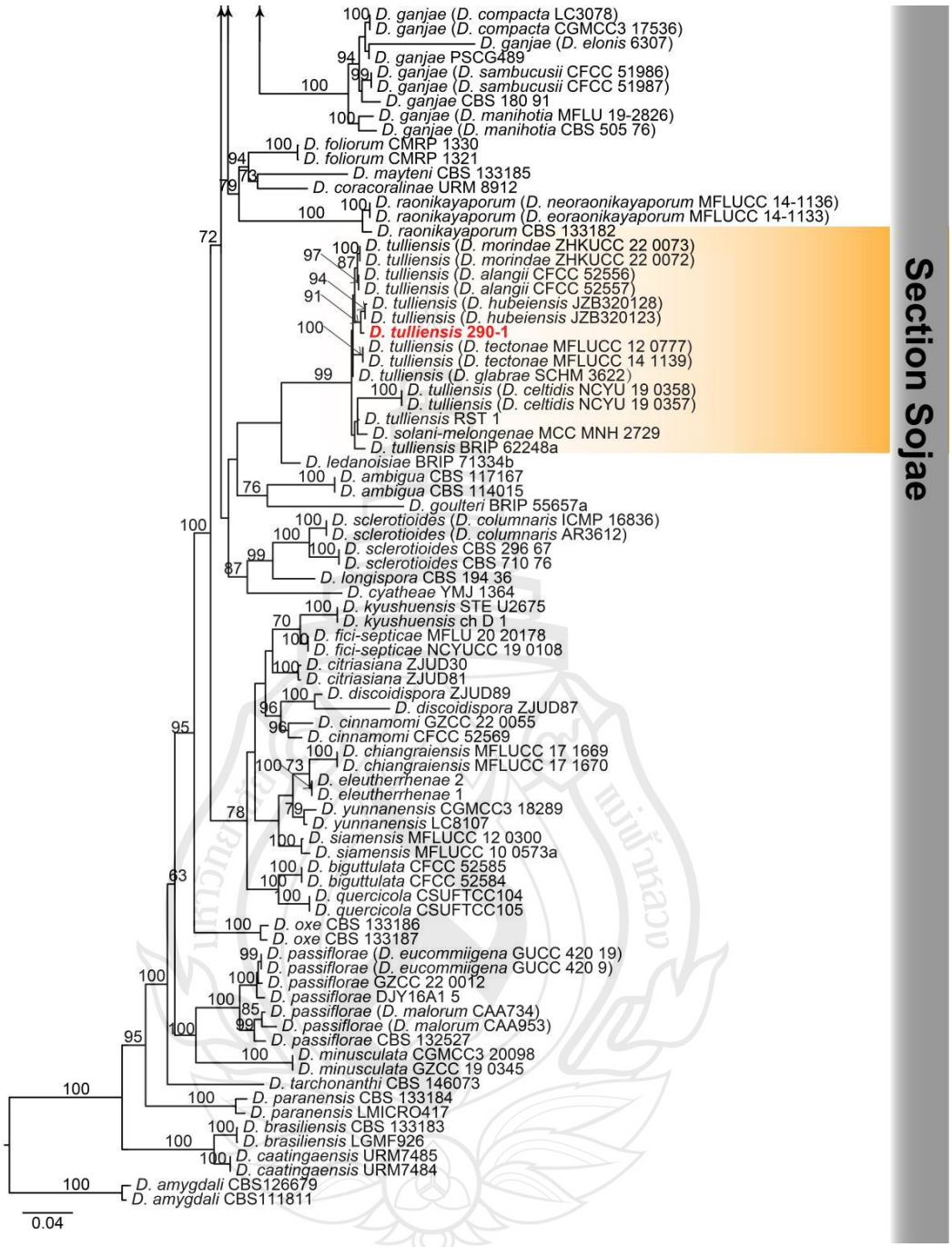


Figure 4.42 Phylogenetic tree of *Diaporthe*



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *cal*, *his*3, *tef*1-α, and *tub*2 sequence data. Bootstrap support values for ML equal to or greater than 70%. The tree was rooted to *D. amygdali* (CBS126679 and CBS111811). The newly generated sequences are shown in red.

Figure 4.42 (continued)

Subclass *Hypocreomycetidae* O.E. Erikss. & Winka

Glomerellales Chadef. ex Réblová et al.

Glomerellales was validly introduced by Réblová et al. (2011); they have clarified the taxonomy of this order with accepted *Glomerellaceae* and two newly described families, *Australiascaceae* and *Reticulascaceae* based on morphology and a multi-locus phylogenetic analysis (LSU, SSU, and *rpb*2). Later, *Plectosphaerellaceae* and *Malaysiascaceae* were added to the order by Maharachchikumbura et al. (2016) and Tibpromma et al. (2018), respectively. However, the status of *Malaysiascaceae* may need further revision as the divergence time for *Malaysiascaceae* falls in the genus status (Hyde et al., 2020a).

Glomerellaceae Locq.

Glomerellaceae was initially introduced by Locquin (1984) it was not validated for publication. Zhang et al. (2006) accepted and formally introduced *Glomerellaceae* as a distinct family and placed it in *Hypocreomycetidae*. Maharachchikumbura et al. (2016) and Hyde et al. (2020a) confirmed that *Glomerellaceae* is monophyletic with a single genus *Colletotrichum*.

Colletotrichum Corda

Colletotrichum, the type genus of *Glomerellaceae*, is a speciose and ecologically diverse genus that includes endophytes, saprobes, plant pathogens, or can occur in several life modes, and a few species that are human pathogens and animal pathogens (Cai et al., 2009; Shivaprakash et al., 2011; Huang et al., 2013; Buchta et al., 2019; Liu et al., 2021, 2022; Jayawardena et al., 2021). Previously, the identification of *Colletotrichum* species was mainly based on host range and morphological characteristics. However, the characteristics of *Colletotrichum* species are not suitable for species-level identification due to their environmental dependencies, polyphyly, and the potential for multiple species to infect the same host plant (Than et al., 2008; Cai et al., 2009; Liu et al., 2022; Talhinhas & Baroncelli, 2023; Zhang et al., 2024b). In recent years, a multi-locus phylogenetic approach has been presented for *Colletotrichum* species delimitation, which has greatly improved the identification of *Colletotrichum* species (Fu et al., 2019; Bhunjun et al., 2021b; Liu et al., 2022; Zhang et al., 2023a; Peng et al., 2023; Zhang et al., 2024b; Zhou et al., 2024; Sui et al., 2024). To date, 15 *Colletotrichum* species complexes have been identified (Liu et al., 2022; Zhou et al., 2024). Index Fungorum (2024) listed 2054 records of *Colletotrichum*;

however, only about one-fifth have sequence data available in the GenBank database (Zheng et al., 2022). In this study, two new species and four new host records are described based on phylogeny and morphology.

Colletotrichum dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov*., Figure 4.43

Etymology: Refers to the host plant *Dicranopteris*, on which the Holotype: was collected.

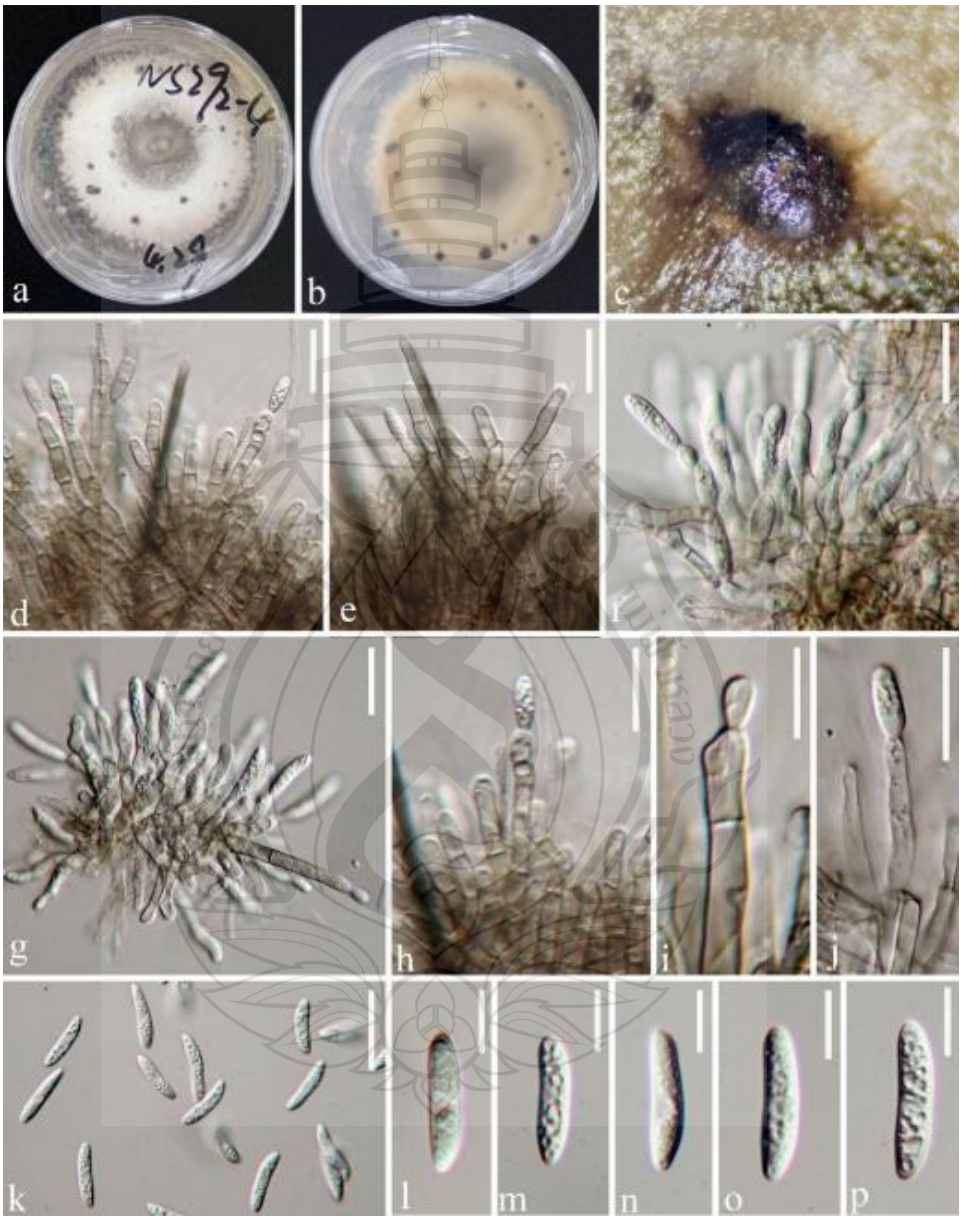
Endophytic in fresh leaves of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Vegetative hyphae* hyaline or pale brown, smooth-walled, septate, branched. *Conidiomata* acervular, gregarious, paleluteous. *Setae* medium brown, paler towards the apex, smooth-walled, 2–4-septate, tip acute or round. *Conidiophores* 44–70 × 3.5–5 µm ($\bar{x}$ = 57 × 4.4 µm, n = 25), cylindrical, hyaline when young, becoming brown to dark brown when mature, hyaline to pale brown towards the apex, brown to dark brown at the base, branched, septate, smooth-walled. *Conidiogenous cells* 11–19 × 3–4.5 µm ($\bar{x}$ = 15.6 × 4 µm, n = 35), phialidic, integrated, terminal, hyaline, smooth-walled, cylindrical to clavate. *Conidia* 21–25 × 5–6 µm ($\bar{x}$ = 23.1 × 5.5 µm, n = 35), hyaline, aseptate, guttulate, dry, cylindrical, straight or slightly curved, rounded or obtuse at the apex, obtuse at the end, straight or slightly curved, smooth-walled. *Appressoria*: not observed.

Cultural characteristics Colonies on PDA reaching 68–70 mm diam within 14 days, flat, entire margin, aerial mycelium white, cottony, conidiomata visible at maturity, white on the surface, brown to dark grey on reverse, without pigmentation,

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the fresh leaves of *Dicranopteris pedata*, 16 March 2022, J.Y Zhang, 292–4 (holotype), ex-type culture GZCC 23–0706.

Notes: In our phylogenetic analysis, our new isolate *Colletotrichum dicranopteridis* (GZCC 23–0706) clustered within *C. graminicola* species complex, and sister to *C. paraendophytum* (LC13888) with 98% ML bootstrap support (Figure 4.44). *Colletotrichum dicranopteridis* (GZCC 23–0706) is similar to *C. paraendophytum* in having dark brown, smooth-walled, septate setae, branched conidiophores and hyaline, aseptate, guttulate, smooth-walled conidia. However, *C. dicranopteridis* (GZCC 23–0706) differs from *C. paraendophytum* in having 2–4-septate setae and cylindrical, straight or slightly curved conidia with round or obtuse apex and obtuse end. While the setae of

C. paraendophytum are 1–2-septate, and conidia are gradually tapering towards a rounded apex and a usually truncate base, with a similar radian (Liu et al., 2022) a comparison of nucleotide in ITS, *tub*2, and *act* gene region revealed 11bp, 19bp, and 29bp differences. Thus, based on both phylogeny and morphological characteristics we introduce our new isolate as a new species.



Note a, b Front and reverse colony on PDA. c Conidiomata on the PDA. d, e Conidial mass with setae. g Conidiophores, conidiogenous cells, and conidia. h–j Conidiogenous cells and conidia. k–p Conidia. Scale bars: d–h, j = 20um, i, l–p = 10um, k = 30 um

Figure 4.43 *Colletotrichum dicranopteridis* (292–4, holotype)

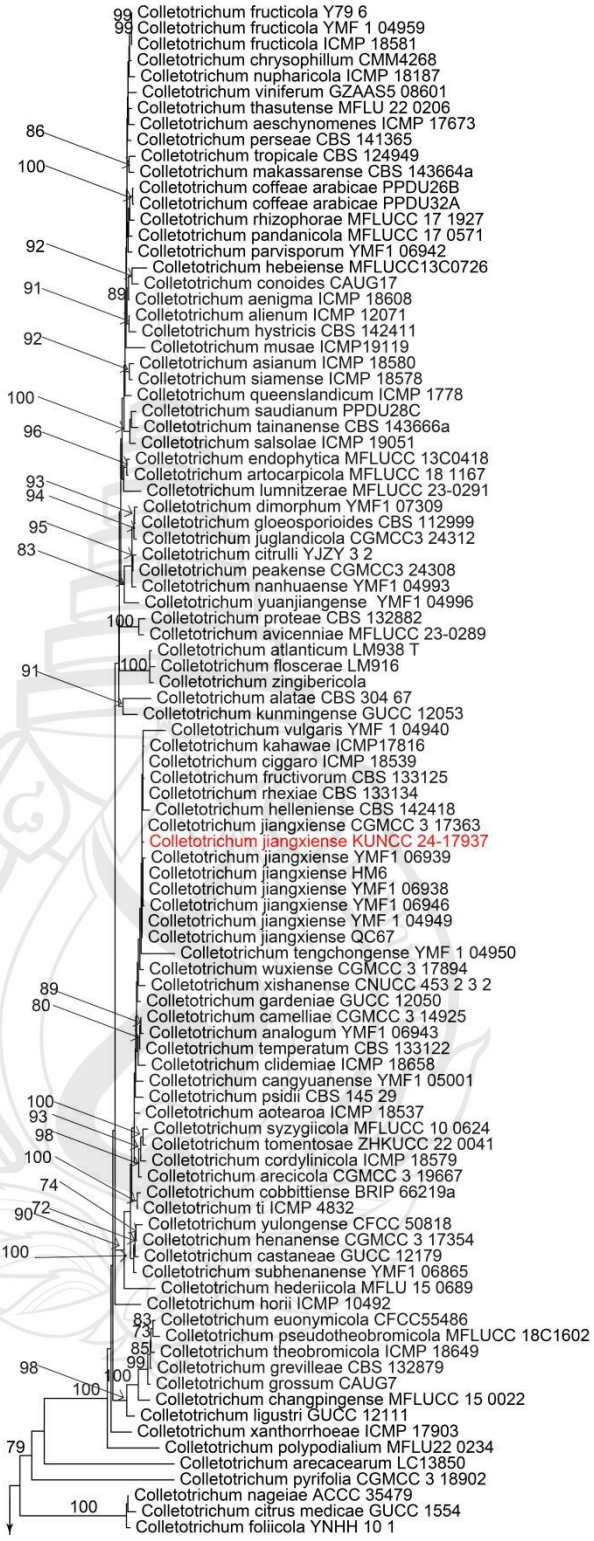


Figure 4.44 Phylogenetic tree of *Colletotrichum*

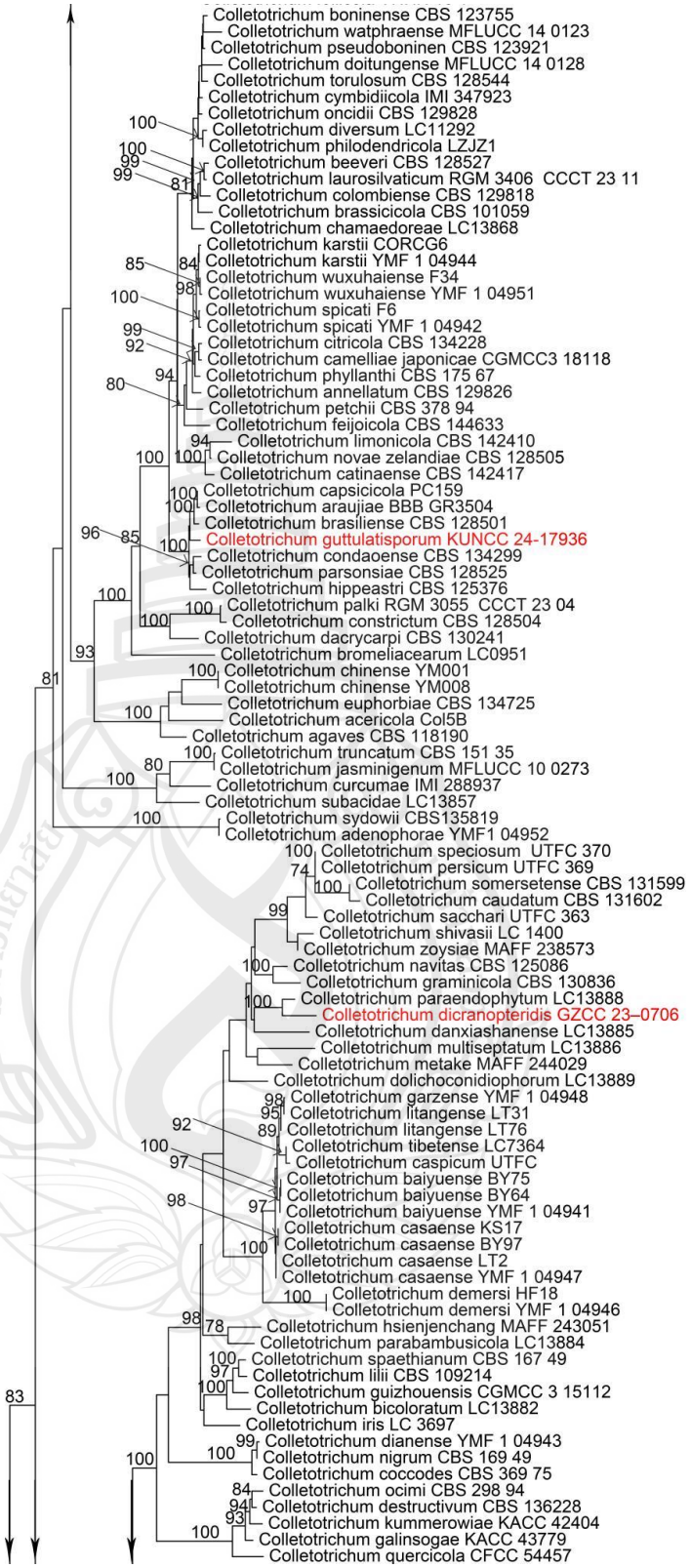
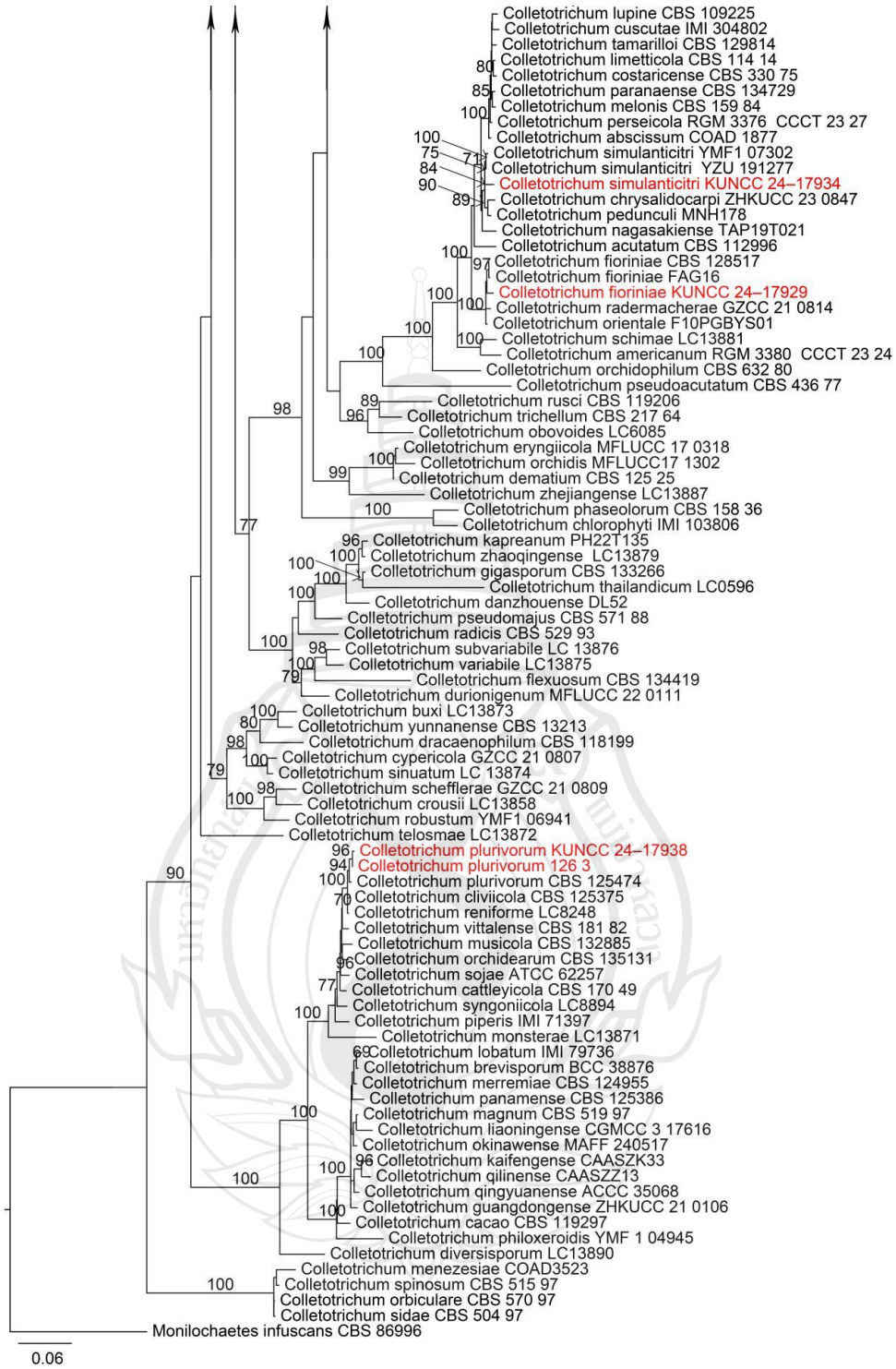


Figure 4.44 (continued)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *act*, *chs*, *gapdh*, and *tub*2 sequence data

Figure 4.44 (continued)

Colletotrichum fioriniae (Marcelino & Gouli) Pennycook, Mycotaxon 132(1): 150 (2017)

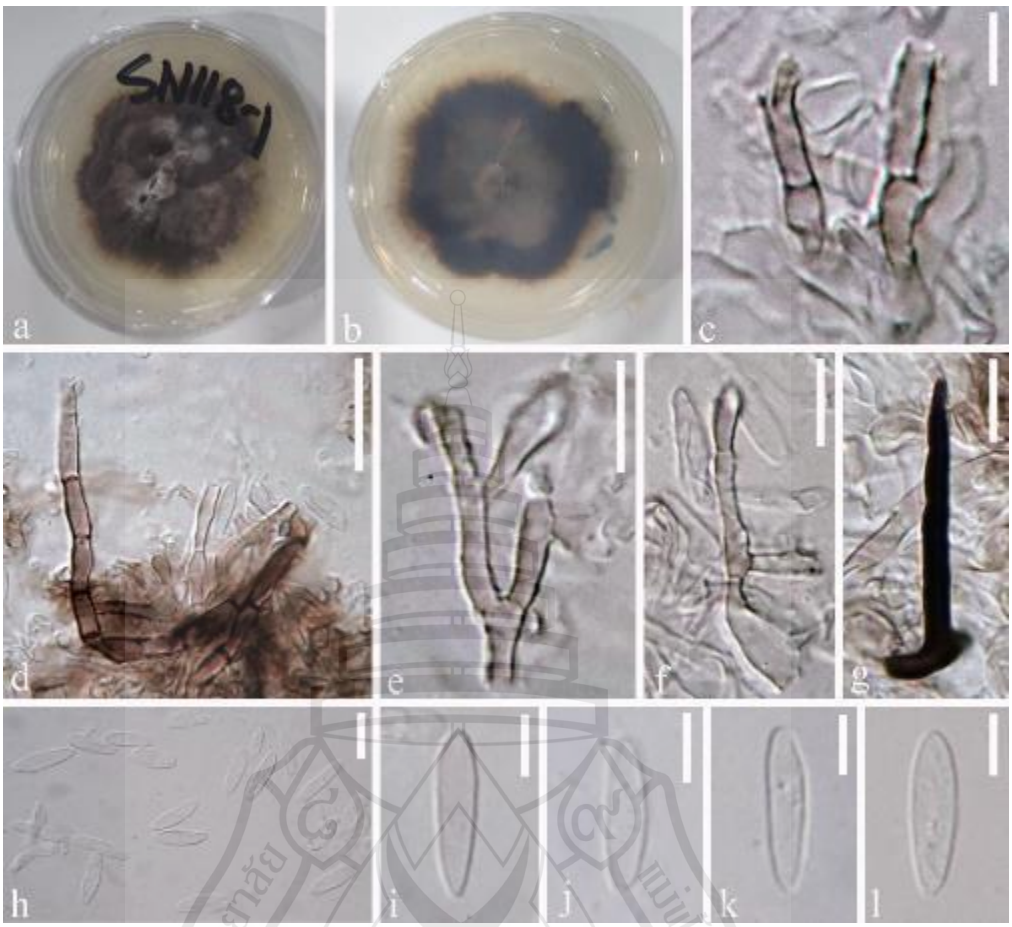
Fungal Names number: FN 553097; Figure 4.45

Endophytic in the stem of *Dicranopteris ampla*. Sexual morph: Not observed. Asexual morph: *Vegetative hyphae* hyaline or pale brown, smooth-walled, septate, branched. *Conidiomata* not observed. *Setae* 39–57 × 2.5–3 µm ($\bar{x}$ =48.4 × 2.8 µm, n = 15), dark brown, smooth-walled, 3–4-septate, tip acute or round. *Conidiophores* cylindrical, hyaline to dark brown, branched, septate, smooth-walled. *Conidiogenous cells* 8–13 × 2–3 µm ($\bar{x}$ = 10.7 × 2.6 µm, n = 15), phialidic, integrated, terminal, hyaline to pale brown, smooth-walled, ampulliform. *Conidia* 10–13 × 3–3.5 µm ($\bar{x}$ = 12 × 3.2 µm, n = 35), fusiform with both ends acute, straight, or slightly curved, hyaline, aseptate, dry, guttulate, smooth-walled. *Appressoria*: not observed.

Cultural characteristics: Colonies on PDA reaching 30–40 mm diam within 14 days, flat, entire margin, dark grey to greyish brown on the surface, brown to dark grey a reverse, without pigmentation,

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the stem of *Dicranopteris ampla*, 2 March 2022, J.Y Zhang, 118–1 (KUN-HKAS 136234), living culture KUNCC 24–17929.

Notes: In the current phylogenetic analysis, our new isolate KUNCC 24–17929 clustered as a sister taxon to *Colletotrichum fioriniae* (Figure 4.44). The nucleotide differences between isolate KUNCC 24–17929 and *C. fioriniae* (CBS 128517) in the ITS and *gapdh* gene regions are 0.04% (2/492 bp) and 1.8% (4/211 bp), respectively. The nucleotide sequences of the *act* gene between KUNCC 24–179291 and *C. fioriniae* are completely identical. These differences are not significant enough to separate our isolate from *C. fioriniae*. Morphologically, our new isolate is similar to *C. fioriniae*, having hyaline, ampulliform, smooth-walled conidiogenous cells and fusiform, hyaline, aseptate conidia with acute ends. However, our isolate has setae, a feature not observed in *C. fioriniae*. Studies have shown that setae may be present or absent in different strains of the same species (e.g., *C. plurivorum*) (Damm et al., 2019). Therefore, this characteristic is insufficient to distinguish our new isolate from *C. fioriniae*. Based on both phylogenetic and morphological evidence, we identified our new isolate as *C. fioriniae*.



Note a, b. Front and reverse colony on PDA. c–f Conidiophores. g Setae. h–l Conidia. Scale bars: c, i–l = 5 um, d = 20 um, e–h = 10 um

Figure 4.45 *Colletotrichum fioriniae* (KUN-HKAS 136234)

Colletotrichum guttulatisporum J.Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov*., Figure 4.46

Etymology: Refers to the guttulate ascospores of the fungus.

Holotype: KUN-HKAS 136231

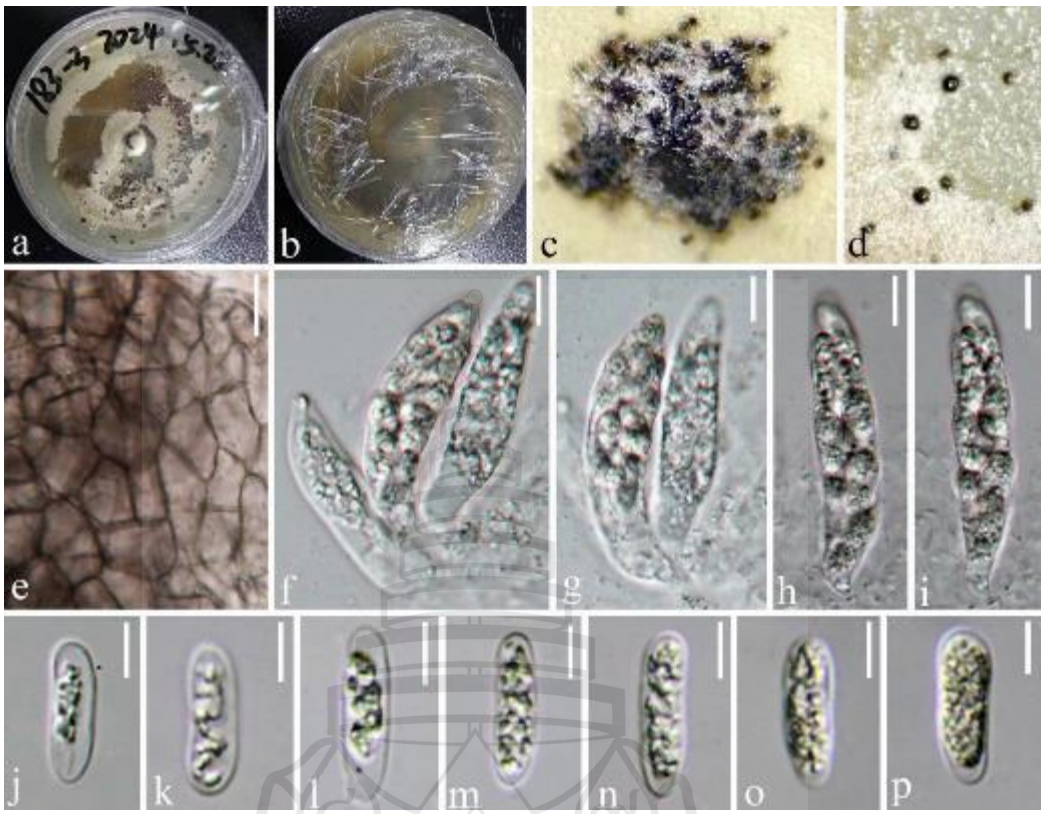
Endophytic in the leaves of *D. padata*. Sexual morph: *Ascomata perithecia*, solitary, or superficial or immersed in the agar medium, non-stromatic, subglobose, ostiolate, medium to dark brown. Hamathecium not observed. *Ascomatal wall* composed of several layers of pale brown *textura angularis*. *Asci* 47–67 × 4.5–6 µm ($\bar{x}$ = 57.4 × 13.3µm, n =20), unitunicate, 8-spored, cylindrical to clavate, tapering to apex and base, smooth-walled, the base broadly truncate. *Ascospores* 13–15× 3.5–5 µm ($\bar{x}$ = 14.2 × 4.2 µm, n = 30), uni- or biseriately arranged, aseptate, hyaline, smooth-walled, fusiform with round ends, straight

or rarely very slightly curved, guttulate. Asexual morph: Not observed.

Cultural characteristics: Colonies on PDA reaching 45–50 mm diam within 14 days. Colony entire, white to pale grey, with felted mycelium, brownish to black ascomata erumpent at maturity, coated with white hypha, granular at the margin, reverse pale brown, with brownish dots when maturity.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from fresh leaves of *D. padata*, 16 March 2022, J.Y Zhang, 183–3 (KUN-HKAS 136231), living culture KUNCC 24–17936.

Notes: In our phylogenetic analysis, *Colletotrichum guttulatisporum* formed a distinct lineage within *Colletotrichum* and basal to *C. araujiae*, *C. capsicicola* and *C. brasiliense* (Figure 4.43). *Colletotrichum guttulatisporum* is reported here only by the sexual morph, while only asexual morphs are known for the other species. *Colletotrichum guttulatisporum* is phylogenetically distinct from the three species (Figure 4.44). Morphologically, *C. guttulatisporum* is quite similar to *C. plurivorum* in having astromatic, globose to obpyriform, ostiolate ascomata, a peridium of pale brown flattened *textura angularis* and uni- or biseriately, aseptate, hyaline, smooth-walled, fusiform ascospores with round ends. However, *C. guttulatisporum* differs from *C. plurivorum* in having narrower asci (4.5–6 vs. 10.5–12.5 μm) and guttulate, smaller ascospores (13–15× 3.5–5 vs. (13–)14.5–18(–22) × (4–)5–6(–7) μm) (Damm et al., 2019).



Note a, b. Front and reverse colony on PDA. c, d Ascomata on the PDA. e Ascomatal wall. f–i Asci. j–p Ascospores. Scale bars: e–i = 10 um, j–p = 5 um

Figure 4.46 *Colletotrichum guttulatisporum* (KUN-HKAS 136231, holotype)

Colletotrichum jiangxiense F. Liu & L. Cai, in Liu, Weir, Damm, Crous, Wang, Liu, Zhang & Cai, Persoonia 35: 82 (2015)

= *Colletotrichum gracile* Z.F. Yu, in Yu, Jiang, Zheng, Zhang & Qiao, Journal of Fungi 8(2, no. 185): 14 (2022)

= *Colletotrichum oblongisporum* Z.F. Yu, in Yu, Jiang, Zheng, Zhang & Qiao, Journal of Fungi 8(2, no. 185): 20 (2022)

= *Colletotrichum nullisetosum* Z.F. Yu, in Yu, Jiang, Zheng, Zhang & Qiao, Journal of Fungi 8(2, no. 185): 18 (2022)

Fungal Names number: FN 809161; Figure 4.47

Endophytic in the leaves of *Dicranopteris ampla*. Sexual morph: Not observed. Asexual morph: *Vegetative hyphae* hyaline or pale brown, smooth-walled, septate, branched. *Conidiomata* not observed. *Setae* not observed. *Conidiophores* 24–40 × 2.5–3.5 µm ($\bar{x}$ = 32.2 × 3.9 µm, n = 15, hyaline to pale brown, branched. *Conidiogenous*

cells 9–23 × 2–3.5 µm ($\bar{x}$ = 16.1 × 2.8 µm, n = 15). *Conidia* 14–18 × 3–4 µm ($\bar{x}$ = 15.6 × 3.5 µm, n = 30), hyaline, aseptate, smooth-walled, cylindrical, both ends bluntly rounded, or one end bluntly rounded and one end acutely rounded. *Appressoria* single, brown to dark brown, smooth-walled, variable in shape, irregular unlobed or slightly lobed.

Culture characters: Colonies on PDA occupied the whole plate in 7 days at 25°C. Colony entirely white, reverse pale yellowish. Aerial mycelium white, velvety, margin well defined.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi and Miao Autonomous County, from the leaves of *Dicranopteris ampla*, 17 March 2022, J.Y Zhang, 122–6 (KUN-HKAS 136232), living culture KUNCC 24–17937.

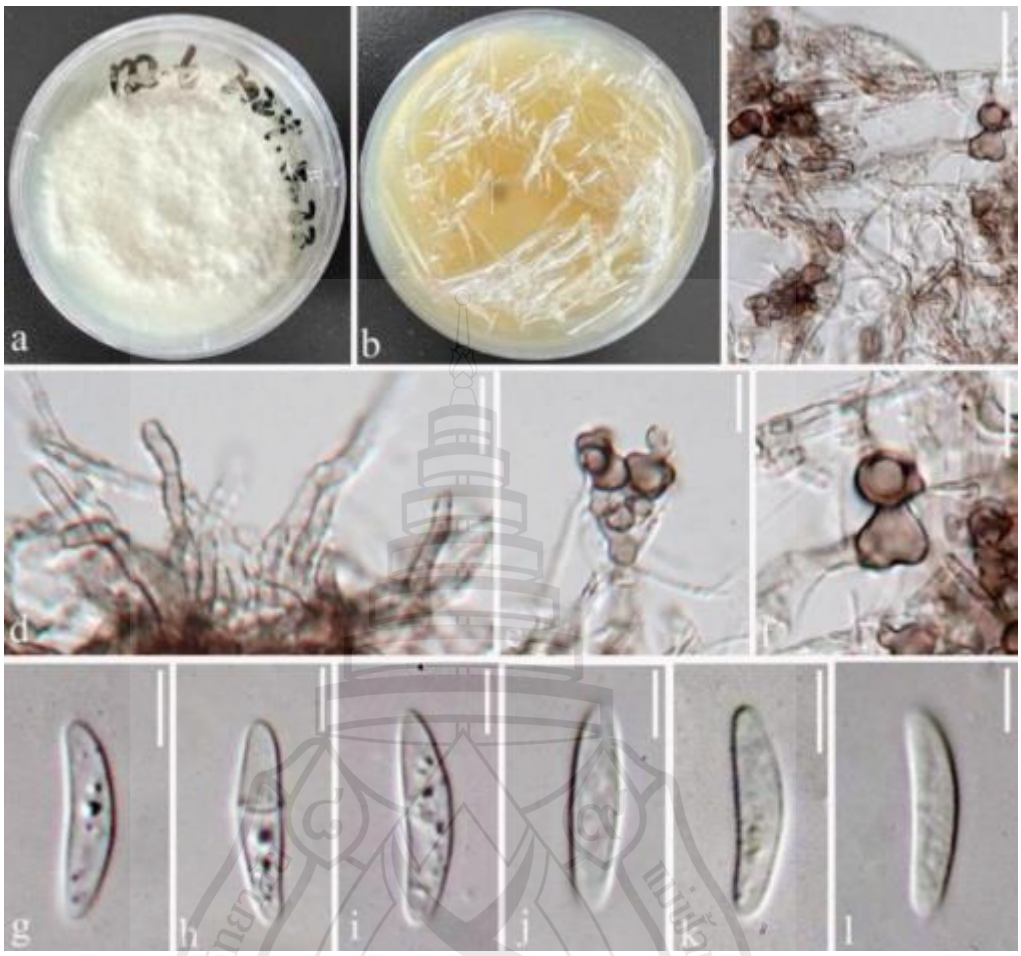
Notes: *Colletotrichum jiangxiense* was introduced by Liu et al. (2015). The conidiogenous cells are hyaline to pale brown and cylindrical. The conidia are hyaline, aseptate, smooth-walled, and cylindrical, with both ends rounded or one end rounded and the other end acute. In our phylogenetic analysis, the newly obtained strain KUNCC 24–17937 grouped with *C. jiangxiense* (CGMCC 3.17363, HM6, YMF 1.04949, and QC67), *C. gracile* (YMF 1.06939), *C. oblongisporum* (YMF 1.06938), and *C. nullisetosum* (YMF 1.06946) (Figure 4.43). Notably, *C. gracile* (YMF 1.06939), *C. oblongisporum* (YMF 1.06938), and *C. nullisetosum* were intermingled with the strains of *C. jiangxiense* (CGMCC 3.17363, HM6, YMF 1.04949, and QC67) in the phylogenetic tree (Figure 4.44). We compared the sequence data of our new strain and these species, the results showed that they are identical in the ITS and *act* gene regions with minor differences in the *tub*2 and *gapdh* gene regions (Table 4.3). There were no significant morphological differences of these strains and our new strain (KUNCC 24–17937) although two conidial shapes were observed in *C. nullisetosum*, however, sometimes the conidial shapes may change in species, and one of the conidial shapes has also been found in the other three species, and phylogeny this species is also not significantly different from the other three species (Table 4.3). Therefore, we propose combining these taxa into a single species. *Colletotrichum gracile* (YMF 1.06939), *C. oblongisporum* (YMF 1.06938), and *C. nullisetosum* (YMF 1.06946) were recently introduced by Yu et al. (2023). To prioritize *C. jiangxiense*, we synonymize *C. gracile*, *C. oblongisporum*, and *C. nullisetosum* under *C. jiangxiense*.

Additionally, our new isolate (KUNCC 24–17937) represents a new host record for *Dicranopteris ampla*.

Table 4.3 Comparison of nucleotide differences among our new strain

Species	Strain	*tub*2		*gapdh*			*chs*	
C. nullisetosum	YMF1.06946	T	G	A	G	G	C	C
C. oblongisporum	YMF1.06938	T	G	T	A	G	C	C
C. gracile	YMF1.06939	T	T	T	A	A	T	T
C. jiangxiense	KUNCC 24–17937	C	G	T	A	G	C	-
C. jiangxiense	CGMCC 3.17363	C	G	T	A	G	C	-
C. jiangxiense	HM6	-	-	T	A	G	C	C
C. jiangxiense	QC67	-	-	T	A	G	C	C
C. jiangxiense	YMF 1.04949	-	-	T	A	G	C	C

Note (KUNCC 24–17937), *C. jiangxiense* (CGMCC 3.17363, HM6, YMF 1.04949 and QC67), *C. gracile* (YMF 1.06939), *C. oblongisporum* (YMF 1.06938), and *C. nullisetosum* (YMF 1.06946). "-" refers to the unavailability of the sequence data.



Note a, b Front and reverse colony on PDA. c Mycelium with Appressoria. d conidiophores. e–f Appressoria, g–l Conidia. Scale bars: c = 20 um, d–f = 10 um, g–l = 5 um

Figure 4.47 *Colletotrichum jiangxiense* (KUN-HKAS 136232)

Colletotrichum plurivorum Damm, Alizadeh & Toy. Sato, in Damm, Sato, Alizadeh, Groenewald & Crous, Stud. Mycol. 92: 31 (2018)

Fungal Names number: FN 824228; Figure 4.48

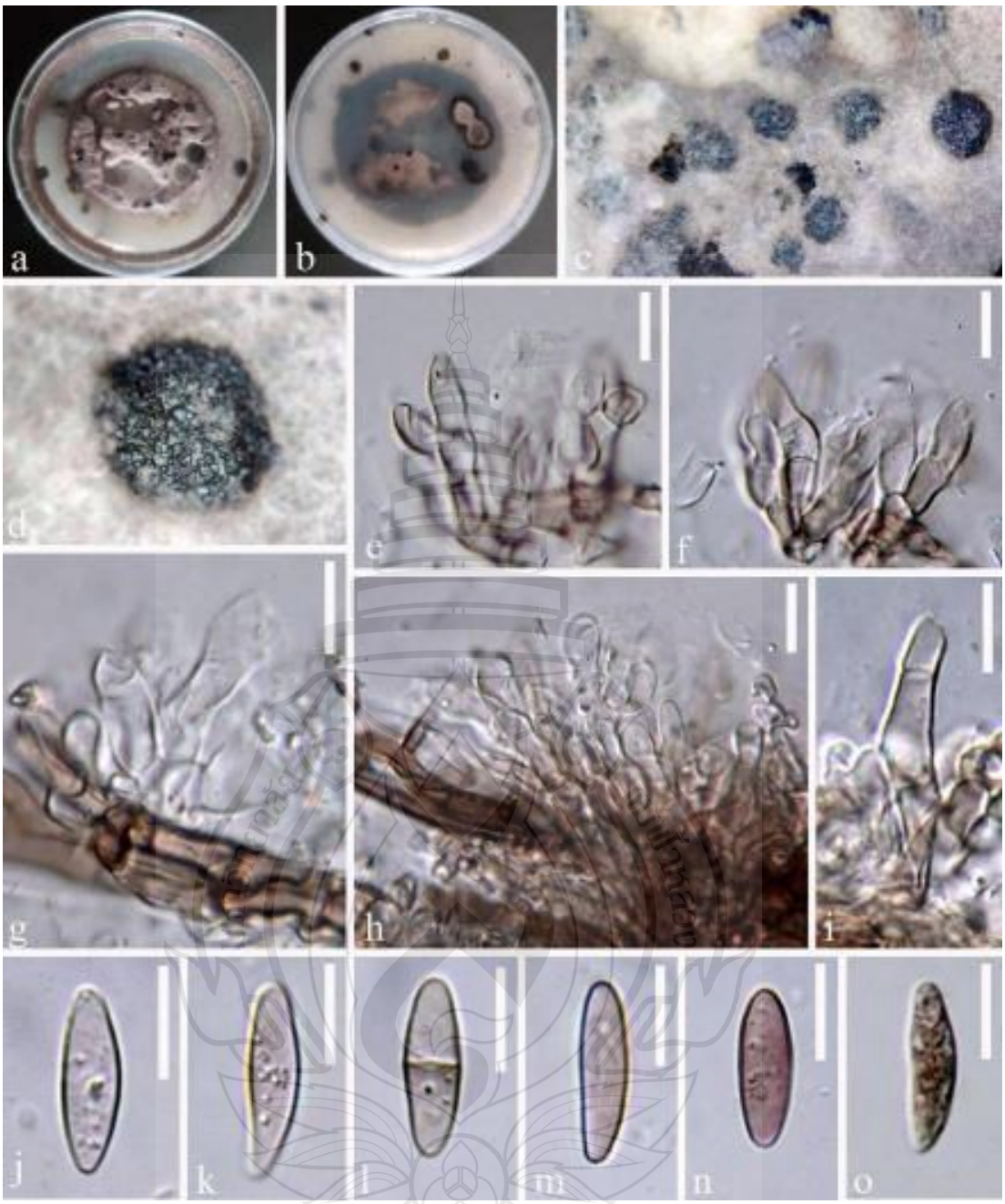
Endophytic in fresh leaves of *Dicranopteris ampla*. Sexual morph: Not observed. Asexual morph: *Vegetative hyphae* hyaline to brown, septate, branched, smooth-walled. *Conidiomata* gregarious, dark brown to black. *Setae* not observed. *Conidiophores* reduced to conidiogenous cells, hyaline to pale brown, smooth-walled, septate, branched. *Conidiogenous cells* 8.5–13 × 3–4.5 µm ($\bar{x}$ = 10.9 × 4 µm, n = 20), phialidic, integrated, terminal hyaline to pale brown, smooth-walled, cylindrical clavate

to doliifor. *Conidia* 15–19× 4.5–6 µm ($\bar{x}$ = 17.1 × 5.4 µm, n = 35), hyaline to brown, aseptate, guttulate, cylindrical, obtuse at both ends, smooth-walled. *Appressoria*: not observed.

Cultural characteristics: Colonies on PDA reaching 55 mm diam within 10 days, flat, dense, and raised in the center, cottony, dense, and regular to rhizoid and aerial mycelium scarce towards the periphery, greyish-pink on the surface, dark grey to greyish pink on reverse.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the fresh leaves of *Dicranopteris ampla*, 16 March 2022, J.Y Zhang, 197–3 (KUN-HKAS 136230), living culture KUNCC 24–17938.

Notes: In the multi-gene phylogenetic tree, the new strain (KUNCC 24–17938) clustered with *Colletotrichum plurivorum* (CBS 125474) with 92% ML and 1.00 BYPP value (Figure 4.44). Morphologically, our isolate is comparable to the Holotype: of *C. plurivorum*, except for the color of the conidia, which are hyaline to brown, whereas those of the Holotype: are hyaline (Damm et al., 2019). Therefore, we identified our isolates as *C. plurivorum*. This is the first report of *C. plurivorum* associated with *Dicranopteris ampla*.



Note a, b Front and reverse colony on PDA. c, d Conidiomata on the PDA. e–i Conidiophores. j–o Conidia. Scale bars: e–o = 10 um

Figure 4.48 *Colletotrichum plurivorum* (KUN-HKAS 136230)

Colletotrichum simulanticitri Z.F. Yu, in Yu, Jiang, Zheng, Zhang & Qiao, Journal of Fungi 8(2, no. 185): 24 (2022)

= *Colletotrichum juglandis* Xin Wei & J.X. Deng, in Wei, Yang, Jiang, Cui, Deng & Zhang, Phytotaxa 556(3): 263 (2022)

Fungal Names number: FN 842560; Figure 4.49

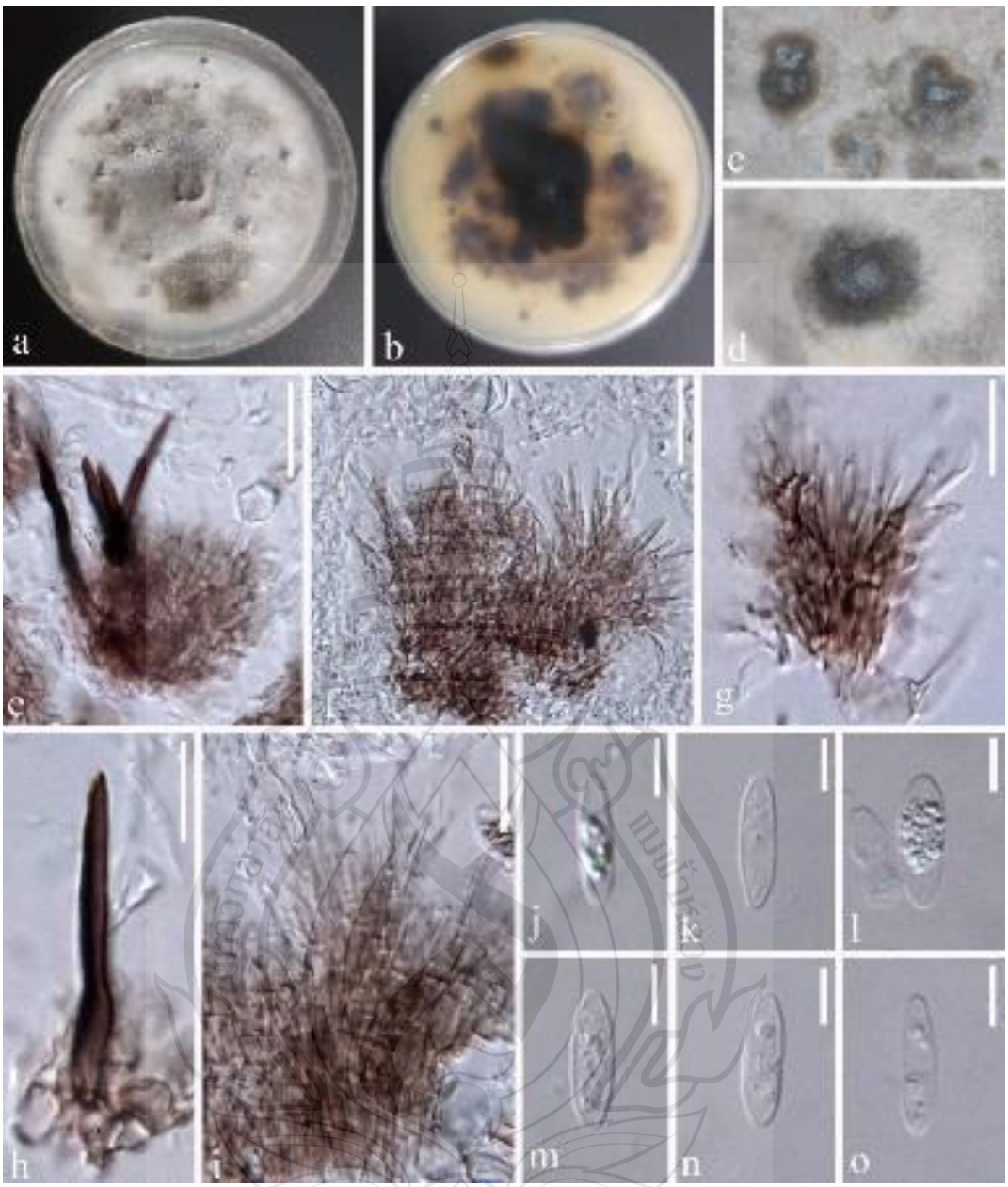
Endophytic in fresh leaves of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* dark brown to black, scattered or in groups. Setae 19–37.5 × 2–3.5 μm ($\bar{x}$ = 28.4 × 2.5 μm, n = 15), cylindrical to subulate, obtuse at the apex, 0–1-septate, smooth-walled, dark brown, smooth-walled. *Conidiophores* cylindrical, branched, brown to dark brown, septate, smooth-walled. *Conidiogenous cells* 11–43 × 2.5–4 μm ($\bar{x}$ = 24.8 × 3.4 μm, n = 15), cylindrical to clavate, brown, smooth-walled. *Conidia* 10–12 × 2.5–4 μm ($\bar{x}$ = 11.2 × 3.3 μm, n = 35), hyaline, cylindrical to oblong, straight or slightly curved, hyaline, aseptate, dry, guttulate, smooth-walled. *Appressoria*: not observed.

Cultural characteristics: Colonies on PDA occupied the whole plate in 7 days at 25 ◦C, surface mycelium pink to pale brown at the centre, dense, felted, conidiomata erumpent at maturity, reverse dark brown in the center, white towards margin.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the fresh leaves of *Dicranopteris pedata*, 16 March 2022, J.Y Zhang, 130–1 (KUN-HKAS 136228), living culture KUNCC 24–17934.

Notes: In the phylogenetic analysis, the new isolate KUNCC 24–17934 clustered sister to *C. simulanticitri* and *C. juglandis* (Figure 4.44). The nucleotides of ITS and act sequence data of our new isolate (KUNCC 24–17934), *C. simulanticitri* (YMF1 07302) and *C. juglandis* (YZU 191277) are completely identical. The comparison of nucleotide of *gapdh* gene revealed 0.21% (5/228 bp) and 0.25% (6/239 bp) differences of our isolate (KUNCC 24–17934) with *C. simulanticitri* and *C. juglandis* respectively. The nucleotide differences in *gapdh* between *C. simulanticitri* and *C. juglandis* are 0.93% (1/228 bp). This indicates no significant differences between our new isolate (KUNCC 24–17934), *C. simulanticitri*, and *C. juglandis* in the sequence data.

Morphologically, our isolate (KUNCC 24–17934), *C. simulanticitri*, and *C. juglandis* share similar characteristics, including hyaline, cylindrical to oblong, aseptate, guttulate conidia. The only notable difference is that both our isolate and *C. simulanticitri* have setae, which were not observed in the type of *C. juglandis* (Wei et al., 2022). Damm et al. (2019) demonstrated that the presence or absence of setae can vary among strains of the same species. Therefore, this morphological variation is insufficient to distinguish our isolate, *C. simulanticitri*, and *C. juglandis* as separate species. This conclusion is further supported by nucleotide comparisons, where all three species exhibit less than 2% variation across all gene regions. Based on this evidence, we propose synonymizing *C. juglandis* under *C. simulanticitri*. Additionally, this study establishes a new host record for *C. simulanticitri* in association with *Dicranopteris pedata*.



Note a, b Front and reverse colony on PDA. c, d Conidiomata on the PDA. e Conidiophores and setae. f, g, i Conidiophores. h Setae. j–o Conidia. Scale bars: e, f = 20 um, g–i = 10 um, j–o = 5 um

Figure 4.49 *Colletotrichum simulanticitri* (KUN-HKAS 136228)

Hypocreales Lindau, in Engler & Prantl, Nat.

Hypocreales is an ecologically highly diverse order with various life style including bryophilous, endophytic, entomogenous, caulicolous, corticolous, foliicolous, fungicolous, herbicolous, lichenicolous, and algicolous to coprophilous. Some are associated with humans and animals; some occur with myxomycetes (Perera et al., 2023; Bao et al., 2023; Wei et al., 2023). Hypocreales species have a worldwide distribution and have been found from diverse substrates such as leaf litter, soil, water, and air in terrestrial, freshwater, and marine habitats (Hyde et al., 2020; Perera et al., 2023; Bao et al., 2023). Perera et al. (2023) provided an up-to-date DNA sequence-based phylogenies (ITS, LSU, *rpb*2, *tef*1-α, and *tub*2) for *Hypocreales*, and accepted 17 families in the order.

Hypocreaceae De Not.

The latest treatment of *Hypocreaceae* was provided by Perera et al. (2023) and Bao et al. (2023) with acceptance of 16 genera *viz. Arachnocrea*, *Dialhypocrea*, *Escovopsioides*, *Escovopsis*, *Hypocreopsis*, *Hypomyces*, *Kiflimonium*, *Lichenobarya*, *Mycogone*, *Protocrea*, *Rogersonia*, *Sepedonium*, *Sphaerostilbella*, *Sporophagomyces*, *Stephanoma*, and *Trichoderma*.

Sphaerostilbella (Henn.) Sacc. & D. Sacc.

Sphaerostilbella, a fungicolous genus (Põldmaa et al., 2000), was formally introduced by Seifert (1985) with *S. aurifila* as the type species. *Sphaerostilbella* is characterized by perithecial, superficial or semi-immersed in subiculum, solitary to gregarious, obpyriform, yellowish white to ochraceous, KOH- ascomata, 8-spored, cylindrical asci and fusiform to naviculate or ellipsoid, 1-septate, hyaline, finely spinulose or grossly warted-tuberculate ascospores (Põldmaa et al., 2000; Perera et al., 2023). The asexual morphs of *Sphaerostilbella* are *Gliocladium* or gliocladium-like (Põldmaa et al., 2000; Zare & Gams, 2016). Currently, 13 species are listed in the Index Fungorum (2024), of which ten species are associated with sequence data.

Sphaerostilbella dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & J.C. Kang, *sp. nov*., Figure 4.50

Etymology: The specific epithet dicranopterisis refers to the fern genus *Dicranopteris*, from which the type strain was isolated.

Holotype: KUN-HKAS 124930

Endophytic in the root of *Dicranopteris pedata*. Sexual morph: Undetermined. Asexual morph: *Mycelium* on agar media superficial and partly immersed composed of septate, branched, hyaline, smooth, and thick-walled hyphae. *Conidiophores* formed laterally on aerial hyphae, semi-macronematous, mononematous, erect, straight, penicillate, septate, smooth-walled, hyaline, cylindrical, with 2−3 phialides at each level or branches, 13–29(–38) µm long, 2–4.5 µm wide near base, slightly tapering to 1.5–3 µm just below the phialides. *Conidiogenous cells* 5.5–13.5 × 2–3.5 µm ($\overline{x}$ = 9.6 × 2.9 µm, n = 15), holo- to polyblastic to phialidic, hyaline, cylindrical, in whorls of 2–3. *Conidia* 6–8(–10) × 3–5.5(–8) µm ($\overline{x}$ = 7.2 × 4.3 µm, n = 35), in slimy mass, asepate, ellipsoidal, rounded at the apex, acute at the base, guttulate, hyaline, smooth-walled.

Culture characteristics: Conidia germinating on PDA within 12 h. and germ tubes produced from conidia. Colonies growing on PDA, slow growing, reaching 20 mm in diam. in 20 days at 26°C, circular, flat, velvety, with dense, white mycelium on the surface with undulate margin, from below olivaceous brown at the center, yellow at the edge and does not produce pigmentation in culture.

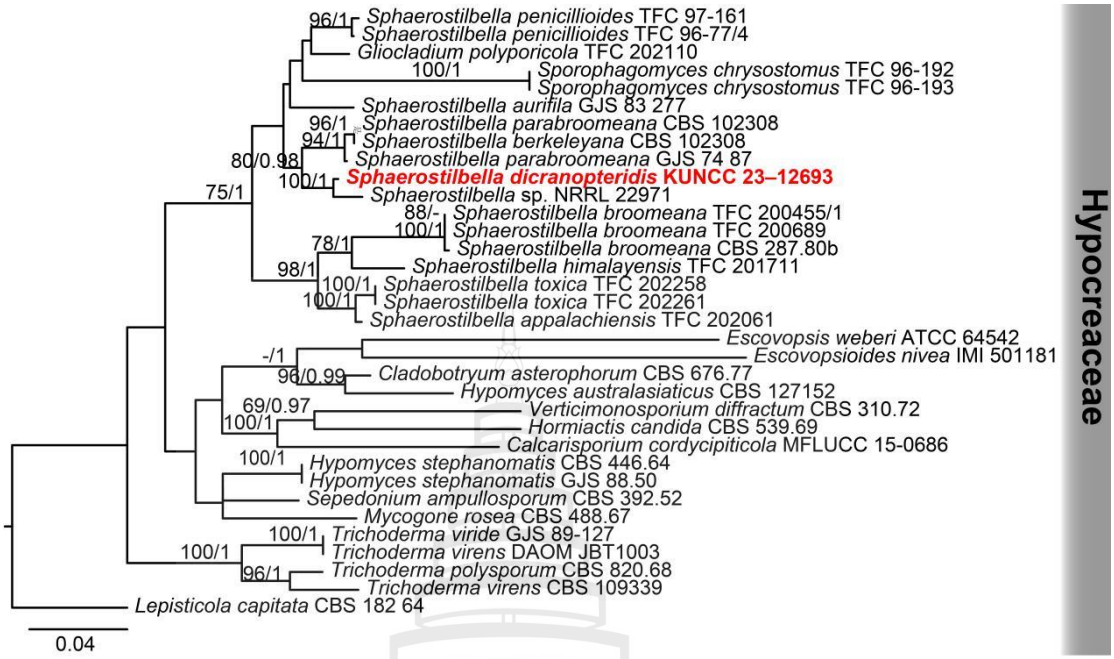
Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Cheheng County, isolated from the healthy roots of *Dicranopteris pedata* in a disturbed forest near the roadside, 16 Mar. 2020, J.Y. Zhang, NS155–2 (KUN-HKAS 124930, holotype), ex-type living culture: KUNCC 23–12693.

Notes: In the phylogenetic analysis, *Sphaerostilbella dicranopteridis* clustered sister to *Sphaerostilbella* sp. (NRRL 22971) (Figure 4.50), which is an unidentified strain and lacks a morphological description and illustration. The nucleotide of ITS sequence data showed 13bp differences between our new isolate and *Sphaerostilbella* sp. (NRRL 22971); only ITS sequence data is available for this strain; it is insufficient to identify it. Thus, we introduce our new isolate as a novel species. However, morphological descriptions and more genetic data are necessary to clarify the placement of this strain (NRRL 22971). *Sphaerostilbella dicranopteridis* is phylogenetically

closely related to *S. parabroomeana* (Figure 4.51), but differs from *S. parabroomeana* in having aseptate, ellipsoidal conidia with round apex and acute base. While, the conidia of *S. parabroomeana* are cylindrical to short-cylindrical and 0−1-septate (Zare & Gams, 2016).

Note a–c Colonies on PDA. d–q Conidiophores, conidiogenous cells, and conidia. r–s Conidia. t–u Another mode of sporulation by conidiogenous cells. v Conidia. Scale bars: d–v = 10 μm

Figure 4.50 *Sphaerostilbella dicranopteridis* (KUN-HKAS 124930, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. A total of 34 taxa were included in the combined analyses, which comprised 1526 characters after alignment. The best scoring RAxML tree with a final likelihood value of -8100.374701 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Lepisticola capitata* (CBS 182.64), the new strain is in red and bold.

Figure 4.51 Phylogenetic tree of *Sphaerostilbella*

Nectriaceae Tul. & C. Tul.

Nectriaceae was introduced with *Nectria* as the type genus by Tulasne and Tulasne (1865). The family is characterized by orange, yellow, red to purple, uniloculate ascomata, reacting in KOH and lactic acid (LA); ascospores not disarticulating, globose, ellipsoid to long-fusiform (never truly filiform) (Lombard et al., 2015; Rossman et al., 1999); with phialidic asexual morphs. The taxonomy of *Nectriaceae* has been studied and reviewed by many authors with different conceptions (Rossman et al., 1999; Lumbsch & Huhndorf, 2010; Lombard et al., 2015; Maharachchikumbura et al., 2016; Hyde et al., 2020). Recently, Perera et al. (2023)

accepted 77 genera in the family. Bao et al. (2023) accepted 78 genera, where, *Varicosporella* has been synonymized under *Atractium*, *Neocalonectria* and *Sedecimiella* are accepted in the family, which were previously placed in *Hypocreales* genera *incertae sedis*. The latest treatment of *Nectriaceae* was provided by Hyde et al. (2024), with 83 genera accepted in the family.

Dactylonectria L. Lombard & Crous

Dactylonectria was introduced by Lombard et al. (2014) with two new species and eight new combinations, most of which were previously placed in *Ilyonectria* except *D. pauciseptata* was treated in *Cylindrocarpon*. *Dactylonectria* differs from *Ilyonectria* and *Neonectria* in having ovoid to obpyriform, smooth to finely warted, dark-red perithecia with papillate ostiolar region at the apex and rarely produce chlamydospores in culture (Lombard et al., 2014). Later, seven new species were introduced to *Dactylonectria* (Gordillo et al., 2017; Mora-Sala et al., 2018; Berlanas et al., 2020). Presently, 17 species are included in the genus and all the species have been studied with sequence data. All members of *Dactylonectria* were associated with plant roots from various hosts such as grapevine, *Vitis vinifera*, *Piper* sp. (*Piperaceae*), and strawberry (Gordillo et al., 2017; Mora-Sala et al., 2018).

Dactylonectria dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov*. Figure 4.52

Etymology: The specific epithet dicranopterisis refers to the host plant genus *Dicranopteris*.

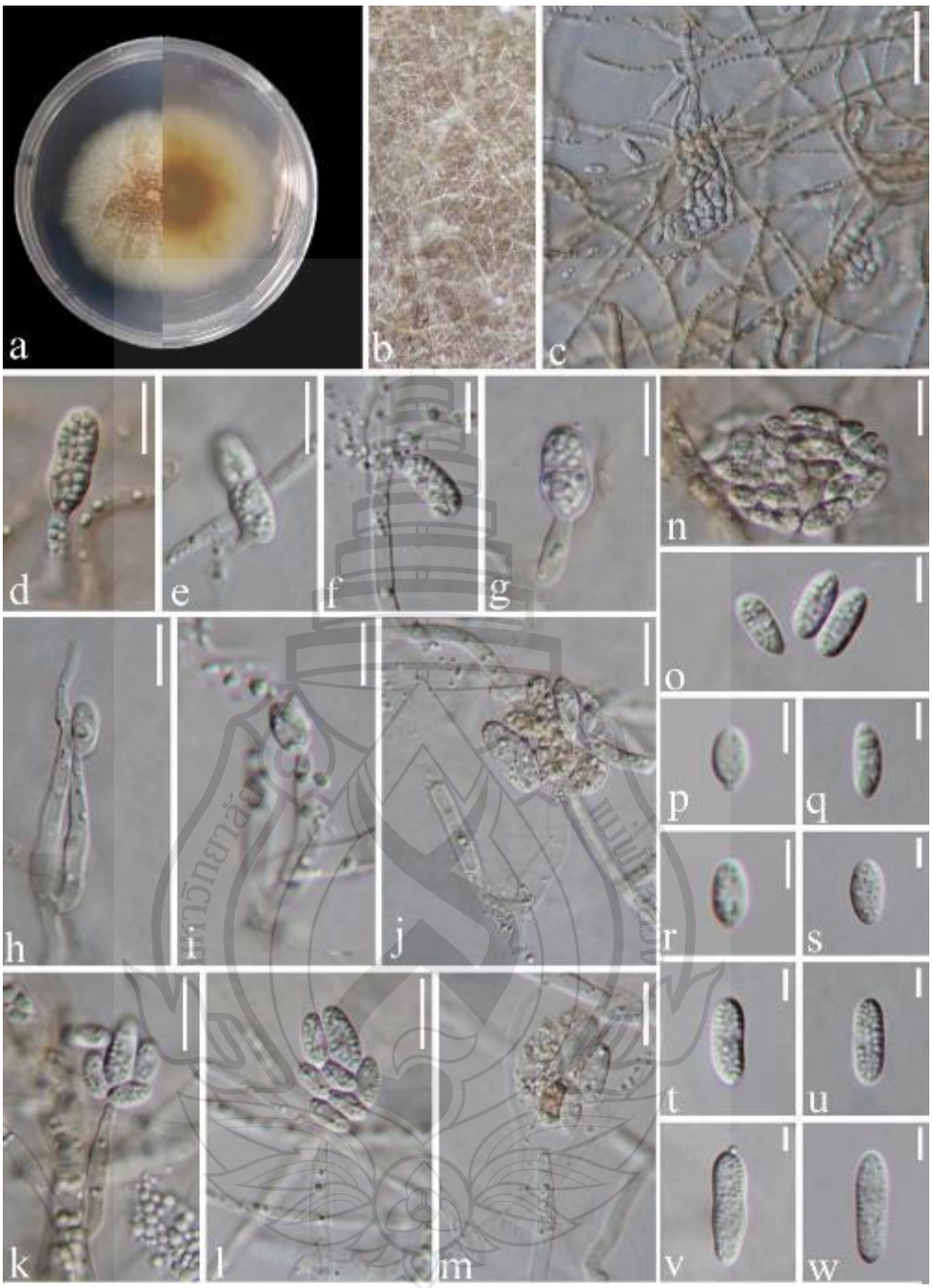
Holotype: GZAAS 23–0811

Endophytic in the healthy rhizome of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Mycelium* felty, white to pale buff, margin uneven, buff to amber; reverse buff to saffron, zonation irregular concentric brown. *Conidiophores* solitary to loosely aggregated, arising laterally or terminally from aerial mycelium, unbranched or sparsely branched, hyaline, guttulate, smooth-walled. *Conidiogenous cells* 13–26.5 × 2.5–4 µm ($\bar{x}$ = 19.8 × 3µm, n = 20), phialidic, hyaline, cylindrical, slightly tapering towards the tip. *Microconidia* 6–9 × 3–4 µm ($\bar{x}$ = 7.7 × 35µm, n = 34), formed in heads, clavate, ellipsoid to short cylindrical, straight to faintly curved, rounded at both ends or sometimes rounded at the apex, tapering at the base, 0–1-septate, hyaline, smooth-walled. *Macroconidia* not observed.

Culture characteristics: Colonies on PDA medium circular, growly fast, reaching 40 mm diam after 5 d at 28 ℃ in natural light, with sparse or no aerial mycelium, margin white, orange in sectors towards the centre, the reverse brownish yellow to orange.

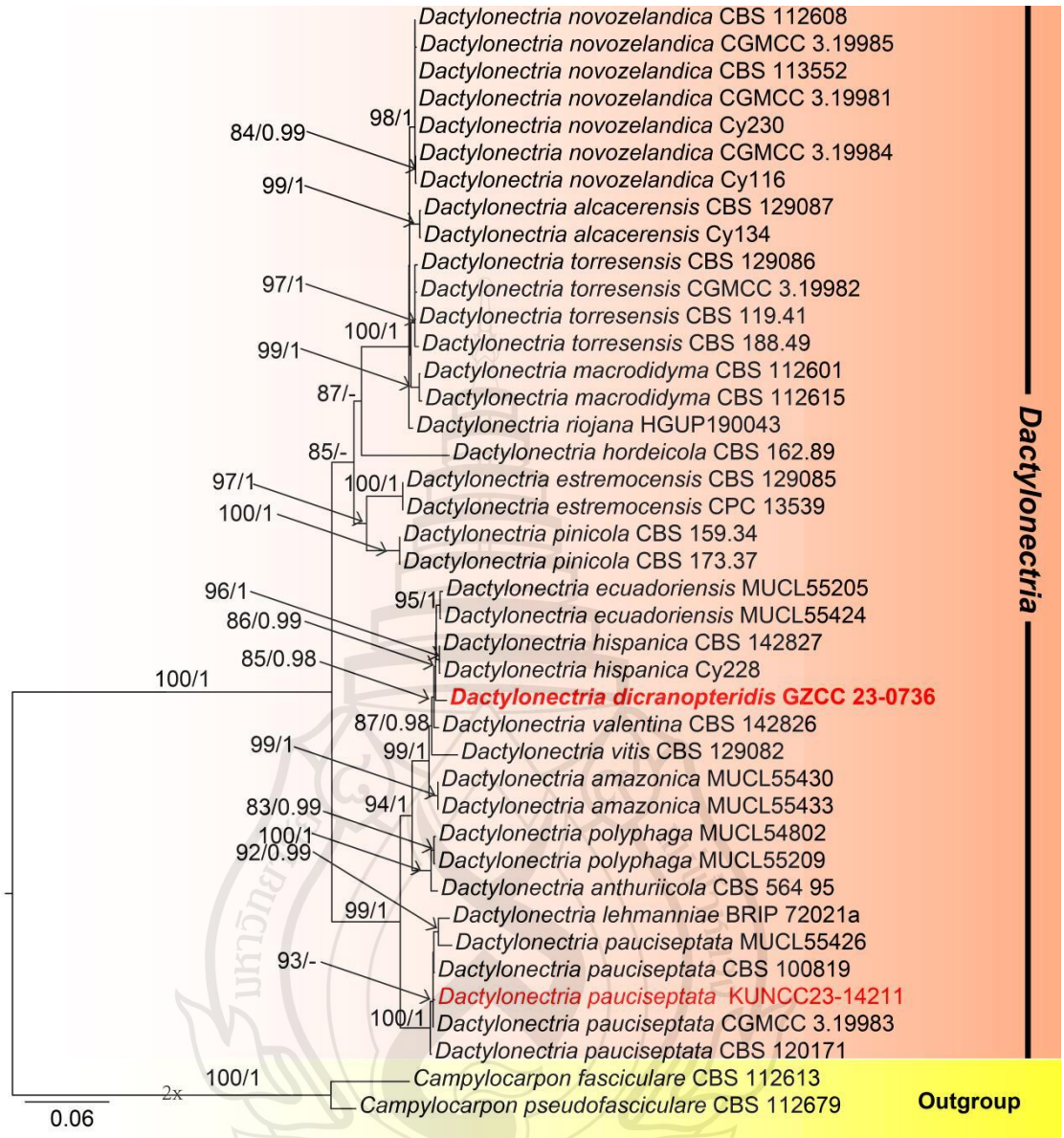
Material examined: CHINA, Guizhou Province, Guiyang City, from the rhizome of *Dicranopteris pedata*, 2 August 2022, J.Y. Zhang, S52-6 (GZAAS 23–0811, holotype), ex-type living culture GZCC 23–0736.

Notes: *Dactylonectria* species have very similar morphologies, making it difficult to distinguish them based on only morphology. Thus, a multi-locus phylogenetic analysis was utilized to understand the relationships better and identify *Dactylonectria* species. Based on phylogenetic analysis of combined ITS, *tub*2, *his*3, and *tef*1-α sequence data, our new isolate formed a distinct lineage between *D. ecuadoriensis* and *D. valentina* (Figure 4.53). The microconidia of both *D. ecuadoriensis* and *D. valentina* are subglobose to ovoid. Our new isolate has clavate, ellipsoid to short cylindrical, 0–1-septate microconidia, which are rounded at both ends or sometimes rounded at the apex, tapering at the base. Therefore, based on phylogenetic analysis and morphological characteristics, we introduce our new isolate as a new species.



Note a Culture on PDA from above and below. b Mycelium. c Mycelium and conidia d–m Conidiophores, conidiogenous cells, and conidia. n–w Conidia. Scale bar: c = 20μm; d–h, j–n = 10μm, i, o–w = 5 um

Figure 4.52 *Dactylonectria dicranopteris* (GZAAS 23–0811, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *tub*2, *his*3, and *tef*1-α sequence data. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree is rooted to *Campylocarpon fasciculare* (CBS 112613) and *C. pseudofasciculare* (CBS 112679); the new strain is in red and bold.

Figure 4.53 Phylogenetic tree of *Dactylonectria*

Dactylonectria pauciseptata (Schroers & Crous) L. Lombard & Crous, Phytopath. Mediterr. 53(3): 527 (2014)

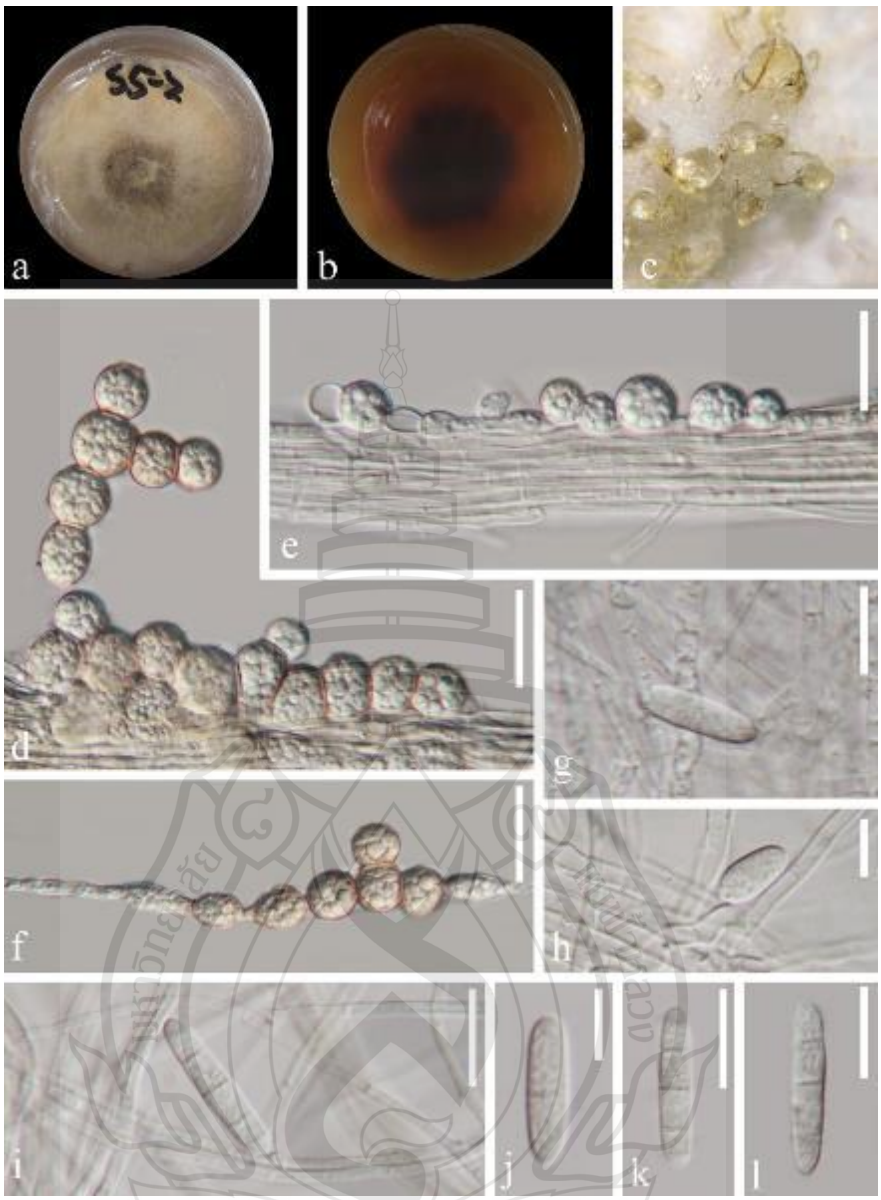
Fungal Names number: FN 810151; Figure 4.54

Endophytic in the healthy rhizome of *Dicranopteris linearis*. Sexual morph: unknown. Asexual morph: *Mycelium* felty, white to pale buff, margin uneven, buff to amber; reverse buff to saffron, zonation irregular concentric brown. *Conidiophores* arising laterally or terminally from aerial mycelium, solitary, unbranched or sparsely branched. *Conidiogenous cells* phialidic, hyaline, cylindrical. *Macroconidia* 20–38 × 5–8 µm ($\bar{x}$ = 28 × 6.5µm, n = 20), cylindrical, straight to faintly curved, with both ends rounded, 1–4-septate, hyaline, smooth-walled. *Microconidia* ellipsoid to short cylindrical, with obtuse ends, straight, aseptate, hyaline, smooth-walled, mostly with a visible, centrally located, or slightly laterally displaced hilum. *Chlamydospores* 9–13×8–14 µm, globose to ellipsoid, smooth, smooth, thick-walled, formed intercalary in chains or in clumps, hyaline to golden-brown.

Culture characteristics: Colonies on PDA medium circular, growly fast, reaching 55 mm diam after 5 d at 28 °C in natural light, regular, convex, entire, dry, dark brown at center with light brown edges; reverse margin entire, light to dark brown.

Material examined: CHINA, Guizhou Province, Ziyun Miao and Buyi Autonomous County, Anshun City, from the rhizome of *Dicranopteris linearis*, 2 August 2022, J.Y. Zhang, S5-2 (GZAAS 23–0782), living culture KUNCC 23–14211.

Notes: Our multi-locus phylogenetic analysis showed that the newly obtained strain (KUNCC 23–14211) clustered with four strains of *D. pauciseptata* with 93% ML statistical support (Figure 4.53). Morphologically, our new isolate is similar to *D. pauciseptata* in having solitary, unbranched or sparsely branched conidiophores that arise laterally or terminally from aerial mycelium, phialidic, hyaline, cylindrical conidiogenous cells and cylindrical macroconidia, with both ends rounded, 1–4-septate, hyaline, and smooth-walled. We, therefore, identified our new isolate as *D. pauciseptata* based on phylogenetic analysis and morphological characteristics. *Dactylonectria pauciseptata* (= *Cylindrocarpon pauciseptatum*) was isolated from partly decayed roots of *Vitis* in Slovenia (Schroers et al., 2008; Lombard et al., 2014). Our new strain was isolated from the rhizome of *Dicranopteris lineari*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–f: Chlamydospore. g, i–l Macroconidia. h Microconidia. Scale bar: d–i, k–l = 20μm, j = 10 μm

Figure 4.54 *Dactylonectria pauciseptata* (GZAAS 23–0782)

Ilyonectria P. Chaverri & Salgado

Ilyonectria, one of several genera that are segregated from *Cylindrocarpon*, was introduced by Chaverri et al. (2011) with *I. radicicola* as the type species. Since the genus was established, several new species have been consequently introduced in *Ilyonectria* based on phylogenetic analysis and morphological characters (Cabral et al., 2012a, 2012b; Aiello et al., 2013, 2017; Zeng et al., 2013; Lombard et al., 2013; Martínez-Diz et al., 2018; Lu et al., 2020a; Zhang et al., 2024c). Currently, 38 species are listed in the (http://www.indexfungorum.org/ accessed on July 10, 2024), of which eight have been transferred to *Dactylonectria* and *Cylindrodendrum*. *Ilyonectria* is characterized by red, globose to subglobose perithecia with scaly or slightly warted perithecial walls, and producing ellipsoidal, 1-septate ascospores. The asexual morphs of this genus are cylindrocarpon-like and produce abundant ellipsoidal to ovoid, 0–1-septate microconidia, almost straight, 1–3-septate macroconidia and intercalary, globose chlamydospores (Chaverri et al., 2011). Members of *Ilyonectria* are reported as plant pathogens associated with various hosts, such as grapevines (Cabral et al., 2012a, 2012b; Reis et al., 2013; Martínez-Diz et al., 2018; Probst et al., 2019), *Proteaceae* (Lombard et al., 2013), *American ginseng* (Zhang et al., 2019b), and *Aceraceae* (Aiello et al., 2014). While *I. radicigena* has been reported as endophytes (Zhang et al., 2024c). In this study, a new endophytic species, *I. dicranopteridis*, was isolated from *Dicranopteris*.

Ilyonectria dicranopteridis J.Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov.*, Figure 4.55

Etymology: The specific epithet dicranopterisis refers to the host genus *Dicranopteris*.

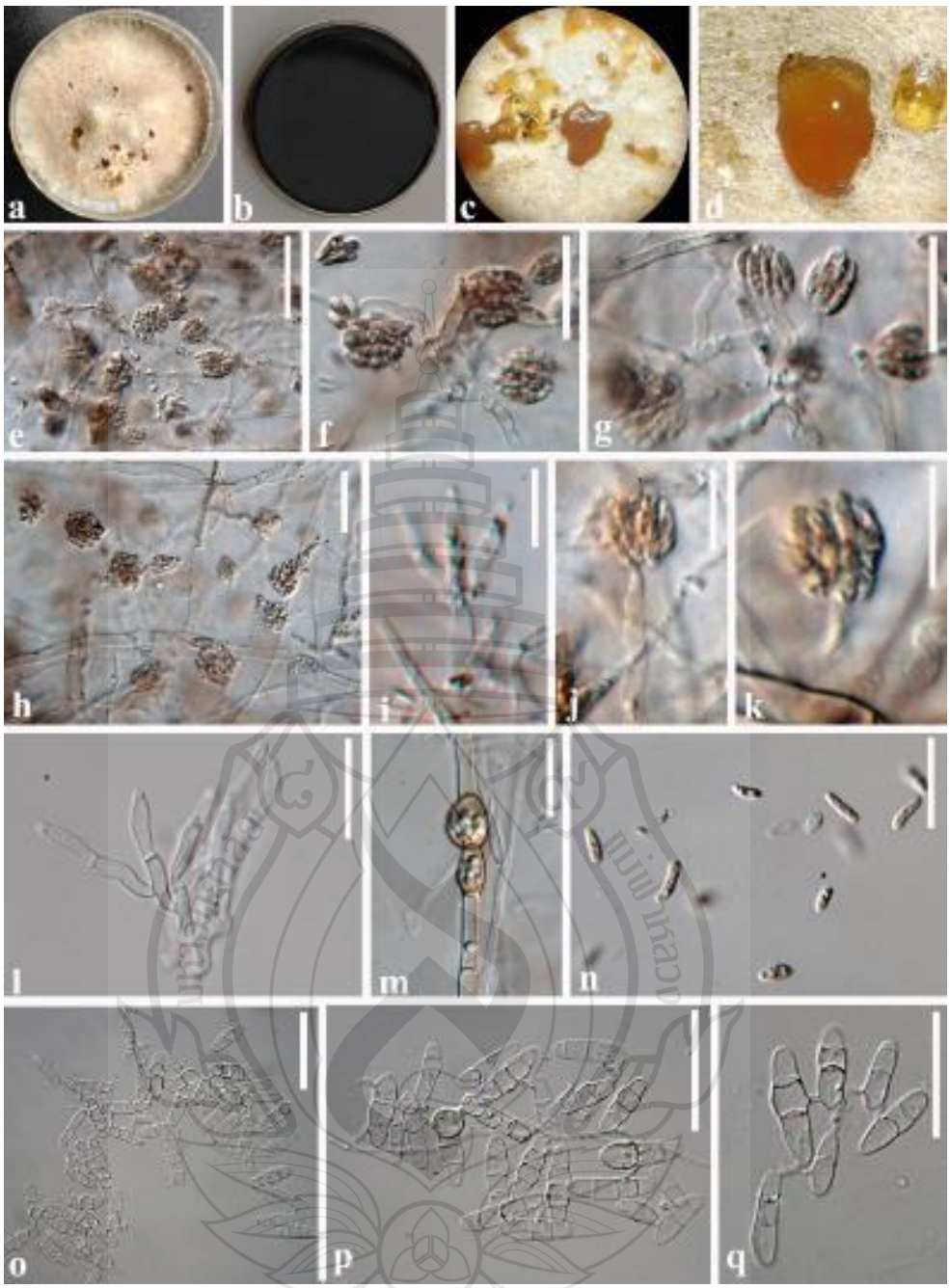
Endophytic in the root of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Conidiophores* simple or complex. *Simple conidiophores* arising laterally or terminally from aerial mycelium, unbranched or sparsely branched, solitary to loosely aggregated, one to three phialides, one- to two-septate, 24–38 × 2.5–3.5 µm ($\bar{x}$ = 31.1 × 3.1 µm, n = 15). *Densely aggregated conidiophores* cylindrical, irregularly branched, tapering towards the apex, with flared collarette. *Phialides* 12.5–15 × 2.5–3.5 µm ($\bar{x}$ = 13.9 × 3.2 µm, n = 15), monophialidic, straight or slightly curved, cylindrical to subcylindrical, slightly tapering towards the apex at the top, with a small

flared collarette. Densely aggregated conidiophores cylindrical, richly and irregularly branched; mostly widest near the base; tapering towards the apex, with flared collarette. *Macroconidia* predominant, formed in flat domes of slimy masses, (1-)3-septate, mostly 3-septate, straight or slightly curved, cylindrical or minutely widening towards the tip, appearing somewhat clavate, particularly when still attached to the phialide; apex or apical cell typically slightly bent to one side and minutely beaked; base mostly with a visible, centrally located or laterally displaced hilum; one-septate conidia (11–)13.5–20.5(–23) × 4.5–6.5 µm ($\bar{x}$ = 17 × 5.4 µm, n = 30); two-septate conidia 21–27.5 × 6–8 µm ($\bar{x}$ = 24.3 × 6.9 µm, n = 30), and three-septate conidia 24.5–29 × 7–8 µm ($\bar{x}$ = 26.8 × 7.4 µm, n = 30). *Microconidia* 5–8 × 2–3 µm ($\bar{x}$ = 6.6 × 2.3 µm, n = 40), various in the shape, ellipsoid to ovoid, cylindrical, oval, aseptate, straight or slightly curved, with or without an aminutely or clearly laterally displaced hilum, hyaline to medium brown, guttulate, smooth-walled. *Chlamydospores* 9–12 × 8.5–10 µm ($\bar{x}$ = 10.4 × 9.3 µm, n = 30), abundant, globose, subglobose, ellipsoidal, hyaline to golden brown with age, thick walled, sometimes intercalary in chains, solitary, in short or chains or aggregated, uni- or multicellular, smooth but often appearing rough due to deposits.

Culture characteristics: Colonies on PDA medium occupied the whole plate in 15 days at 25◦C; from above: round, cream to pale yellow, slightly low, irregular to rhizoid and aerial mycelium scarce near the center, cottony, dense and raised towards the periphery, with abundant aerial mycelium, regular margins; reverse: buff.

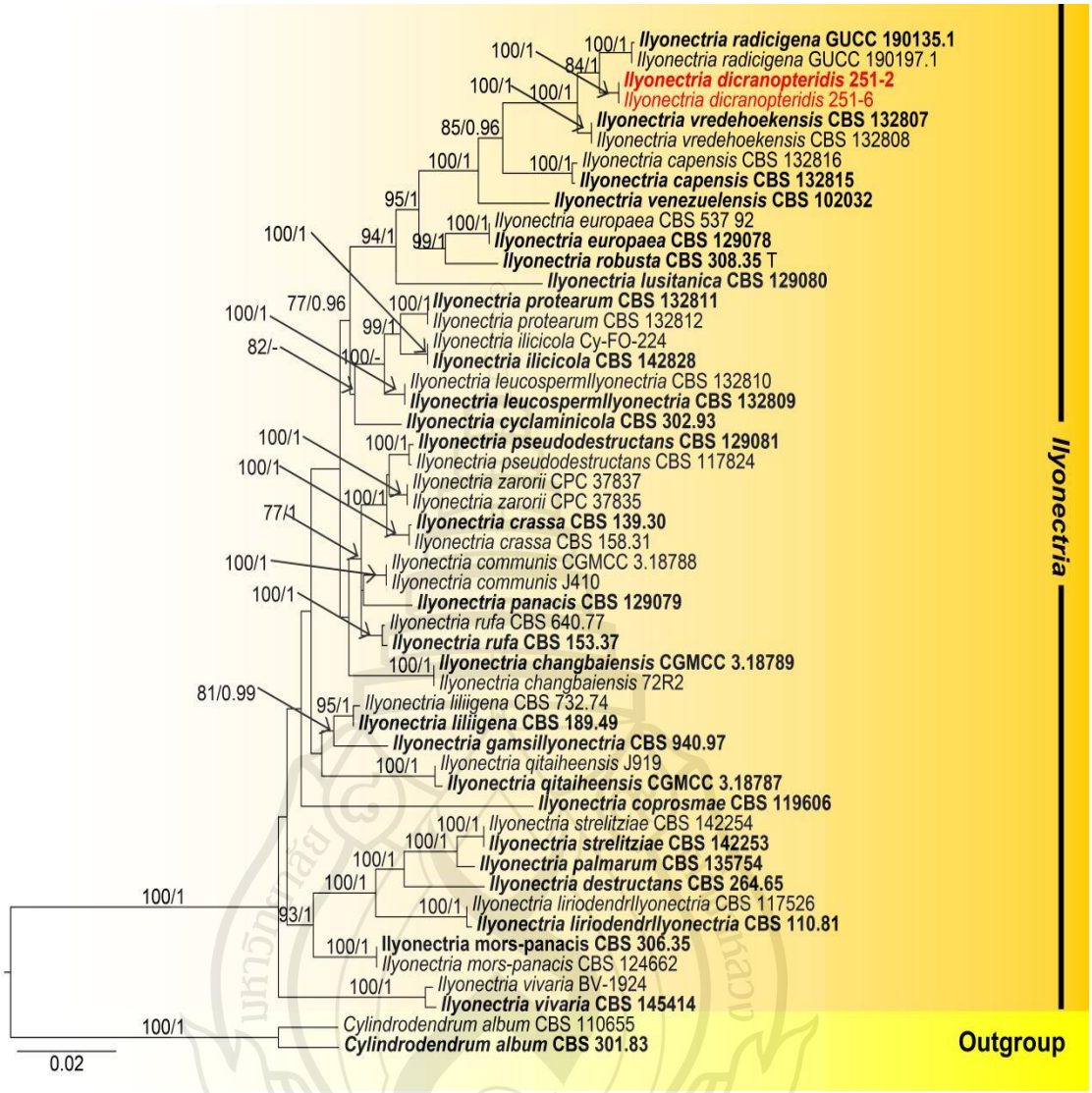
Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the roots of *Dicranopteris ampla*, 20 February 2022, J.Y. Zhang, NS251–2, holotype. *ibid.* NS251–6.

Notes: Phylogenetic analysis showed that our two new isolates grouped together and sister to *Ilyonectria radicigena* (Figure 4.56). However, *I. dicranopteridis* is different from *I. radicigena* in having (1–)3-septate, mostly 3-septate macroconidia and aseptate microconidia which are various in shape, ellipsoid to ovoid, cylindrical, oval. While *I. radicigena* has one- to three septate (mostly one) macroconidia and zero- to one septate, oval to ellipsoidal to subcylindrical microconidia (Zhang et al., 2024c).



Note a, b Culture on PDA from above and below. c, d Colonies on MEA. e–k Mycelium, conidiophores and conidia. l Conidiophores. m Chlamydospores. n Microconidia. o–q Macroconidia. Scale bar: e, p, q = 30 μm; f–h = 20μm, i–k = 10 um, l–n = 20 um, o = 50 um

Figure 4.55 *Ilyonectria dicranopteridis* (251–2, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *his*3, *tef*1-α, and *tub*2, sequence data. 51 taxa were included in the combined analyses, which comprised 2527 characters after alignment. The best scoring RAxML tree with a final likelihood value of -10247.337190 is presented. Bootstrap support values for maximum likelihood (ML) greater than 70% and Bayesian posterior probabilities greater than 0.90 are indicated above branches as ML BS/PP. The tree is rooted to *Cylindrodendrum album* (CBS 110655 and CBS 301.83); the new strain is in bold red.

Figure 4.56 Phylogenetic tree of *Ilyonectria*

Chaetosphaeriales Huhndorf, A.N. Mill. & F.A. Fernández

Chaetosphaeriales was established by Huhndorf et al. (2004) for *Chaetosphaeriaceae*. Currently, the order comprises four families *viz. Chaetosphaeriaceae*, *Helminthosphaeriaceae*, *Leptosporellacea*e and *Linocarpacea*e (Wijayawardene et al., 2022).

Chaetosphaeriaceae Réblová, M.E. Barr & Samuels

Chaetosphaeriaceae, the largest family in *Chaetosphaeriales*, was invalidated and introduced by Locquin (1984) to accommodate *Chaetosphaeria*. It was formally established by Réblová et al. (1999) with seven genera *Ascocodinaea*, *Chaetosphaeria*, *Melanopsammella*, *Porosphaerella*, *Porosphaerellopsis*, and *Striatosphaeria* based on LSU sequence data. The taxonomy of this family has long been problematic, and has been reviewed by various authors; for example, Lin et al. (2019) expanded the family to accommodate 49 genera. While, Hyde et al. (2020) accepted 39 genera in the family. Réblová et al. (2020, 2021a, 2021b, 2021c, 2021d, 2021e) systematically reviewed several polyphyletic genera and established several new genera under the family. The latest treatment of the family was provided by Wu and Diao (2022), who conducted a systematic study on diversity, taxonomy, and phylogeny of anamorphic *Chaetosphaeriacea*e in China using an integrated approach of morphological observation and phylogenetic analysis, which expanded the family to include 89 accepted genera. In addition, several polyphyletic genera, e.g., *Codinaea*, *Dictyochaeta* and *Tainosphaeria* complex, have been resolved by re-delimited *Codinaea* and *Dictyochaeta* with a narrower concept (Réblová et al., 2020b, 2021a, 2021b, 2021c, 2021d, 2021e; Wu & Diao, 2022). Hyde et al. (2024) accepted 109 genera in the family.

Geniculoseta Réblová

The monotypic genus *Geniculoseta* was recently established by Réblová et al. (2023) with a single species *G. preussii*, which was previously introduced as *Chaetosphaeria preussii*. Réblová et al. (2023) showed that *C. preussii* is morphologically different and distantly related to its presumed asexual morph, *Chloridium preussii*. They, therefore, introduced a new genus *Geniculoseta*, to accommodate this species. In this study, a new endophytic fungus, *G. dicranopteridis* is introduced based on morphological and phylogenetic analyses.

Geniculoseta dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & J.C. Kang, *sp. nov*., Figure 4.57

Etymology: The specific epithet dicranopterisis refers to the host plant genus *Dicranopteri*.

Holotype: GZAAS 23–0791

Endophytic in the healthy roots of *Dicranopteris ampla*. Sexual morph: unknown. Asexual morph: *Conidiophores* 160–170 × 3–4.1μm, macronematous, solitary, scattered, crowded or caespitose, erect, straight or slightly flexuous, subulately tapering, unbranched, brown to greenish-brown, with 1–3 percurrent proliferations assuming a geniculate appearance. *Conidiogenous cells* 2.5–8 × 1.8–3.5 μm ($\bar{x}$ = 4.8 × 2.5 μm, n =7) monophialidic with a single conidiogenous locus, integrated, terminal, rarely discrete, lateral, extending percurrently, subulate or narrowly lageniform, pale greenish-brown, smooth, with a collarette. *Conidia* 2–3.5 × 1.5–2.5 μm ($\bar{x}$ = 2.7 × 2.1μm, n = 33), acrogenous, aseptate, globose to ellipsoidal, cuneiform, sub-triangular, hyaline, smooth, guttulate.

Culture characteristics: Colonies on PDA medium, irregular, dry, convex, entire, surface dark brown at center with white to cream edges; reverse margin entire, light brown to yellow.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the roots of *Dicranopteris ampla*, 20 February 2022, J.Y. Zhang, SN203-1 (GZAAS 23–0791, holotype), living culture KUNCC 23–14189 = GZCC 23–0705.

Notes: In our phylogenetic analysis, the new isolate (KUNCC 23-14189) forms a distinct clade close to *Geniculoseta preussii* (Figure 4.58). However, it can be differentiated from *G. preussii* by its brown to greenish-brown conidiophores with 1–3 percurrent proliferations, which assume a geniculate appearance and are not bulbous at the base. The conidia are aseptate, globose to ellipsoidal, cuneiform, or sub-triangular. In contrast, the conidiophores of *G. preussii* are bulbous at the base, brown to dark reddish-brown, and have 1–5 percurrent proliferations with a geniculate appearance, and the conidia are ellipsoidal to oblong (Réblová et al., 2023).

Although the phylogenetic analysis showed that our new isolate did not cluster within the genus *Geniculoseta*, morphologically it aligns with the generic characteristics of *Geniculoseta*. It exhibits macronematous, mononematous, erect, solitary, scattered, crowded, or caespitose unbranched conidiophores with several percurrent proliferations; conidiogenous cells are monophialidic with a single conidiogenous locus, terminal, and extend percurrently, with flaring, funnel-shaped collarettes, and conidia are hyaline, aseptate, smooth conidia, which accumulate in slimy heads. Currently, only a single species is recognized in *Geniculoseta*, making it challenging to accurately determine the status and placement of this genus. Additionally, *Geniculoseta* is phylogenetically close to *Gongromeriza*, and morphologically, these two genera are quite similar, with a close phylogenetic affinity. Therefore, the status of these two genera may need to be re-evaluated with more collections (Réblová et al., 2023). Considering these factors, we tentatively place our new isolate within *Geniculoseta*. However, further sampling and additional sequence data are necessary to confirm the status of the genus and the precise placement of our new species.

Note a, b Culture on PDA from above and below. c Colonies on PDA. d–i Conidiophores, conidiogenous cells, and conidia. j–l Conidia. Scale bar: d–f = 50μm, g–i = 10μm, j–l = 5μm

Figure 4.57 *Geniculoseta dicranopteridis* (GZAAS 23–0791, holotype)

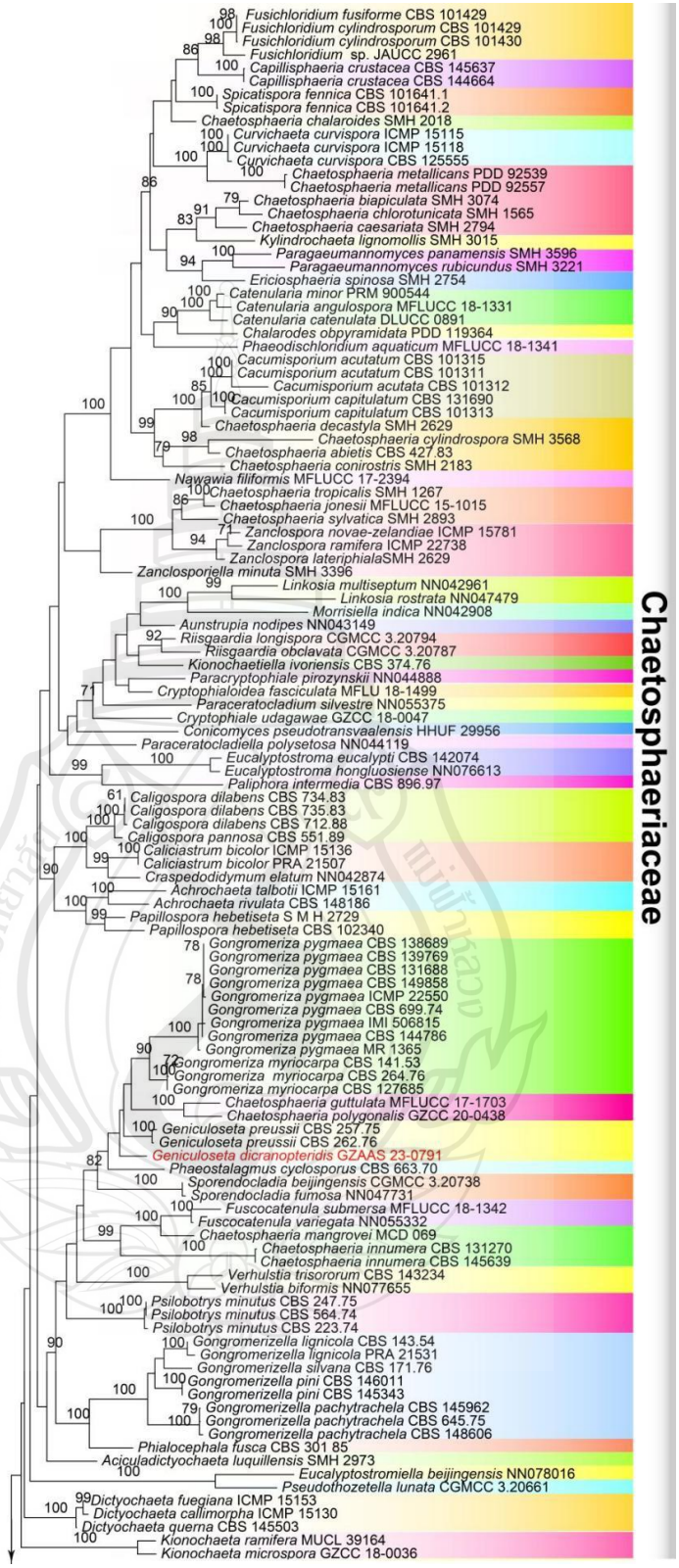
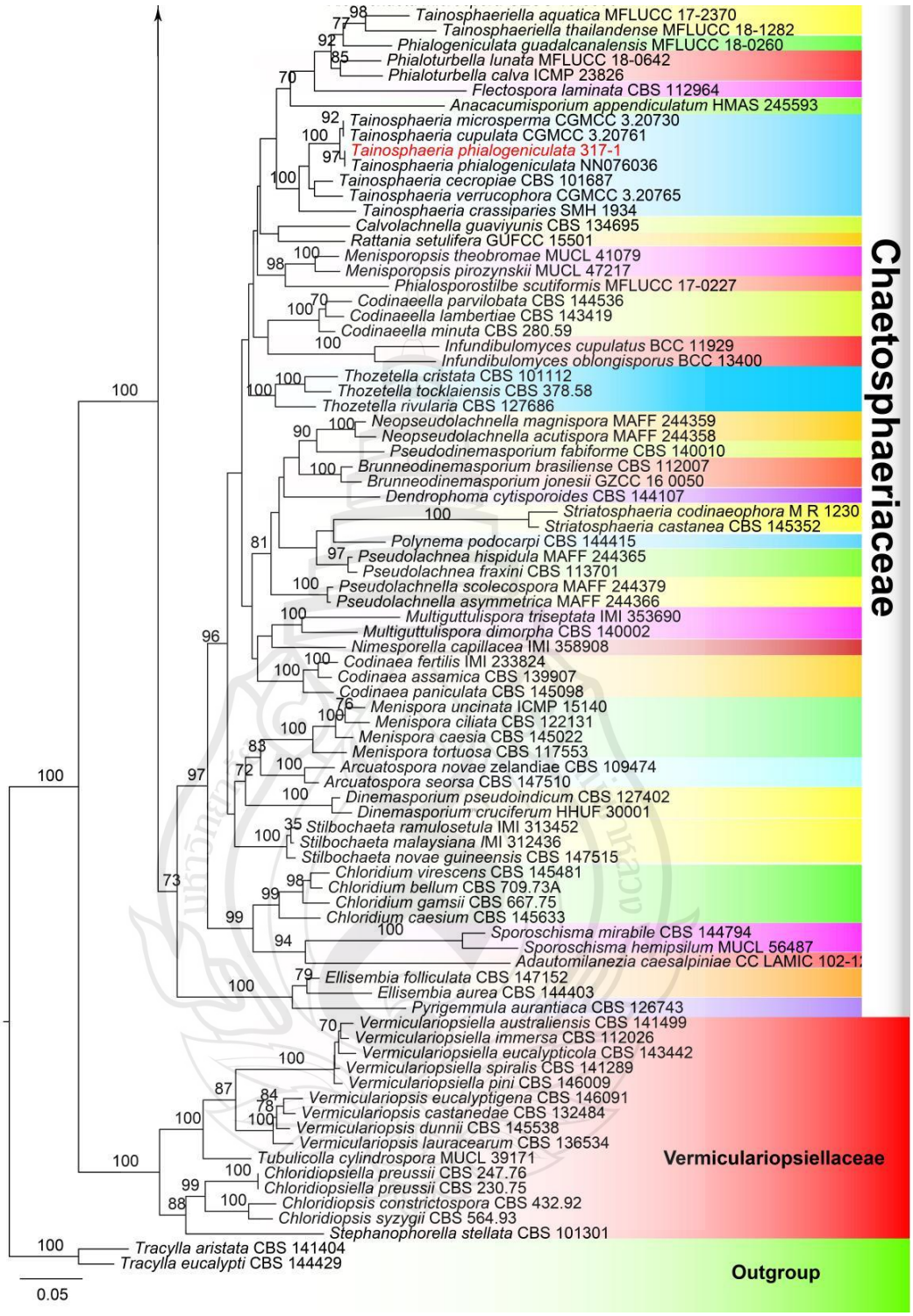


Figure 4.58 Phylogenetic tree of Chaetosphaeriaceae



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *his*3, and *tef*1-α sequence data. The new strains are in red.

Figure 4.58 (continued)

Tainosphaeria F.A. Fernández & Huhndorf

Tainosphaeria was established by Fernández and Huhndorf (2005) with *T. crassiparies* as the type, which was introduced based on both sexual and asexual morphs. Subsequently, several new species have been consequently added to the genus (Lu et al., 2016; Luo et al., 2019; Lin et al., 2019; Wu & Diao, 2022). However, the phylogenetic analysis of Réblová et al. (2021b) showed that *Tainosphaeria* is polyphyletic, and they separated the genus into three genera (*Tainosphaeria*, *Phialoturbella* and *Flectospora*) with acceptance of five species in *Tainosphaeria*, this was also supported by morphological characteristics. Recently, Wu and Diao (2022) accepted this treatment and provided a key to species of *Tainosphaeria*, accepting 12 species (including five new species) in this genus. Members of *Tainosphaeria* are saprobes on decaying or submerged wood; it is characterized by macronematous, solitary, simple conidiophores, usually monophialidic conidiogenous cells, and falcate, setulate conidia (Fernández & Huhndorf, 2005; Liu et al., 2016; Luo et al., 2019; Réblová et al., 2021b; Wu & Diao, 2022). In this study, *Tainosphaeria phialogeniculata* is reported as an endophyte from *Dicranopteris ampla*; this is the first species of *Tainosphaeria* reported as an endophyte.

Tainosphaeria phialogeniculata W.P. Wu & Y.Z. Diao, Fungal Diversity: 116(1):216 (2022)

Fungal Names number: FN 841592; Figure 4.59

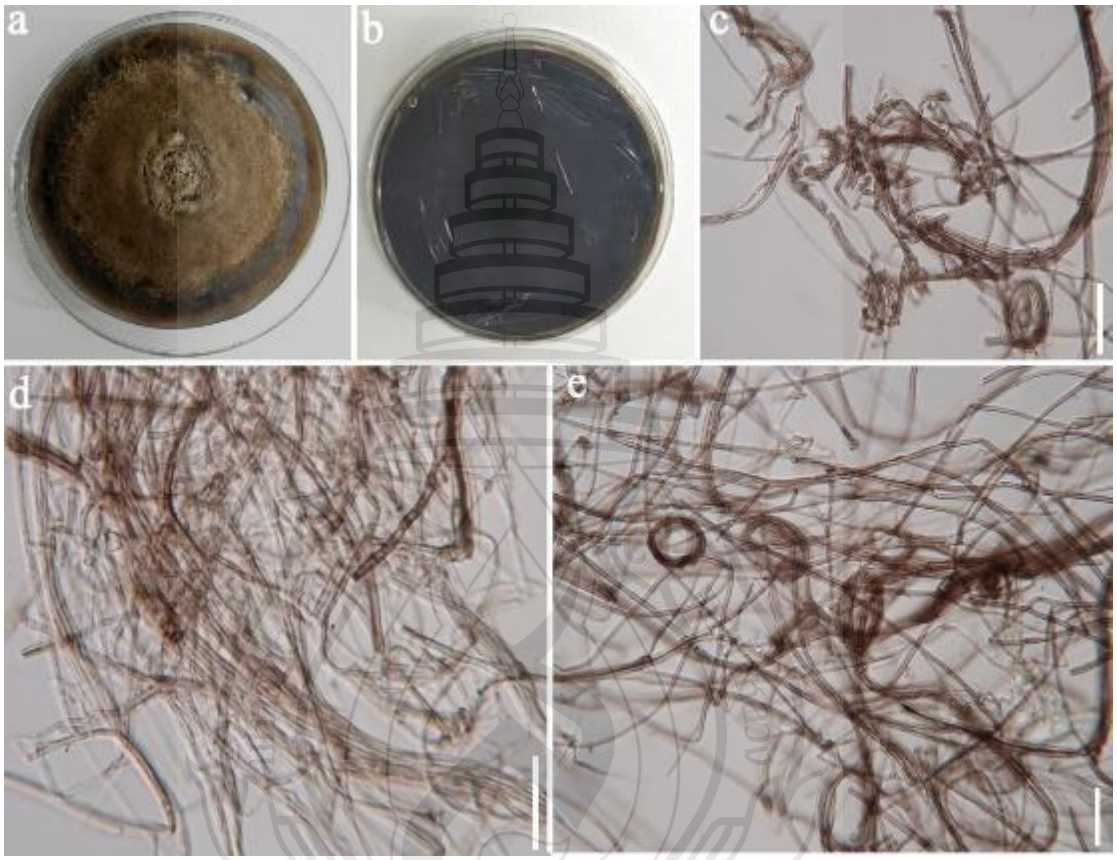
See the description in Wu and Diao (2022)

Culture characteristics: Colonies on MEA reaching 55 mm diameter after 20 days at 25°C, colonies circular, margin wavy, flat, velvety appearance with brown aerial mycelia in the middle, colony from above brown to dark brown; reverse: dark brown to black.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the rhizome of *Dicranopteris ampla*, 17 March 2022, J.Y. Zhang, NS317–1.

Notes: Based on the combined ITS and LSU phylogeny, this new isolate (NS 317-1) clustered with *Tainosphaeria phialogeniculata* (NN076036) (Figure 4.58). We were unable to observe asexual or sexual morph characters in the culture. However, the nucleotides of ITS and LSU sequences data of our new isolate are identical to those of

T. phialogeniculata (NN076036). Thus, we identified our new isolate as *T. phialogeniculata*. *Tainosphaeria phialogeniculata* was introduced by Wu and Diao (2022), which is a saprobe found on dead leaves of an unidentified tree in Yunnan, China. Here we record the endophytic lifestyle of *T. phialogeniculata* from the rhizome of *Dicranopteris ampla* in Guizhou Province, China.



Note a, b Culture on PDA from above and below. c–e Mycelium. Scale bar: c = 30 um, d, e = 20 um

Figure 4.59 *Tainosphaeria phialogeniculata* (317–1)

Magnaporthales Thongk., Vijaykr. & K.D. Hyde

In this study, we follow the latest treatment and updated accounts of *Magnaporthales* by Feng et al. (2024), who accepted six families *viz. Ceratosphaeriaceae*, *Magnaporthaceae*, *Ophioceracea*e, *Plagiosphaeraceae*, *Pseudohalonectriaceae*, and *Pyriculariaceae* in this order.

Magnaporthaceae P.F. Cannon

Magnaporthaceae was established by Cannon (1994), placed in *Magnaporthales, Sordariomycetes*. The latest treatment of this famly was provided by Feng et al. (2024), they transferred *Plagiosphaera*, *Muraeriata*, and *Aquafiliformis* to a newly introduced family *Plagiosphaeraceae*, accepting 28 genera in *Magnaporthaceae*, including 10 new genera.

Omnidemptus P.F. Cannon & Alcorn, Mycotaxon 51: 483

Omnidemptus was introduced as the sexual morph of Mycoleptodiscus by Cannon and Alcorn (1994). Hernández-Restrepo et al. (2019) showed that *Omnidemptus* formed an independent lineage within Magnaporthaceae, thus, they formaly treated *Omnidemptus* as a distinct genus, as well as introduced two new species *O. graminis* and *O. lunatus* in the genus. Recently, Zhang et al. (2024) inroduced four new species to the genus. Currently, seven species are included in this genus. *Omnidemptus* is characterized by superficial, perithecial, ostiolate, pyriform ascomata with a long neck, bitunicate, 8-spored, cylindric-clavate short-stalked asci with an obtuse apex, apical pore and biseriate, fusiform, centrally swollen, 1–3-septate, hyaline ascosporse; phialidic, ampulliform or elongated, cylindrical, clavate or ellipsoid, dark brown conidiogenous cells with a circular aperture enclosed by a cylindrical to flared collarette, and falcate, hyaline, 1–2(–3)-septate conidia (Zhang et al., 2024).

Omnidemptus dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov*., Figure 4.60

Etymology: The specific epithet dicranopterisis refers to the fern genus *Dicranopteris*.

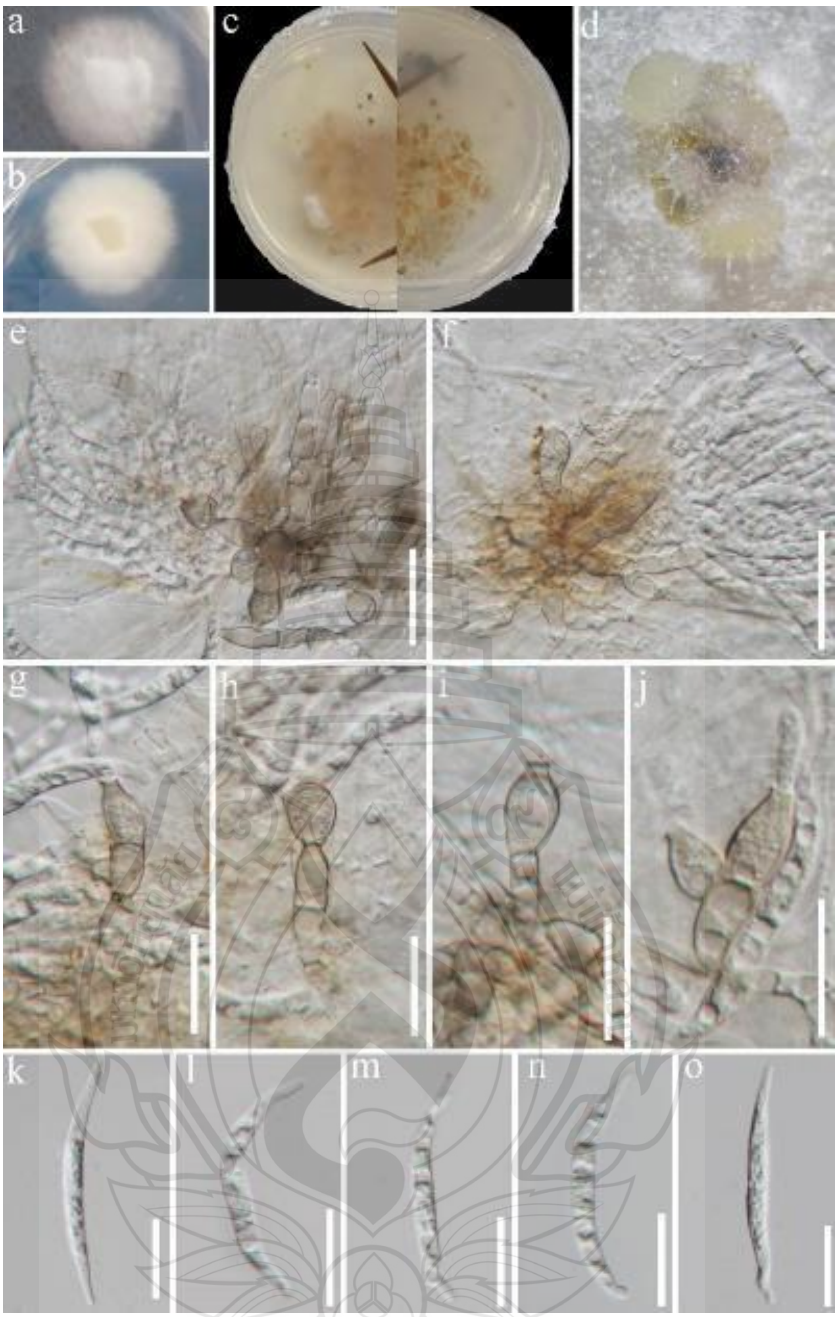
Holotype: KUN-HKAS 129909

Endophytic in the stem of *Dicranopteris ampla*. *Mycelium* mostly immersed composed of septate, branched, hyaline to pale brown, with smooth and thick-walled hyphae. Sexual morph: Undetermined. Asexual morph: *Conidiophores* 10–57 × 5–7.5 µm (n = 20), macronematous, mononematous, unbranched, swollen at the apex, pale brown, septate, smooth-walled. *Conidiogenous cells* 10–19 × 6.5–10 µm (n = 20), phialidic, terminal or intercalary, cylindrical to lageniform, subhyaline to pale brown, *Conidia* 45–63 × 4–6 µm (n = 30), lunate, fusiform to filiform, tapering towards the ends, slightly curved, hyaline, septate, smooth.

Culture characteristics: Colonies on PDA medium circular with entire margin, cottony to fluffy, white and not sporulate in culture; Colonies on medium of WA-carrot mixture sporiferous, irregulate, with several white to brown spots, thin, flat, hyaline to white, and does not produce pigmentation in culture.

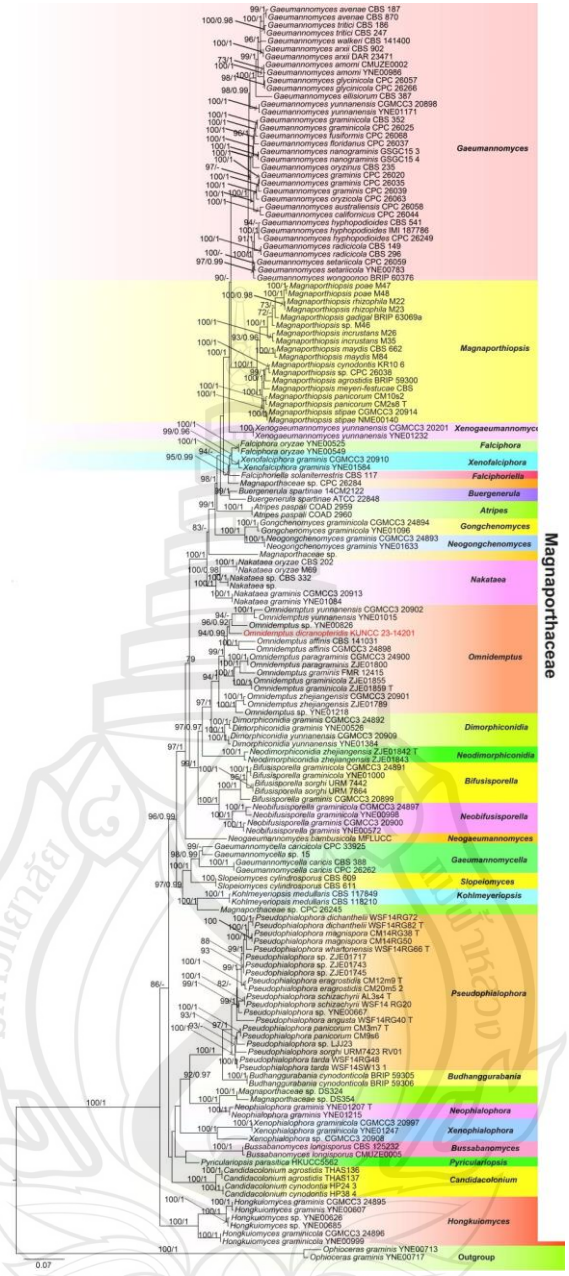
Material examined: CHINA, Guizhou Province, Southwest Guizhou Buyi and Miao Autonomous Prefecture, Zhenfeng County, isolated from the healthy stem of *Dicranopteris ampla*, 17 March 2022, J.Y Zhang, NS299-3 (KUN-HKAS 129909, holotype), ex-type culture KUNCC 23-14201.

Notes: In a BLASTn search of NCBI GenBank, the closest match of the ITS sequence of *Omnidemptus* dicranopteridis (KUNCC 23–14201, ex-type) with 93.57% similarity was *O. graminis* FMR 12415. The closest match with the LSU sequences with 99.32% similarity was *O. affinis* strain BRIP 17195b, but there are 39bp differences in ITS gene region between them. Phylogenetic analhysis showed that *O. dicranopteridis* (KUNCC 23–1420) formed a distinct lineage in the genus (Figure 4.61). Morphologically, *O. dicranopteridis* fits well with the generic concept in having phialidic, ampulliform or elongated, brown conidiogenous cells with a circular aperture enclosed by a cylindrical to flared collarette and falcate, hyaline, septate conidia. It is phylogenetically close to *Omnidemptus* sp. (YNE00826). *Omnidemptus* sp. (YNE00826) was introduced by Feng et al. (2024) without description and illustration, but they are phylogenetically distinct, the nucleotide comparisons revealed that *O. dicranopteridis* is different from *Omnidemptus* sp. (YNE00826) in 44/446 bp (9.86%) of the ITS, which strongly support *O. dicranopteridis* as a new species.



Note a, b Cultures on PDA from above and below. c Cultures on WA-carrot mixture. d Colonies on the media of WA-carrot mixture. e–j Conidiophores, conidiogenous cells and conidia. k–o Conidia. Scale bars: e, f = 30 μm, g–o = 20 μm

Figure 4.60 *Omnidemptus dicranopteridis* (KUN-HKAS 129909, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, *mcm*7 and *rpb*1 sequence data. 159 taxa were included in the combined analyses, which comprised 2793 characters after alignment. The best scoring RAxML tree with a final likelihood value of -14189.447665 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree is rooted to *Ophioceras graminis* (YNE00713 and YNE00717).

Figure 4.61 Phylogenetic tree of *Omnidemptus*

Pseudodactylariales Crous

Pseudodactylariales was established by Crous et al. (2017) with a single family *Pseudodactylariaceae*. The status of this order is well-supported by phylogenetic analysis and divergence time estimates (Hyde et al., 2020).

Pseudodactylariaceae Crous

Crous et al. (2017) introduced *Pseudodactylariaceae* to accommodate a single genus, *Pseudodactylaria*. Currently, *Pseudodactylariaceae* includes one genus with 10 species, all of which are saprobes from terrestrial and freshwater habitats (Crous et al., 2017; Lin et al., 2018b; Hyde et al., 2020b; Lu et al., 2020b; Yang et al., 2023b).

Pseudodactylaria Crous

Pseudodactylaria, a well-studied genus with all species has sequence data available in the GenBank (Lin et al., 2018b; Hyde et al., 2020b; Lu et al., 2020b; Bao et al., 2021; Boonmee et al., 2021; Yang et al., 2023b). The genus was introduced by Crous et al. (2017) to accommodate the type species *P. xanthorrhoeae* which was reported isolated from *Xanthorrhoea* sp. in Australia. To date, ten species are accepted in *Pseudodactylaria*, characterized by single, unbranched, septate conidiophores, polyblastic, denticulate conidiogenous cells, and solitary, fusoid-ellipsoid, hyaline conidia (Crous et al., 2017; Hyde et al., 2020b; Bao et al., 2021; Yang et al., 2023b).

Pseudodactylaria dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov*., Figure 4.62

Etymology: The specific epithet dicranopterisis refers to the fern genus *Dicranopteris*.

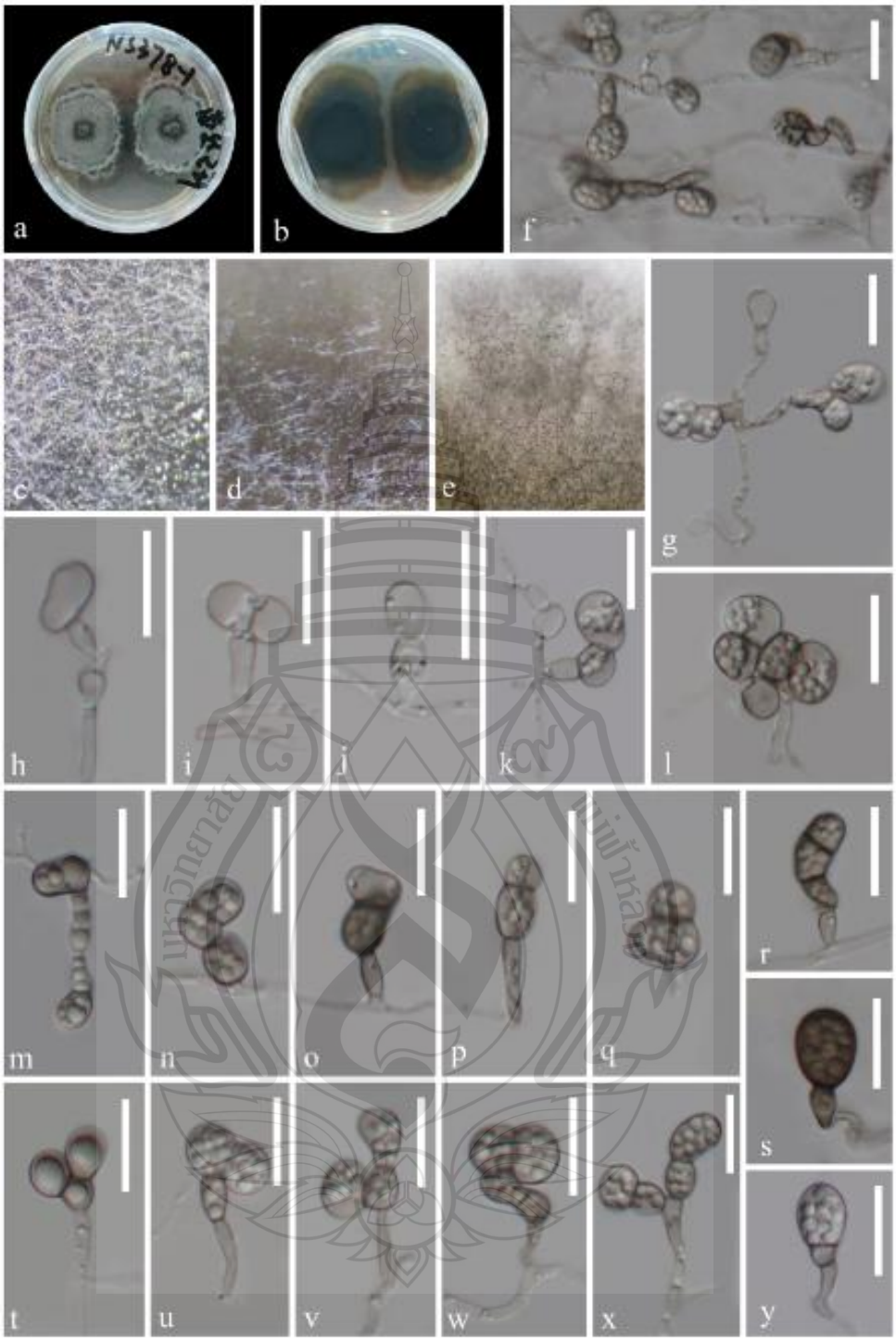
Holotype: GZAAS 23–0788

Endophytic in the rhizome of *Dicranopteris pedate*. *Mycelium* superficial and immersed composed of septate, branched, hyaline to pale brown, with smooth and thick-walled hyphae. *Chlamydospores* 10–19 × 8–14 µm ($\bar{x}$ = 13.5 × 9.5 µm, n = 30), solitary, subglobose, coiled, irregular, hyaline to subhyaline when young, brown when mature, septate, guttulate.

Culture characteristics: C*olonies* on PDA medium under natural light, circular, with a flat surface, edge undulate, reaching 38 mm in 20 days at 26°C, spread, without veined and wrinkle, taupe to grey to brown from center to margin from above; dark brown to brown towards the edge in reverse, and not producing pigmentation in culture.

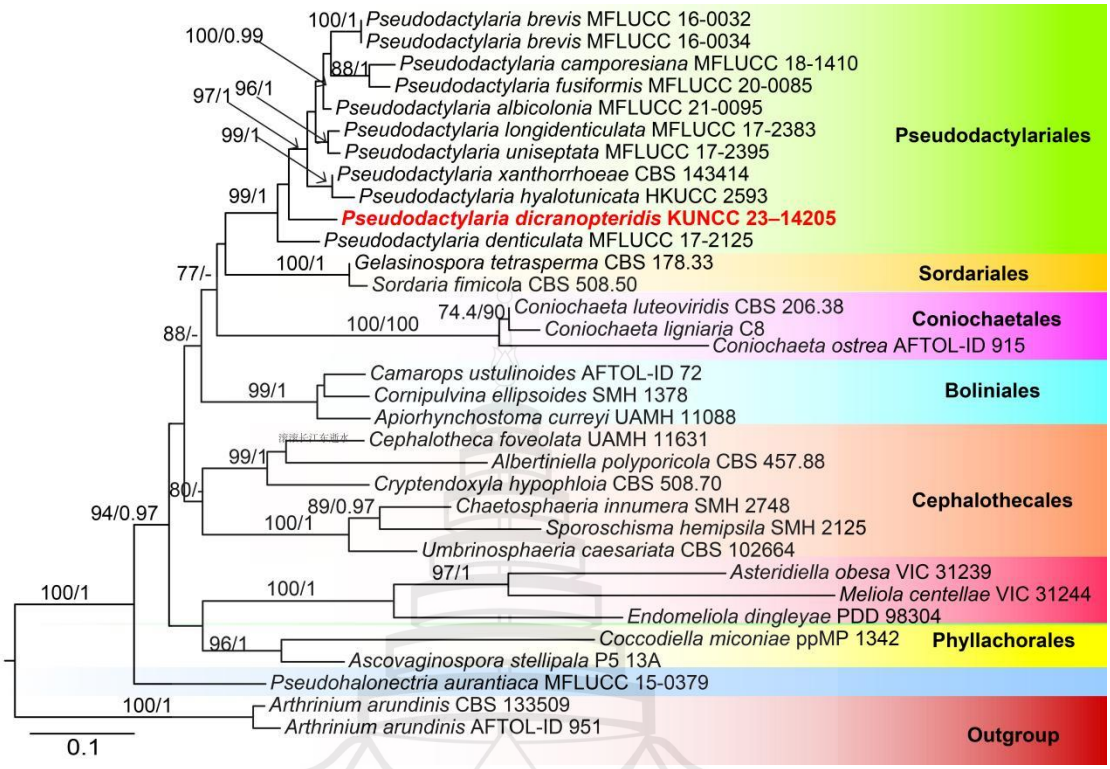
Material examined: China, Guizhou Province, Southwest Guizhou Buyi and Miao Autonomous County, Libo County, isolated from the healthy rhizome of *Dicranopteris pedata*, 8 April 2022, Y. Yang, 378–1 (GZAAS 23–0788, holotype), ex-type living culture KUNCC 23–14205.

Notes: The genus has ten identified species, all of which are saprobes, with the majority from freshwater habitats. (Crous et al., 2017; Lin et al., 2018b; Hyde et al., 2020; Lu et al., 2020b; Bao et al., 2021; Boonmee et al., 2021; Yang et al., 2023b). Our collection is the only endophytic species in *Pseudodactylaria*; only chlamydospores have been found in the culture. The conidia and denticulate conidiogenous cells were not observed from our culture. In the phylogenetic analyses, our new strain KUNCC 23–14205 formed a distinct clade within the *Pseudodactylaria* group, which supports our species as a new species (Figure 4.63). Therefore, we introduce *P. dicranopteridis* as a new species based on phylogenetic analysis.



Note a, b Cultures on PDA from above and below. c–e Colonies on the PDA. f–y Hyphae with chlamydospores. Scale bars: f–y = 20 μm

Figure 4.62 *Pseudodactylaria dicranopteridis* (GZAAS 23–0788, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. 33 taxa were included in the combined analyses, which comprised 1392 characters after alignment. The best scoring RAxML tree with a final likelihood value of -11439.250915 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree is rooted to *Arthrinium arundinis* (CBS 133509 and AFTOL-ID 951).

Figure 4.63 Phylogenetic tree of *Pseudodactylaria*

Sordariales Chadef. ex D. Hawksw. & O.E. Erikss.

Sordariales was introduced by Hawksworth and Eriksson (1986) and further clarified by Huhndorf et al. (2004) based on an analysis of LSU sequence data. In this study, we follow the latest treatment of Sordariales provided by Wijayawardene et al. (2022).

Chaetomiaceae G. Winter

Chaetomiaceae species are important human and animal pathogens, such as severe opportunistic infections in immunocompromised individuals and equine mycotic encephalitis (Ahmed et al., 2016; Plumlee et al., 2017). Species of this genus are medically and commercially important; they have proven a large potential for use in biological control and the development of beneficial secondary metabolites (Berka et al., 2011; Yang et al., 2014; Singh, 2016; Ahmed et al., 2016; Plumlee et al., 2017; Vivi et al., 2019; Wang et al., 2022). The family was described by Winter (1885) and the members of this family are globally dispersed, with the majority being saprobes, and have been found in soil, feces, air, seed, compost, decaying plant materials, and indoor habitats (Cooney & Emerson, 1964; Tiscornia et al., 2009; Betancourt et al., 2013; Wang et al., 2016a, 2016b). Many authors have studied the taxonomy of this family; Maharachchikumbura et al. (2016) accepted 20 genera in the family, as well as a key to genera of *Chaetomiaceae* was provided and Wijayawardene et al. (2018) included 26 genera in this family. While Hyde et al. (2020a) accepted 25 genera. Recently, Wang et al. (2022) provided an up-to-date overview of the taxonomy and phylogeny of *Chaetomiaceae*, based on the phylogeny and molecular dating analyses; together with morphological characteristics and temperature-growth characteristics, 50 genera and 275 species are accepted in *Chaetomiaceae*.

Arcopilus X. Wei Wang, Samson & Crous

Arcopilus was proposed by Wang et al. (2016b) to accommodate five new combinations, with *A. aureus* as the type species based on morphological characteristics and multi-locus phylogenetic analysis. Since then, several new species have been described. Index Fungorum listed 14 species of *Arcopilus*. However, based on sequence data, Wang et al. (2022) considered *A. globulus* as a synonym of *A. aureus*. Therefore, 13 species are currently accepted in the genus (Wang et al., 2016b; Sousa et al., 2020; Raza et al., 2019; Tavares et al., 2022; Wang et al., 2022; Crous et al., 2021a; Yang et al., 2023c). The typical morphological characteristics of this genus is the ascomata hairs are usually arcuate, with apices incurved and circinate to coiled and the ascospores are relatively diverse in shape, such as fusiform, navicular, reniform, lunate or limoniform, and exudate production that result in colony coloration, ranging from yellow, orange, or red to rust (Wang et al., 2016b; Tavares et al., 2022) a*rcopilus* species have been used

to control phytopathogens, with potential antifungal, anticancer, antiviral, and antibacterial properties (Kanokmedhakul et al., 2006; Kabbaj et al., 2015; Vilavong & Soytong, 2016; Tann & Soytong, 2017; Liu & Chang, 2018). We are investigating endophytic fungi in *Dicranopteris*, *A. aureus* was isolated and identified based on phylogeny and morphology. It is the first report of *Arcopilus* isolated from *Dicranopteris*.

Arcopilus globulus Raza & L. Cai, in Raza, Zhang, Hyde, Diao & Cai, Fungal Diversity 99: 75 (2019)

Fungal Names number: FN 556674; Figure 4.64

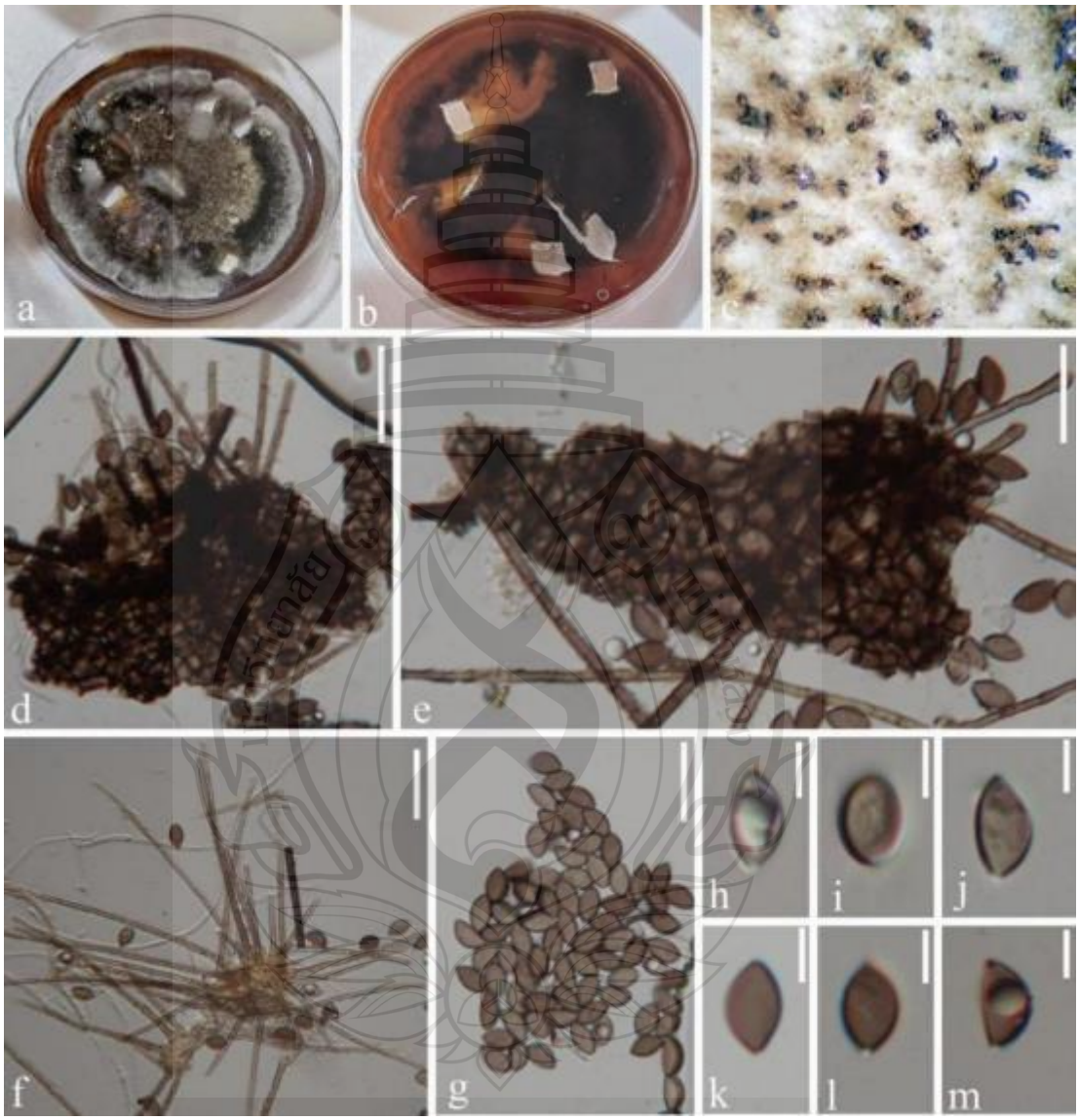
Endophytic in roots of *Dicranopteris pedata*. Sexual morph: *Ascomata* 130–210 × 30–70 µm ($\bar{x}$ = 170 × 50 µm, n = 10), superficial, ostiolate, with ascomatal hairs, ellipsoid. *Ascomatal wall* brown, membranaceous, comprised of dark brown. *Terminal hairs* 2–5 µm wide at the base, verrucose, brown to dark in reflected light, septate, fading and tapering towards the tips, lateral hairs apically incurved. *Asci* appeared quickly when the culture matured; they could not be seen during observation. *Ascospores* 9–12 × 5–7 µm ($\bar{x}$ = 10.5 × 6 µm, n = 30), brown when mature, limoniform or broadly fusiform, usually biapiculate at both ends, with a germ pore, guttulate, smooth-walled. Asexual morph: Undetermined.

Culture characteristics: Colonies on PDA medium circular, growly fast, reaching 55 mm diam after 6 d at 25°C in natural light, cottony, velvety, dense, light to dark brown with grayish-white margins from above; dull dark in reverse. Forming a few dark-brown fruiting bodies after two months in PDA, also produced reddish brown pigments in PDA.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, isolated from healthy roots of *Dicranopteris pedata* (*Gleicheniaceae*) collected from the rock crevices, 16 March 2022, J.Y. Zhang. 173–4 (KUN-HKAS 129885), living culture KUNCC 23–14182.

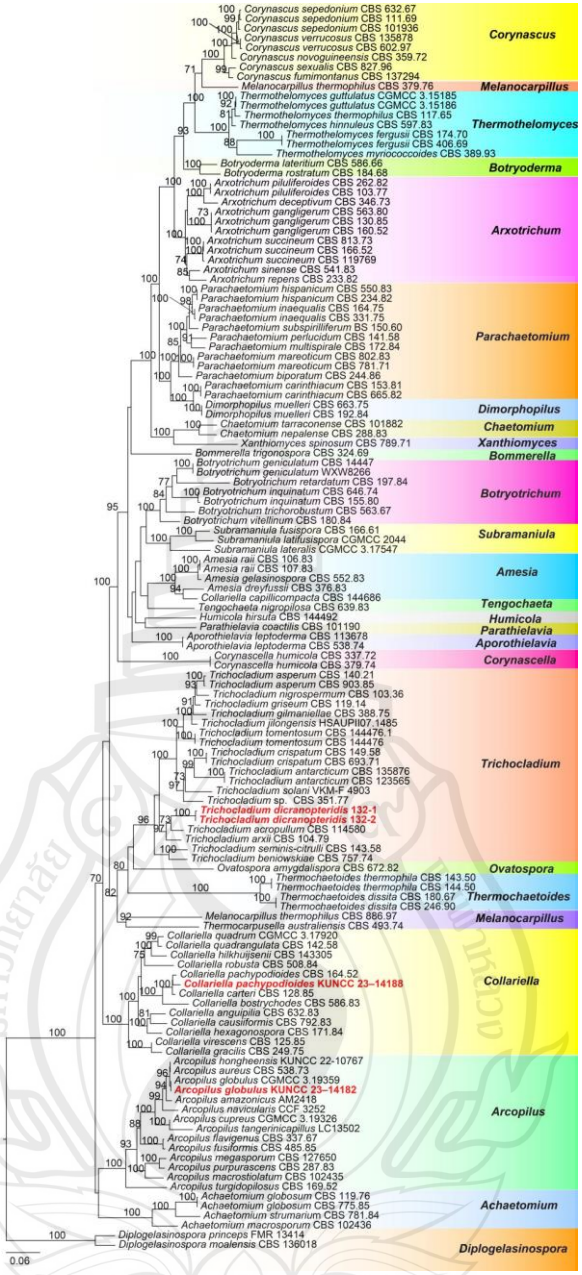
Notes: The morphology of our new isolate (KUNCC23–14182) matches with *Arcopilus globulus* based on the morphology of the Holotype: given by Raza et al. (2019), and the size of ascomata and ascospores overlap with the holotype. Based on phylogenetic evidence, our new isolate clusters with *A. globulus* (CGMCC3.19359) (Figure 4.65) and compares the nucleotide base pairs between *A. globulus*

CGMCC3.19359 and our new isolate (KUNCC23–14182); there were essentially no significant nucleotide differences in the ITS, LSU, *tub*2, and *rpb*2 gene regions. We, therefore, identified our new isolate as *A. globulus*. *Arcopilus globulus* was introduced by Raza et al. (2019) which is a pathogenic fungus isolated from *Saccharum officinarum* in China. This species is found in *Dicranopteris pedata* for the first time.



Note a, b Colonies on PDA medium. c Ascomata on PDA. d, e Ascomatal wall with terminal ascomatal hairs. f Terminal ascomatal hairs. g–m Ascospores. Scale bars: d, f = 30 µm, e, g = 20 µm, h–m = 5 µm

Figure 4.64 *Arcopilus globulus* (KUN-HKAS 129885)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, *rpb*2, and *tub*2 sequence data. 129 taxa were included in the combined analyses, which comprised 2638 characters after alignment. The best scoring RAxML tree with a final likelihood value of -47350.996715 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree is rooted to *Diplogelasinospora princeps* (FMR 13414) and *D. moalensis* (CBS 136018).

Figure 4.65 Phylogenetic tree of Chaetomiaceae

Collariella X.Wei Wang, Samson & Crous

Collariella, typified by *C. bostrychodes*, was introduced by Wang et al. (2016b) to accommodate seven species previously referred to *Chaetomium*. Zhang et al. (2017) introduced two new species *C. quadrum*, which were collected from karst caves in China. Crous et al. (2017) introduced *C. hilkhuijsenii*, and Aghyl et al. (2021) described a new species C. *capillicompacta*. Wang et al. (2022) transferred two *Chaetomium* species to the genus as *C. bostrychodes* and *C. pachypodioides*. Presently, 13 species are included in the genus. *Collariella* is characterized by superficial, ampulliform or cylindrical, ovate, obovate, subglobose, ostiolate ascomata, fusiform or clavate, pedicellate, evanescent asci and broadly limoniform to quadrangular, fasciculate olivaceous brown, bilaterally flattened ascospores with one or two apical or subapical germ pores (Wang et al., 2016b). *Collariella* species are commonly reported from soil and dung; a few have been isolated from the air (e.g., *C. carteri*) worldwide (Wang et al., 2016b; Zhang et al., 2017; Wang et al., 2022). We reported an endophytic species, *C. carteri* from *Dicranopteris*.

Collariella pachypodioides (L.M. Ames) X. Wei Wang & Houbraken, in Wang et al., Stud. Mycol. 101: 167 (2022)

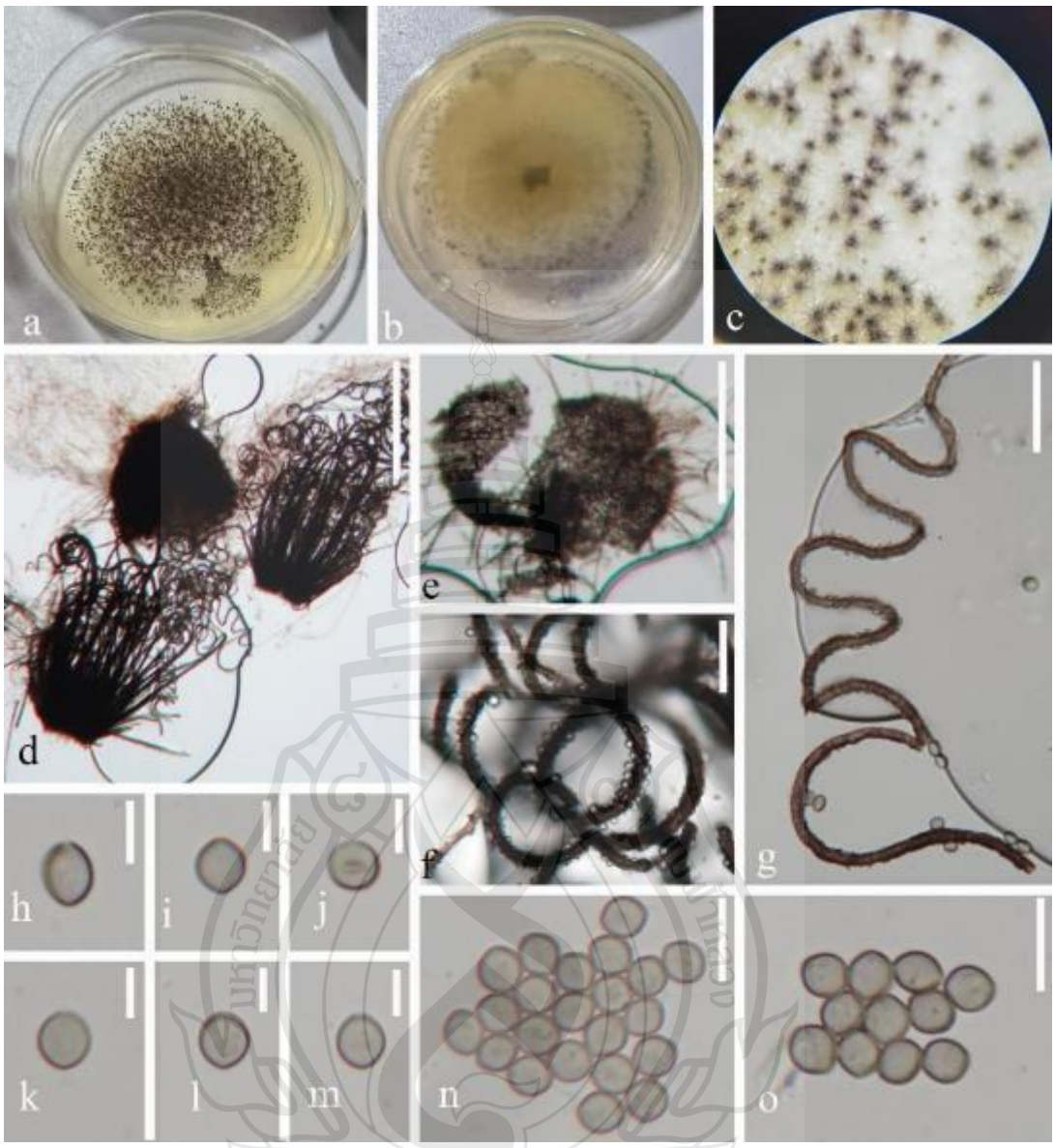
Fungal Names number: FN 840147; Figure 4.66

Endophytic in the healthy roots of *Dicranopteris ampla*. Sexual morph: *Ascomata* 220–270 × 140–200 µm ($\bar{x}$ = 245 × 170 µm, n = 10) superficial, often covered by sparse white aerial hyphae, sepia, globose or subglobose. *Ascomatal wall* brown, *textura intricata* mixed with angularis or epidermoidea in surface view. *Terminal hairs* arising from the apical collar, seta-like or flexuous, 90–200 × 3–6 µm ($\bar{x}$ = 145 × 4.5 µm, n = 30), smooth, dark brown, distinctly septate, tapering and fading towards. Lateral hairs similar but quite sparse. *Asci* appeared soon after the cultures matured; no asci were seen during the observations. *Ascospores* globose or subglobose, 5.5–7.0 × 4.0–6.0 µm ($\bar{x}$ = 6.2 × 5 µm, n = 30) asexual morph: Undetermined.

Culture characteristics: Colonies on PDA medium circular, entirely to slightly filamentous, growly fast, reaching 50 mm diam after 5 days at 25°C in natural light, cottony, velvety, loose, dull green from above; pale luteous in reverse.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Cheheng County, isolated from the healthy roots of *Dicranopteris ampla* collected from the rock crevices, 16 March 2022, J.Y. Zhang, NS198–2 (KUN-HKAS 129892), living culture KUNCC 23–14188.

Notes: Phylogenetic analyses of ITS, LSU, *tef*1-α and *tub*2 showed that the new isolate clustered with *Collariella pachypodioides* (CBS 164.52) (Figure 4.65). *Collariella pachypodioides* was initially introduced by Greathouse and Ames (1945) as *Chaetomium pachypodioides*. von Arx et al. (1986) treated it as a synonym of *Col. bostrychodes*. However, Wang et al. (2022) showed that this species is phylogenetically distinct from *Col. bostrychodes*, they therefore identified it as a distinct species and synonymized it as *Col. pachypodioides*. Morphologically, our new isolate matches the original description of *Col. pachypodioides* as provided by Greathouse and Ames (1945). Therefore, we identified our new as *Col. pachypodioides* based on both phylogeny and morphology.



Note a, b Colonies on PDA medium. c Ascomata on PDA. d, e Ascomata. f–g Terminal ascomatal hairs. h–o Ascospores. Scale bars: d = 200 µm, e = 150 um, f, g = 30 µm, h–m = 5 µm, n, o = 10 um

Figure 4.66 *Collariella pachypodioides* (HKAS-KUNCC 129892)

Trichocladium Harz

Trichocladium was introduced by Harz (1871) with *T. asperum* as the type species. The genus is a morphologically highly diverse group; Wang et al. (2019) showed that it includes four closely related subclades; however, these subclades no distinctive phenotypic characteristics are linked to any of them, they accepted 14

species in this genus based on both phylogeny and morphology. Subsequently, four new species viz. *T. aquaticum*, *T. microsporium*, *T. solani* and *T. tomentosum* were added to the genus. Species of this genus are commonly found in submerged decomposing wood in tropical regions, or from dead plant material and associated substrata, and a few species are thermophilic and plant pathogens (Goh et al., 1999; Wang et al., 2019; Belosokhov, 2022). This study introduces a new species *T. dicranopteridis*, which is an endophytic fungus isolated from the roots of *Dicranopteris pedata*.

Trichocladium dicranopteridis J.Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov.***,** Figure 4.67

Etymology: The specific epithet dicranopterisis refers to the plant genus *Dicranopteris*.

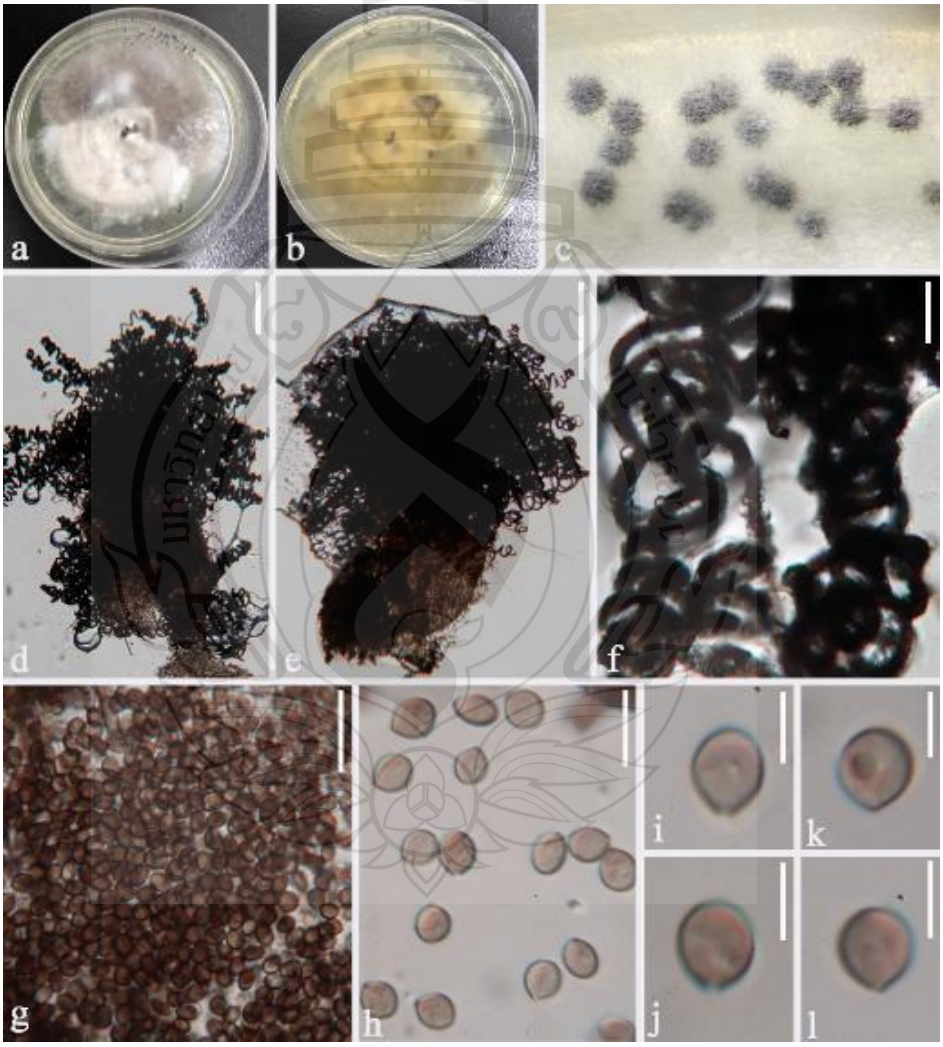
Endophytic in the healthy roots of *Dicranopteris pedata*. Sexual morph: *Ascomata* 230–290 × 204–230 μm ($\bar{x}$ = 258 × 216 μm, n = 10) superficial, often covered by sparse white aerial hyphae, sepia, globose or subglobose. *Ascomatal wall* brown, *textura intricata* mixed with angularis or epidermoidea in surface view. *Terminal* hairs 5–6 μm wide, arising from around the ostiole, flexuous and regularly spirally coiled along their entire length, not changing direction (usually a right-hand spiral), dark brown, thick-walled, unbranched, punctulate or verrucose, filament. *Asci* appeared soon after the cultures matured; asci were not observed. *Ascospores* 5–6 × 4–5 μm ($\bar{x}$ = 5.7 × 4.7 μm, n = 40), 1-celled, globose or subglobose, ovoid, brown to olivaceous-brown, smooth-walled, with an apical germ pore at the attenuated end. Asexual morph: Undetermined.

Culture characteristics: Colonies on PDA medium circular, entirely to slightly filamentous, growly fast, reaching 50 mm diam after one week at 25 °C in natural light, cottony, velvety, loose, dull green from above; pale luteous in reverse.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Cheheng County, isolated from the healthy roots of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS132–2, holotype. *ibid*. NS132–1.

Notes: In our phylogenetic analysis, *Trichocladium dicranopteridis* clustered as a sister taxon to *T. acropullum*, with 100% ML and xx PP statical support (Figure 4.65). The ITS, *tub*2, and *rpb*2 sequences of *T. dicranopteridis* (NS132–2) revealed 14 bp (including gaps), 41 bp (without gaps), and 45 bp (without gaps) differences,

respectively, when compared to the type material of *T. acropullum* (CBS 114580). These genetic differences strongly support the recognition of our isolate as a new species. Morphologically, *T. dicranopteridis* is distinguishable from *T. acropullum* by its wider terminal hairs, which are regularly spirally coiled along their entire length (5–6 µm vs. 3–4.5 µm). In contrast, the terminal hairs of *T. acropullum* are coiled only in the upper half to three-quarters of their length (Wang & Zheng, 2005) additionally, the ascospores of *T. dicranopteridis* are slightly shorter and narrower compared to those of *T. acropullum* (5–6 × 4–5 µm vs. 5.5–9(–10.5) × 5–7.5 × 4.5–5.5 µm). Therefore, *T. dicranopteridis* is introduced as a new species in this study.



Note a, b Colonies on PDA medium. c Ascomata on PDA. d, e Ascomata. f Terminal ascomatal hairs. g–l Ascospores. Scale bars: d, e = 100 µm, f, g = 20 um, h = 10 µm, i-l = 5 µm

Figure 4.67 *Trichocladium dicranopteridis* (132–2, holotype)

Xylariomycetidae O.E. Erikss & Winka

Amphisphaeriales D. Hawksw. & O.E. Erikss.

The status of *Amphisphaeriales* has long been controversial, and the placement of this order has been changed and revised by different studies (Eriksson, 1983; Kang et al., 1998), several studies treated it as a distinct order in *Xylariomycetidae*, while several studies placed it in *Xylariales* (Barr, 1990; Kang et al., 2002; Kirk et al., 2008). Senanayake et al. (2015) revised the subclass *Xylariomycetidae* based on the additional collections and the morpho-phylogenetic analyses, *Amphisphaeriales* with six families *Amphisphaeriaceae*, *Bartaliniaceae*, *Clypeosphaeriaceae*, *Discosiaceae*, *Pestalotiopsidaceae* and *Phlogicylindriaceae*, and *Xylariales* have been confirmed to the subclass. While Maharachchikumbura et al. (2016) treated *Amphisphaeriales* as a synonym of *Xylariales.* Samarakoon et al. (2016) and Hongsanan et al. (2017) accepted *Amphisphaeriales* as a distinct order based on phylogenetic analysis and divergence time estimates. Hyde et al. (2020a) accepted 17 families and 88 genera in this order. Recently, Samarakoon et al. (2022) revised the classification of *Xylariomycetidae* and accepted 22 families in the order based on a multi-locus phylogenetic analysis along with divergence time estimates.

Sporocadaceae Corda

Sporocadaceae was introduced by Corda (1842), and the processes appendage bearing conidia are the typical morphological characteristics of this family. This family includes endophytes, plant pathogens, and saprobes that are associated with a variety of host plants with a global distribution (Liu et al., 2019; Hyde et al., 2020a; Samarakoon et al., 2022; Tian et al., 2023). Liu et al. (2019) provide a natural classification for the *Sporocadaceae* based on multi-locus (LSU, ITS, *tef*-1α, *tub*2, and *rpb*2) and 30 genera were accepted in the family. Hyde et al. (2020) accepted *Annellolacinia* and *Doliomyces* in the family, however, due to the lack of sequence data or cultures for these two genera, the placements for the two genera need to be validated in the future. Wijayawardene (2022) accepted 35 genera, including *Dilophospora*, *Millesimomyces* and *Nothoseiridium*. *Millesimomyces* and *Nothoseiridium* were newly established genera introduced by Crous et al. (2019b) and Crous et al. (2020), respectively. Recently, Razaghi et al. (2024) revisited Sporocadaceae, and introduced a new genus *Cavernicola.* Currently, 35 genera are accepted in this family (Hyde et al., 2024)

Pestalotiopsis Steyaert

Pestalotiopsis is a species-rich asexual genus with appendage-bearing conidia (Barr, 1975; Kang et al., 1999; Lee et al., 2006). It was introduced by Steyaert (1949) with *P. maculans* as the type, characterized by acervuli, fusiform conidia that are usually 5-celled, with 3 colored median cells and 2 colourless end cells with two or more apical appendages and annellidic conidiogenous cells (Sutton, 1980). Species in this genus were mainly distinguished on the basis of conidial form, colour, and size, number and length of apical appendages, number and length of basal appendages (Jeewon et al., 2003; Liu et al., 2010; Maharachchikumbura et al., 2014). However, due to the overlapping morphological characters, thus it is insufficient to identify them. Hence, a multi-locus (ITS, *tef1-α,* and *tub*2) phylogenetic analysis was proposed to resolve and define species diversity within the genus, which has greatly promoted the development of taxonomy (Hu et al., 2007; Liu et al., 2010; Maharachchikumbura et al., 2012, 2015). *Pestalotiopsis* currently contains 414 names in the Index Fungorum (2024), however the majority of these lack sequence data and will need to be clarified in the future.

Pestalotiopsis species are widely distributed and associated with a variety of hosts as endophytes, pathogens, and saprobes. They can exist as both pathogenic and endophytic fungi due to their diverse ways of living (Ellis & Ellis, 1997; Maharachchikumbura et al., 2014; Zhou et al., 2023) However, some species have also been found in non-plant substrates (Guba, 1961; Strobel et al., 1996; Tejesvi et al., 2009). In this study, an endophyte, *Pestalotiopsis chamaeropis* was isolated from *Dicranopteris pedata*; it is the first report of *Pestalotiopsis* species reported on *D. pedata*.

Pestalotiopsis chamaeropis Maharachch., K.D. Hyde & Crous, Stud. Mycol. 79: 158 (2014)

Fungal Names number: FN 809735; *Facesoffungi number*: FoF 11691; Figure 4.68

Endophytic in the stem of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* pycnidial in culture on PDA, globose, semi-immersed or partly erumpent, aggregated or scattered, exuding globose, dark brown to black conidial masses. *Conidiophores* 1–3-septate, branched, subcylindrical, hyaline, smooth-walled. *Conidiogenous cells* discrete, cylindrical, hyaline, smooth-walled, proliferatin percurrently, 10–20 × 3–5 µm ($\bar{x}$ = 14.9 × 3.7 µm, n = 30), collarette present and not

flared, with prominent periclinal thickening. *Conidia* 20–23 × 5–7 µm ($\bar{x}$ = 21.6 × 6 µm, n = 30), fusoid, ellipsoid, straight to slightly curved, 4-septate; basal cell 4–5 µm long, obconic with a truncate base, hyaline, minutely verruculose and thin-walled, 5–6.5 µm long; three median cells doliiform to subcylindrical, 13–16 µm long ($\bar{x}$ = 14.3 µm, n = 30), smooth-walled , concolourous, but occasionally the two upper median cells are slightly darker than the lower median cell, brown, septa darker than the rest of the cell (second cell from the base 4–5 µm long; third cell 4–6 µm long; fourth cell 4–5 µm long); apical cell 3–5 µm long, hyaline, subcylindrical, thin- and smooth walled; with 2–3 tubular apical appendages, arising from the apical crest, unbranched, filiform 11–20 µm long ($\bar{x}$ = 15.5 µm, n = 30); basal appendage 6–10 µm long ($\bar{x}$ = 8.2 µm, n = 30), single, tubular, unbranched, centric.

Culture characteristics: Colonies on PDA attaining 35–45 mm diam after 7 d at 25 °C, with smooth edge, whitish, with sparse aerial mycelium on the surface with black, gregarious conidiomata; reverse similar in colour.

Material examined: CHINA, Guizhou Province, Zhenfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the stem of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, 257–2 (KUN-HKAS 129901), living culture GZCC 23–0707.

Notes: In our phylogenetic analysis, our new isolate clustered with *Pestalotiopsis chamaeropis* with 97% bootstrap support (Figure 4.69). *Pestalotiopsis chamaeropis* was introduced by Maharachchikumbura et al. (2014), and the morphological characteristics of *P. chamaeropis* well-matched by our new isolate (GZCC 23–0707). Thus, we identify it as *P. chamaeropis* based on phylogenetic and morphological investigations and report our isolate GZCC 23–0707 as a new host record on *Dicranopteris pedata.*

Note a, b Colonies on PDA from surface and reverse. c Conidiomata on the PDA. d–i Conidiogenous cells and conidia. j–o Conidia. Scale bars: d–f = 25 µm, g–o = 20 um

Figure 4.68 *Pestalotiopsis chamaeropis* (KUN-HKAS 129901)

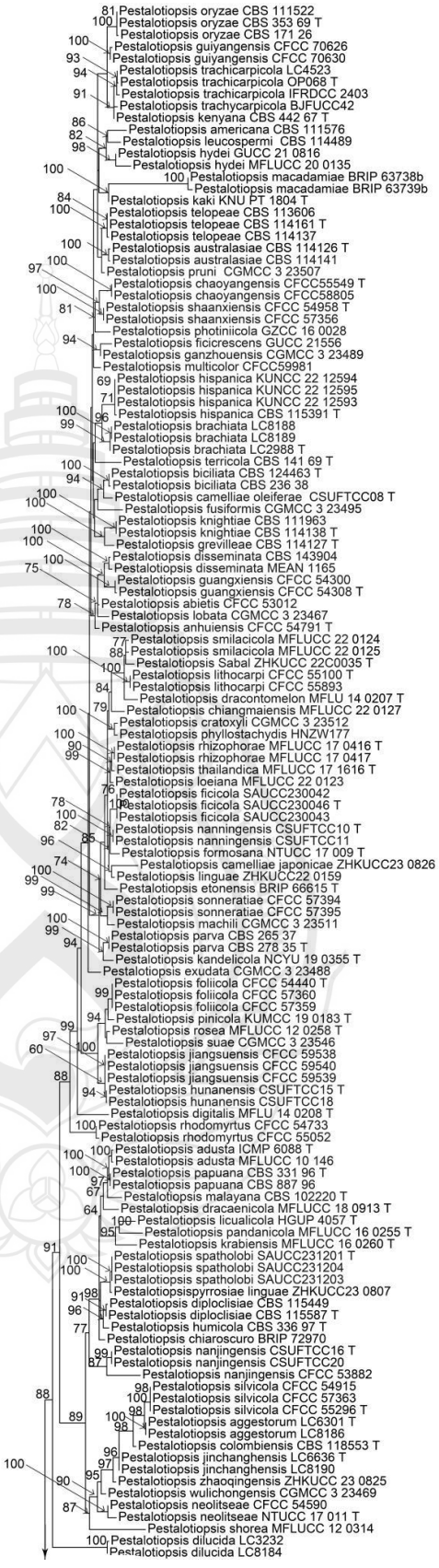
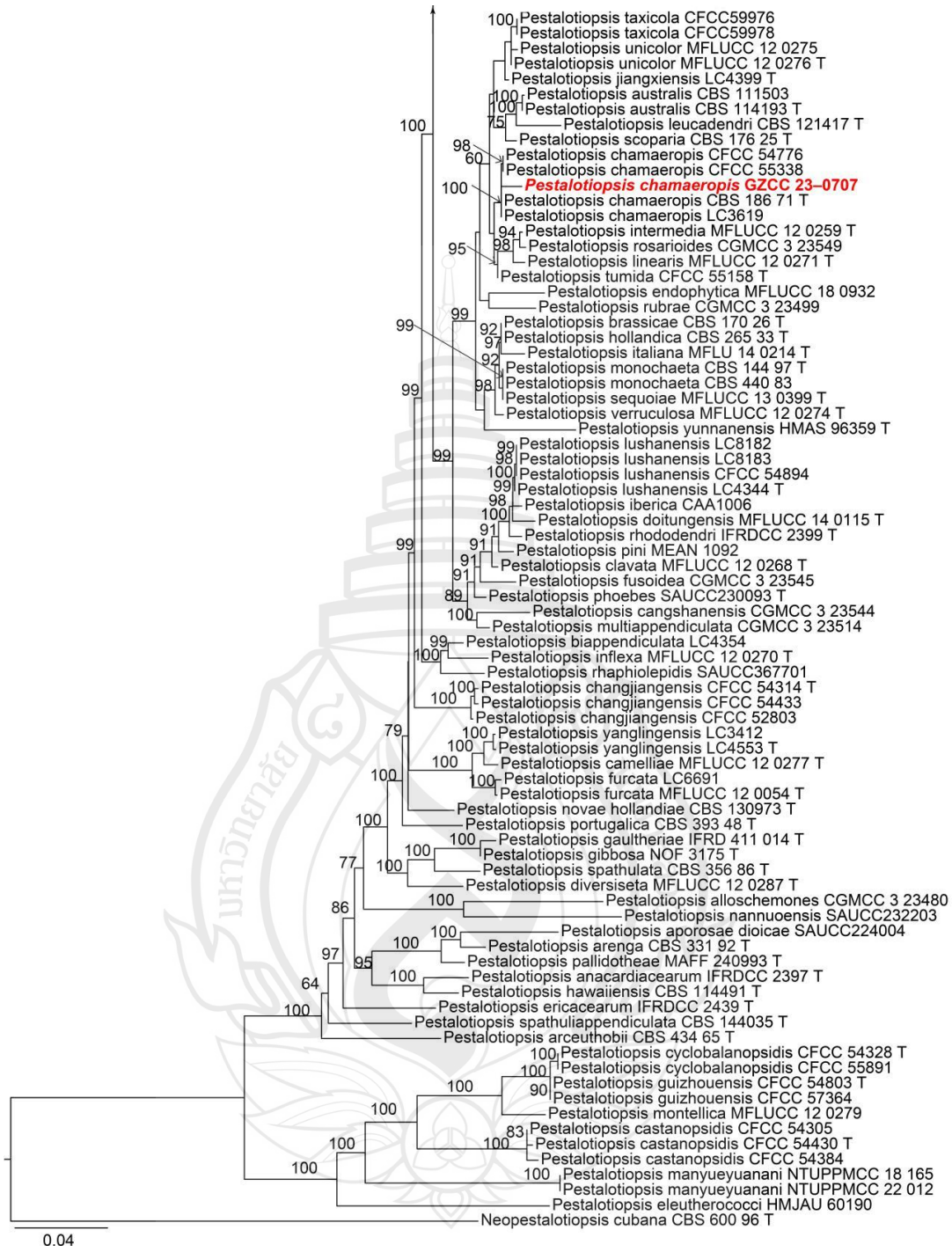


Figure 4.69 Phylogenetic tree of *Pestalotiopsis*



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *tef*1-α, and *tub*2 sequence data. The tree is rooted to *Neopestalotiopsis cubana* (CBS 600.96). The newly generated sequences are shown in red.

Figure 4.69 (continued)

Neopestalotiopsis Maharachch., K.D. Hyde & Crous

Neopestalotiopsis typified by *N. protearum* (Crous & L. Swart) Maharachch., K.D. Hyde & Crous, was introduced by Maharachchikumbura et al. (2014). The genus is distinct from other pestaloid genera (*Pestalotiopsis* and *Pseudopestalotiopsis*) in having varicolored median cells and indistinct conidiophores, which are often reduced to conidiogenous cells (Maharachchikumbura et al., 2014). *Neopestalotiopsis* species are commonly reported as endophytic and pathogenic on a wide range of plants; they can cause leaf spots, trunk diseases, post-harvest fruit rots, and root rots worldwide (Maharachchikumbura et al., 2014; Jayawardena et al., 2019) a total of 119 records of *Neopestalotiopsis* are listed in the Index Fungorum (2024), while none of them have been found from *Dicranopteris* spp. During our investigation of the diversity of endophytic fungi associated with *Dicranopteris*, five known species of *Neopestalotiopsis* viz. *N. concentrica*, *N. ellipsospora*, *N. keteleeria*, and *N. saprophytica*, with a new species, *N. dicranopterisis*, have been described, which indicates the *Neopestalotiopsis* are highly diverse in *Dicranopteris* plants.

Neopestalotiopsis dicranopteridis J.Y. Zhang, D.F. Bao & J.C. Kang, *sp. nov*., Figure 4.70

Etymology: Refers to the host plant *Dicranopteris*.

Holotype: KUN-HKAS 129874

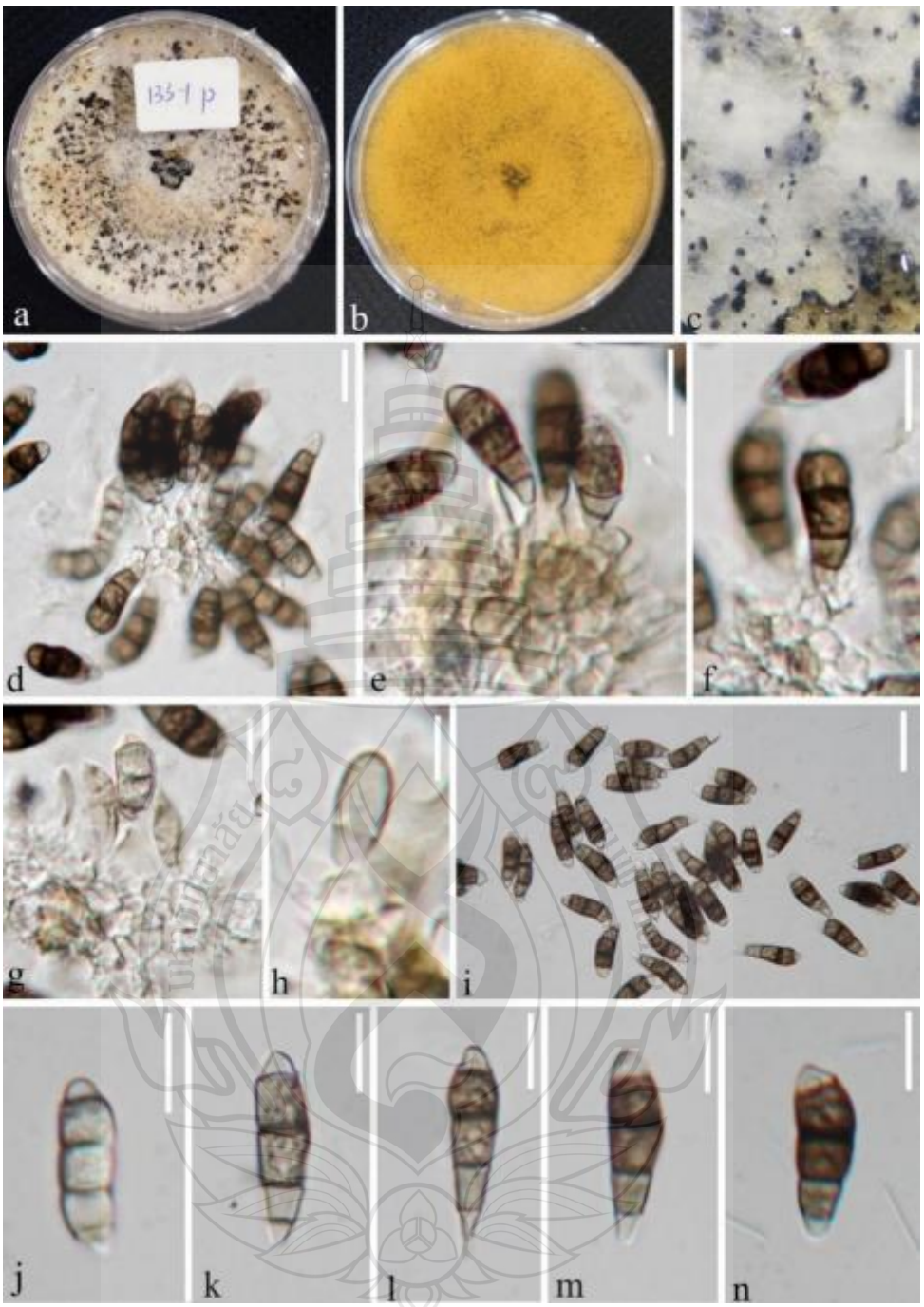
Endophytic in the rhizome of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* variable in shape and size, mostly globose to subglobose, glabrous, solitary or aggregated in clusters, semi-immersed, black; exuding globose, black, glistening, conidial masses. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 2–10 × 1–4 µm ($\bar{x}$ = 6.19 × 2.41 µm, n = 30), holoblastic, discrete or integrated, lageniform, globose to subglobose, hyaline to pale brown. *Conidia* 18–24 × 5–12 µm ($\bar{x}$ = 21.3 × 6.3 µm, n = 30), ellipsoid to fusiform, straight to slightly curved, 4-septate, constricted at the septa, granulate; basal cell conic to obconic with a truncate base, hyaline, thin-walled, 2–4 µm long ($\bar{x}$ = 3 µm, n = 35); three median cells dolioform, 13–17 µm long ($\bar{x}$ = 15.4 µm, n = 35), smooth-walled, yellow-brown to brown, septa darker than the rest of the cell (second cell from the base pale brown, 4–5 µm long; third cell yellow-brown, 4–6 µm long; fourth cell brown, 5–6 µm long); apical cell 2–4 µm long ($\bar{x}$ = 2.9 µm, n = 35), hyaline, cylindric to

subcylindric, thin- and smooth-walled; appendages not observed.

Culture characteristics: Colonies on PDA with dense mycelium, black fruiting bodies on the surface, and colonies appeared white from above and below.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the rhizome of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS133–1 (KUN-HKAS 129874, holotype), ex-type living culture KUNCC 23–14168.

Notes: *Neopestalotiopsis dicranopteridis* is a distinct species in terms of its morphology and DNA phylogeny. This species is characterized by its conidia lacking appendages, which is distinct in the genus. *Neopestalotiopsis dicranopteridis* and *N. steyaertii* forms a sister clade. Morphologically, *N. dicranopteridis* can be differentiated from *N. steyaertii* in having pale brown to brown conidia and lacking appendages (Maharachchikumbura et al., 2014). Phylogenetically, *N. dicranopteridis* is sister to *N. steyaerti* (Figure 4.71), but *N. dicranopteridis* differs from *N. steyaerti* in 9/481 bp (1.87%), 7/450 bp (1.56%), 7/481 bp (1.45%) of the ITS, *tub*2, and *tef*1-α sequences respectively. Thus, we treated *N. dicranopteridis* as a new species.



Note a, b Colonies on PDA from surface and reverse. c Conidiomata on the PDA. d–h Conidiogenous cells and conidia. j–n Conidia. Scale bars: d–g, j–n = 10 µm, h = 5um, i = 20 um

Figure 4.70 *Neopestalotiopsis dicranopteridis* (KUN-HKAS 129874, holotype)

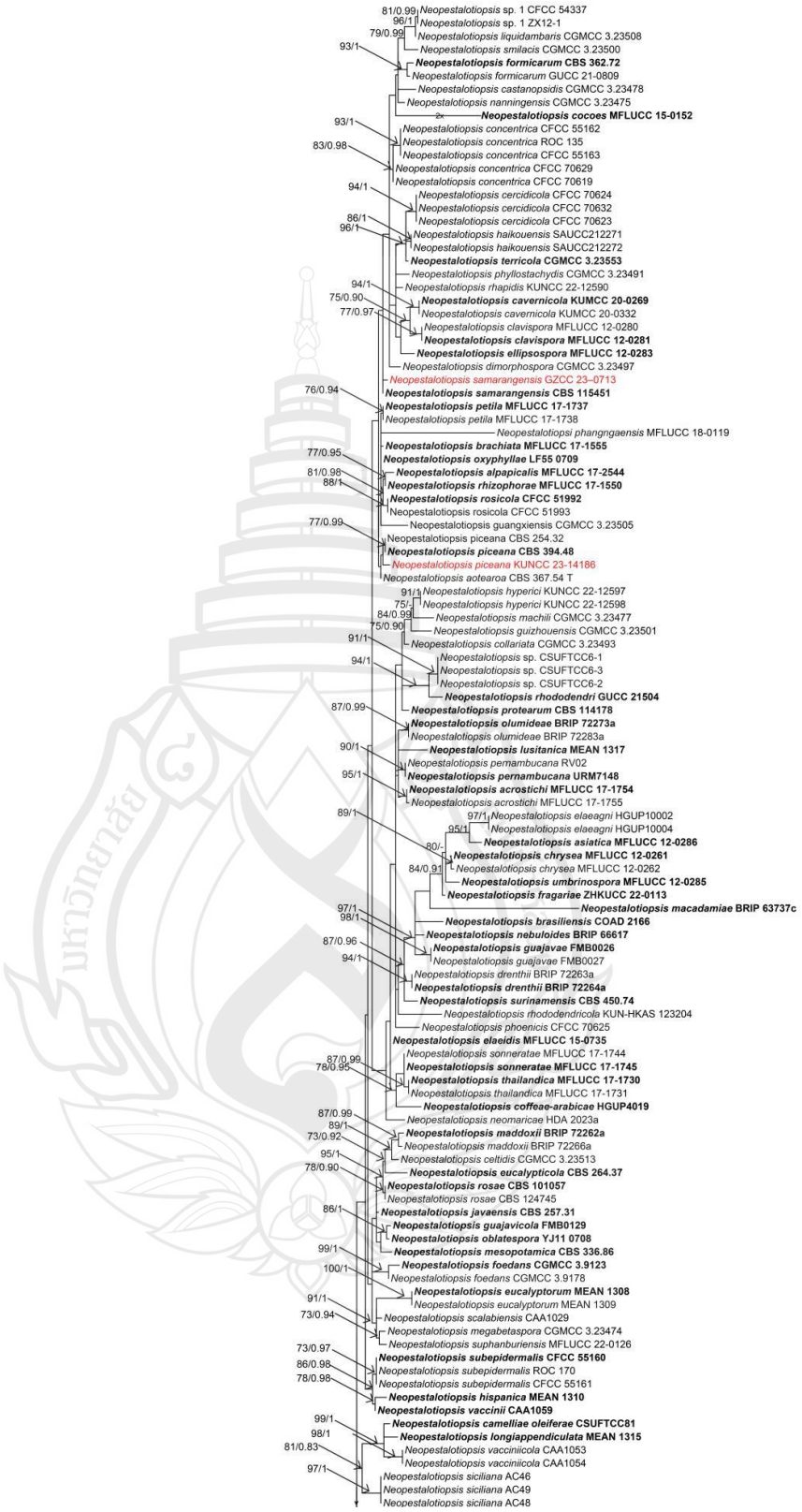
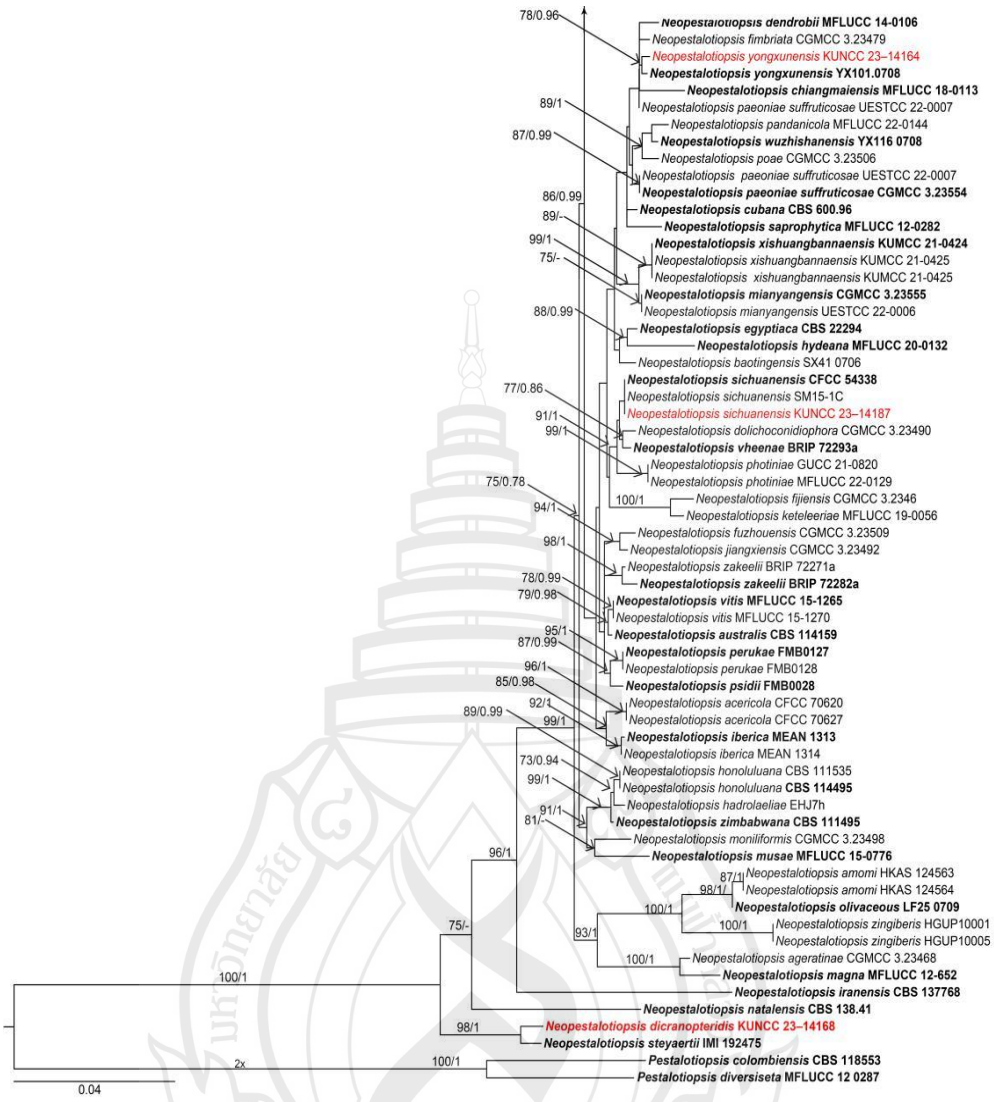


Figure 4.71 Phylogenetic tree of *Neopestalotiopsis*



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *tef*1-α, and *tub*2 sequence data. A total of 177 taxa were included in the combined analyses, which comprised 1806 characters after alignment. The best scoring RAxML tree with a final likelihood value of -11455.7127 is presented. Bootstrap support values for ML equal to or greater than 60%. The tree is rooted to *Pestalotiopsis colombiensis* (CBS 118553) and *P. diversiseta* (MFLUCC 12–0287). The newly generated sequences are shown in red.

Figure 4.71 (continued)

Neopestalotiopsis piceana Maharachch., K.D. Hyde & Crous, Stud. Mycol. 79: 146 (2014)

Fungal Names number: FN 809775; Figure 4.72

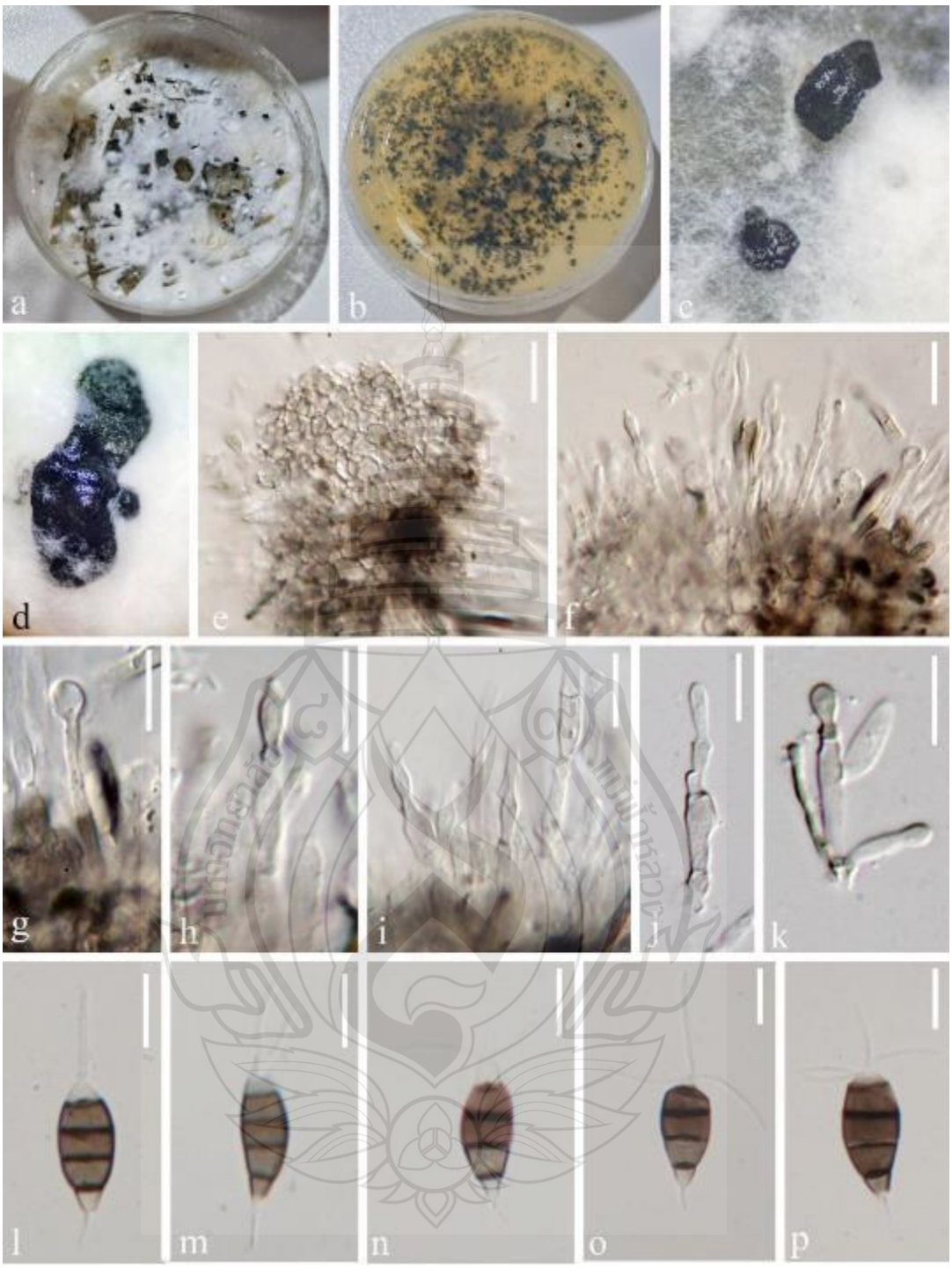
Endophytic in fresh leave of *Dicranopteris pedata*. *Colonies* on PDA, fluffy appearance, white aerial mycelia. *Mycelia* superficial and immersed composed of septate, branched, 2–3 µm wide, hyaline and brown with smooth and thick-walled hyphae. Sexual morph: Not observed. Asexual morph: *Conidiomata* pycnidial on pine needles, globose, solitary or aggregated, embedded or semi-immersed, exuding black conidial masses. *Conidiomatal wall* brown to dark brown, composed several layers of brown to dark brown cells of *textura angularis*. *Conidiophores* cylindrical, branched, septate, hyaline, smooth-walled. *Conidiogenous cells* 6.5–14 × 2–3 µm ($\bar{x}$ = 10.3 × 2.5 µm, n = 30), holoblastic, polyblastic, discrete or integrated, lageniform, globose to subglobose, hyaline to pale brown. *Conidia* 16–20 × 5–7 µm ($\bar{x}$ = 18.1 × 6.1 µm, n = 45), ellipsoid, fusoid, straight to slightly curved, 4-septate; basal cell 2.5–4 µm long ($\bar{x}$ = 12.4 µm, n = 45), hyaline to pale brown, obconic, smooth- and thin-walled; three median cells 11–14 µm ($\bar{x}$ = 12.4 µm, n = 45), brown, doliiform, (the second cell from base 4–5.5 µm long, third cell 4–5 µm long, fourth cell 4–5 µm long); apical cell 3–4 µm long, cylindrical to subcylindrical, conic to bell-shaped, hyaline, smooth- and thin-walled, with 3 tubular apical appendages, 9–14 µm long ($\bar{x}$ = 9.3 µm, n = 45), arising from the apical crest, filiform, basal appendage 3–4.5 µm long ($\bar{x}$ = 3 µm, n = 45), single, tubular, unbranched, straight and centric.

Culture characteristics: Colonies on PDA reaching 4cm diameter after 7 days at 25°C, colonies margin entire, circular, fluffy appearance, white at above with black, gregarious fruiting bodies, reverse white to cream.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leaves of Dicranopteris pedata, 16 March 2022, J.Y. Zhang, 195–1 (KUN-HKAS 129890), living culture KUNCC 23–14186.

Notes: The new isolate (KUNCC 23–14186) clustered with *Neopestalotiopsis piceana* (CBS 394.48 and CBS 254.32) in the combined ITS, *tub*2, and *tef*1-α phylogenetic analysis (Figure 4.71). The *tub*2 and *tef*1-α gene regions of the new isolate (KUNCC23–14186) are similar to those of the ex-type strain of *N. piceana* (CBS

394.48). Morphologically, the new isolate is nearly identical to the Holotype: of *N. piceana*, first described by Maharachchikumbura et al. (2014). Based on these findings, we identify the new isolate as *N. piceana*. This species was originally isolated from *Picea* wood by Maharachchikumbura et al. (2014) and was later reported as an endophyte in *Ananas comosus* (Bhattacharya et al., 2019) and as a pathogen that causes gray blight in *Camellia sinensis* in China (Wang et al., 2023b). Our new isolate, however, was obtained from the rhizome of *Dicranopteris pedata*, and we report it as a new host record for *D. dichotoma*.



Note a, b Colonies on PDA from surface and reverse. c, d Conidiomata on the PDA. e Conidiomatal wall. f–k Conidiophores, conidiogenous cells, and immature conidia. l–p Conidia. Scale bars: e, f = 15 μm, g–p = 10 um

Figure 4.72 *Neopestalotiopsis piceana* (KUN-HKAS 129890)

Neopestalotiopsis samarangensis (Maharachch. & K.D. Hyde) Maharachch., K.D. Hyde & Crous, Stud. Mycol. 79: 147 (2014)

Fungal Names number: FN 809778; Figure 4.73

Endophytic in the leave of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Acervular conidiomata* globose or irregular, superficial to semi-immersed, scattered or aggregated. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 6–8.5 × 4.5–7 µm ($\bar{x}$= 7.3 ± 1.1 × 5.8 ± 1.2 µm), discrete, ampulliform or irregular, lageniform, globose to subglobose, hyaline to pale brown. *Conidia* 17–21(–14) ×(3–) 5–6 µm ($\bar{x}$ = 19.1 ± 2.2 × 5.5 ± 0.6 µm) fusoid, ellipsoid, straight or slightly curved, 4-septate; basal cell conic to obconic with a truncate base, hyaline to subhyaline, thin-walled, 2.5–4.0 µm ($\bar{x}$ = 3.5 ± 0.7 µm) long; three median cells doliiform, 10.5–14(–11) µm ($\bar{x}$ = 12.2 ± 1.6 µm) long, versicoloured, septa darker than the rest of the cell, second cell from the base pale brown, 3.5–5 µm ($\bar{x}$ = 4.3 ± 0.7 µm) long; third cell honey brown, 3–5 µm ($\bar{x}$ = 4.1 ± 1.1 µm) long; fourth cell brown, 3–5 µm ($\bar{x}$ = 4.0 ± 0.7 µm) long; apical cell 2.5–5 µm ($\bar{x}$ = 3.8 ± 1.1 µm) long, hyaline to subhyaline, cylindrical, smooth-walled; with 2–3 tubular apical appendages (mostly three), branched or unbranched, filiform, 6.5–14(–18) µm ($\bar{x}$ = 10.3 ± 3.8 µm) long; basal appendage single, tubular, unbranched, centric, (3–)2.5–6 µm ($\bar{x}$ = 4.3 ± 1.7 µm) long.

Culture characteristics: Colony on PDA with flattened mycelium, white, smoke grey in the centre, reverse with smoke grey pigments formed a concentric ring pattern, reaching at 58–62 mm diam in 15 d at 28°C. Conidiomata globose, irregularly distributed on the medium surface, exuding globose, dark brown to black conidial masses.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi and Miao Autonomous County, from the leave of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, 201–1 (KUN-HKAS 129893), living culture GZCC 23–0713.

Notes: During our investigation of endophytic fungi associated with *Dicranopteris*, a pestalotiopsis-like taxon was collected and identified as *Neopestalotiopsis samarangensis* based on phylogenetic analysis and morphological characters. Although Maharachchikumbura et al. (2013) initially introduced it as *P. samarangensis*, it was later synonymized as *N. samarangensis* based on phylogenetic analysis and morphological characteristics.

Morphologically, our new isolate (GZCC 23–0713) matches with *N. samarangensis* in having discrete, ampulliform, or irregular conidiogenous cells and fusoid, ellipsoid, 4-septate conidia with 2–3 tubular apical appendages and a single basal appendage. Phylogenetically, our new isolate (GZCC 23–0713) clustered with the ex-type of *N. samarangensis* (CBS 115451) as the same species (Figure 4.71). Thus, we identified our new isolate *N. samarangensis* and reported it as a new host record from *Dicranopteris pedata.*

Note a, b Colonies on PDA from surface and reverse. c Conidiomata on the PDA. d–f Conidiogenous cells and conidia. g–k Conidia. Scale bars: d–f = 20 μm, g–k = 10 um

Figure 4.73 *Neopestalotiopsis samarangensis* (KUN-HKAS 129893)

Neopestalotiopsis sichuanensis C.M. Tian & N. Jiang, in Jiang, Fan & Tian, Journal of Fungi 7(1, no. 64): 22 (2021)

Fungal Names number: FN 837792; Figure 4.74

Endophytic in the leave of *Dicranopteris pedata*. Sexual morph: Not observed. Asexual morph: *Conidiomata* variable in shape and size, mostly globose to subglobose, glabrous, solitary or aggregated in clusters, semi-immersed, black; exuding globose, black, glistening, conidial masses. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 5–16.5 × 2.5–4 μm ($\bar{x}$ = 10.8 × 3.41 μm, n = 20), holoblastic,

discrete or integrated, lageniform, globose to subglobose, hyaline to pale brown. *Conidia* 18–23 × 5–7 μm ($\bar{x}$ = 20.2 × 5.9 μm, n = 30), fusiform, straight to slightly curved, 4-septate; with basal cell conical with obtuse end, hyaline, thin and smooth-walled, 3.5–6 μm long ($\bar{x}$ = 4.7 μm, n = 30); with three median cells 11–15 μm long ($\bar{x}$ = 13.5 μm, n = 30), dark brown, septa and periclinal walls darker than the rest of the cell, versicoloured, second cell from base pale brown, 4–6 μm ($\bar{x}$ = 5.0 μm, n = 30); third cell darker brown, 4–5 μm ($\bar{x}$ = 4.6 μm, n = 30); fourth cell darker, 4–6 μm ($\bar{x}$ = 4.9 μm, n = 30); apical cell 3–4.5 μm long($\bar{x}$ = 3.9 μm, n = 30), hyaline, conical; with apical appendages 10–20 μm long ($\bar{x}$ = 15.4 μm, n = 30), tubular, 1–3, arising from the apex of the apical cell; basal appendage small or absent, 2.5–4 μm long ($\bar{x}$ = 3.3 μm, n = 30), filiform.

Culture characteristics: Colonies on PDA reaching 8 cm diam. after 6 days at 25°C, edge crenate, whitish, with aerial mycelium on the surface, with black, gregarious fruiting bodies; reverse of the culture white.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leave of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, 195–2 (KUN-HKAS 129891), living culture KUNCC 23–14187.

Notes: *Neopestalotiopsis sichuanensis* was introduced by Jiang et al. (2021), isolated from leaf spots of *Castanea mollissima*. *Neopestalotiopsis sichuanensis* is characterized by fusiform, 4-septate, conidia with hyaline, conical basal cell, dark brown, septate three median cells, which are darker than the apical and basal cells, and hyaline, a conical apical cell with 1–3 apical appendages and a small or absent basal appendage. Our new isolate (KUNCC 23–14187) fits well with the description of *N. sichuanensis* except the size of conidia (18–23 × 5–7 vs. (23.2–)24.3–30.4(–32.8) × (5.7–)6.3–7.1(–7.5)). Phylogenetically, our new isolate clustered with two strains of *N. sichuanensis,* which were not significantly different from our new isolate (Figure 4.71). Thus, based on both phylogeny and morphology, we identified our new isolate as *N. sichuanensis*. Our strain *N. sichuanensis* (KUNCC 23–14187) is reported as a new host record on *Dicranopteris pedata*.

Note a, b Colonies on PDA from surface and reverse. c Conidiomata on the PDA. d, e Conidia mass with conidiophores. f–i Conidiophores, conidiogenous cells, and immature conidia. j–n Conidia. Scale bars: d–n = 20 um

Figure 4.74 *Neopestalotiopsis sichuanensis* (KUN-HKAS 129891)

Neopestalotiopsis yongxunensis X.F. Cui & Z.G. Hao, Journal of Fungi 10(6, no. 371): 22 (2024)

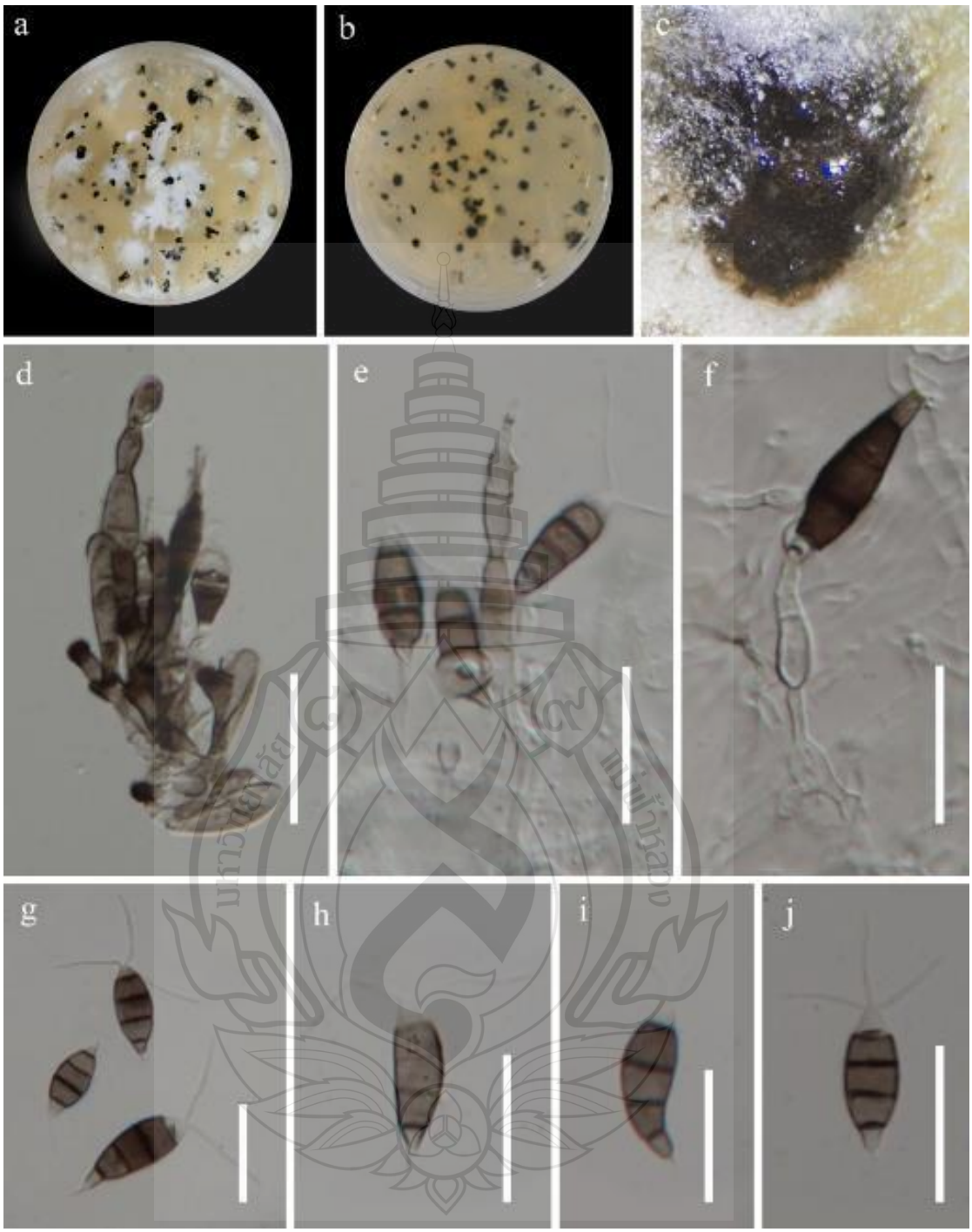
Fungal Names number: FN 854055; Figure 4.75

Endophytic in the stem of *Dicranopteris pedata*. Sexual morph: Undetermined. Asexual morph: *Conidiomata* pycnidial, solitary, black, semi-immersed on PDA, exuding dark brown mass of conidia. *Conidiophores* often reduced to conidiogenous cells, branched or unbranched, hyaline to brown, thin-walled. *Conidiogenous cells* discrete, ampulliform to lageniform, hyaline, thin-walled, smooth. *Conidia* 15.0–20.9 × 2.1–10.8µm ($\bar{x}$ =17.7× 7.8µm, n = 32), fusiform to clavate, straight to slightly curved, 4-septate; basal cell obconic, hyaline or brown, thin-walled, smooth. *Apical cell* triangular, hyaline; 1–3 tubular apical appendages, arising from the apex of the apical cell each at different point, flexuous; basal appendage presents most of the time, single, tubular, unbranched.

Culture characteristics: Colonies on PDA were circular with a rough, black fruiting bodies on the surface and appeared white from above and pale yellow from below.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the stem of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS112–1 (KUN-HKAS 129871), living culture KUNCC 23–14164.

Notes: *Neopestalotiopsis yongxunensis*, was recently described by Cui et al. (2024), isolated from leaves of *Alpinia oxyphylla* in Hainan Province, China. In our phylogenetic analysis, our new isolate clustered with *N. yongxunensis* with strong statistical support (Figure 4.71). Morphology of our new isolate fits well with the Holotype: of *N. yongxunensis* (Cui et al., 2024). We therefore reported this new isolate as a new host record of *N. yongxunensis* isolated from *Dicranopteris pedata*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–f Conidiogenous cells and Conidia. g–j Conidia. Scale bar: d–j = 20 μm

Figure 4.75 *Neopestalotiopsis yongxunensis* (KUN-HKAS 129871)

Xylariales Nannf.

Xylariales is an order of fungi within the class *Sordariomycetes*, known for its ecological diversity and importance. Members of *Xylariales* are typically saprobic, breaking down organic matter such as wood, but many are also plant endophytes or pathogens (Zhang et al., 2006; U'Ren et al., 2016; Rashmi et al., 2019; Daranagama et al., 2018). The taxonomy of *Xylariales* has been continuously refined with advancements in molecular phylogenetic techniques, leading to the discovery of new species and reclassification of known ones (Maharachchikumbura et al., 2016; Wendt et al., 2018; Konta et al., 2020; Hyde et al., 2020a; Samarakoon et al., 2022). The order is large and diverse, with many genera still requiring detailed study for proper classification (Samarakoon et al., 2022). Currently, the order comprises 20 families (Wijayawardene et al., 2022).

Apiosporaceae K.D. Hyde, J. Fröhl., Joanne E. Taylor & M.E. Barr

Apiosporaceae was introduced by Hyde et al. (1998) to accommodate taxa that produce apiospores and a basauxic, arthrinium-like conidiogenesis (Hyde et al., 2020a). Hyde et al. (2020a) accepted five genera *Appendicospora*, *Arthrinium*, *Dictyoarthrinium*, *Endocalyx*, and *Nigrospora* in the family. However, *Dictyoarthrinium*, *Endocalyx*, and *Appendicospora* have been transferred to *Didymosphaeriaceae*, *Cainiaceae* and *Appendicosporaceae*, respectively (Konta et al., 2021; Samarakoon et al., 2022a, 2022b). Pintos and Alvarado (2021) re-evaluated the multigene phylogeny and the morphology of *Arthrinium* and accepted *Apiospora* as a distinct genus within *Apiosporaceae*. Hence, only *Apiospora*, *Arthrinium*, and *Nigrospora* are accepted in *Apiosporaceae* (Wijayawardene et al., 2022).

Apiospora Sacc.

Apiospora Sacc. was introduced by Saccardo (1875) within the family Apiosporaceae (Amphisphaeriales, Sordariomycetes), with *A. montagnei* Sacc. as the type species. Due to the morphological similarities between the genera *Apiospora* and *Arthrinium*, they were long considered synonymous based on the one fungus one name principle (Crous & Groenewald, 2013; Hawksworth et al., 2011; Dai et al., 2016, 2017; Wang et al., 2018). It was not until the study by Pintos and Alvarado (2021) that they were clarified as separate genera based on genetic, ecological, and morphological evidence. This delineation was confirmed and supported by subsequent studies (Tian et

al., 2021; Bhunjun et al., 2022; Kwon et al., 2022; Ma et al., 2022; Phukhamsakda et al., 2022; Pintos et al., 2022; Zhao et al., 2023). Evidence of genome draft was employed within the fungal group *Arthrinium*/*Apiospora* for the first time, which also supported them into two separate genera (Sørensen et al., 2022). Currently, 157 epithets under the genus *Apiospora* are listed in Index Fungorum (September 2023), while 116 epithets are listed in Species Fungorum. Out of these, molecular data have confirmed 91 *Apiospora* species.

Apiospora aseptata J.Y. Zhang and Y.Z. Lu, sp. nov.

Index Fungorum number: IF901115; *Facesoffungi number*: FoF14873; Figure 4.76

Etymology: referring to the aseptate conidia.

Culture characteristics: Colonies on PDA are medium circular, spread, flat with an entire edge, with thin aerial hyphae, reaching ca. 50 mm diam after 10 d at 25°C, grey-brown from above, yellow–brown in reverse. Mycelium consists of septate, branched, hyaline to brown hyphae.

Description: *Endophytic* in the healthy roots of *Dicranopteris pedata*. Sexual morph: Undetermined. Asexual morph: *Conidiophores* are cylindrical, septate, branched, rough-walled, flexuous, and often reduced to conidiogenous cells. *Conidiogenous cells* ca. 3.5 µm wide, aggregated in clusters on hyphae, solitary, mono-polyblastic, cylindrical to subglobose, hyaline to brown. *Conidia* amerospores, aseptate, globose or sub globose, 7–9.5 (–13) µm diam. ($\bar{x}$ = 8 µm, n = 40) in surface view, subglobose; 6–8.5 × 5–7 µm ($\bar{x}$ = 7 × 6 µm, n = 20) from side view, lenticular with a pale longitudinal germ slit, smooth to finely roughened, occasionally micro guttules, pale brown to brown.

*Material examine*d: China, Guizhou Province, Qianxinan Buyi, and Miao Autonomous Prefecture, Chengheng County, isolated from the healthy leaf of *Dicranopteris pedata* near the roadside, 16 March 2022, J.Y. Zhang, 138-3 (HKAS 129875, holotype); ex-type living cultures, KUNCC 23-14169.

GenBank accession numbers: (LSU) OR590335, (ITS) OR590341, (TEF1-α) OR634949, and (TUB) OR634943.

Notes: *Apiospora aseptata* aligns well with the characteristics of the genus *Apiospora* and is most similar to *A*. *pseudoparenchymaticum* in the shape of its conidiogenous cells and conidia. However, they differ in conidial size (Wang et al., 2018) a*piospora aseptata* has noticeably smaller conidia than *A*. *pseudoparenchymaticum* (7–9.5 (–13) µm diam. vs. 13.5–27 × 12–23.5 µm). In phylogenetic analysis (Figure 4.77), *Apiospora aseptata* clusters with *Apiospora* sp. strains (SAUCC 1429 and SAUCC 1430) and forms a sister relationship with the clade that includes *A*. *arctoscopi* (KUC21331), *A*. *jiangxiensis* (LC 4577), and *A*. *obovata* (LC 4940). Unfortunately, we could not compare the morphological characteristics of the *Apiospora* sp. strains (SAUCC 1429 and SAUCC 1430), as the morphology of these strains has not been reported. Based on both phylogeny and morphology, we introduce *Apiospora aseptate* as a new species.

Apiospora dematiacea J. Y. Zhang and Y. Z. Lu, sp. nov., Figure 4.78

Index Fungorum number: IF901116; *Facesoffungi number*: FoF14874.

Holotype: HKAS 129910

Etymology: referring to its dematiaceous spore.

Culture characteristics: *Colonies* on PDA medium circular, cottony, edge entire, flat, spreading, with abundant aerial mycelia, zonate with one concentric circle, reaching 47 mm diam after 10 d at 25°C, white from above, yellowish white to grey to light yellow from center to edge in reverse. *Vegetative hypha* septate, branched, hyaline to light brown.

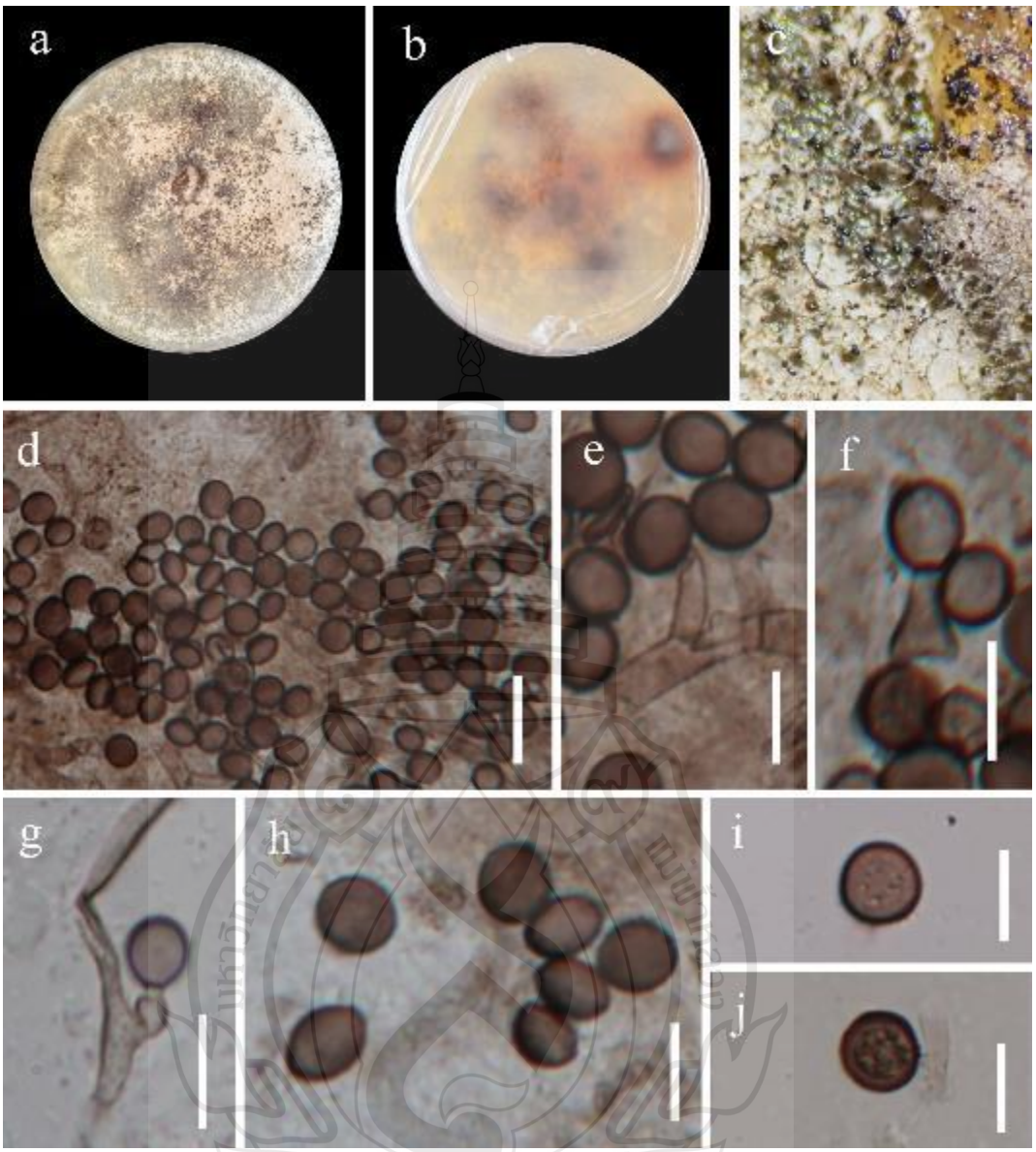
Description: *Endophytic* in the stems of *Dicranopteris ampla*. Sexual morph: Undetermined. Asexual morph: *Conidiophores* reduced to conidiogenous cells, cylindrical, septate, hyaline. *Conidiogenous cells* are cylindrical to subglobose, aggregated in clusters on hyphae, smooth, hyphae-like, and hyaline to brown. Conidia aseptate, globose to ellipsoid in surface view, 14.5–18(–20) µm diam. ($\bar{x}$ = 16.5 µm, n = 30), lenticular to lageniform from side view, 18.5–23(–25) × 10–13 µm diam. ($\bar{x}$ = 21.5 × 11.5 µm, n = 30), with longitudinal, pale germ slit. *Sterile cells* up to 32 µm long, 9–12(–16) µm ($\bar{x}$ = 10.5 µm, n = 20) wide, elongated, mixed among conidia brown, rarely truncate, and have a darkened scar at the base.

Material examined: CHINA, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Ceheng County (24°59′44″ N 105°50′16″ E), isolated from the healthy stem of *Dicranopteris ampla* near the roadside, 16 March 2022, J.Y. Zhang,

307-1 (HKAS 129910, Holotype), ex-living cultures, KUNCC 23-14202.

GenBank accession numbers: (LSU) OR590339, (ITS) OR590346, (TEF1-α) OR634953, and (TUB) OR634948.

Note: *Apiospora dematiacea* morphologically resembles *A*. *hydei*, characterized by conidiogenous cells aggregated in clusters on hyphae and globose conidia in surface view, with a pale equatorial slit when viewed from the side (Crous & Groenewald, 2013). However, *A*. *dematiacea* is distinguishable from *A*. *hydei* due to its hyphae-like conidiogenous cells and more varied conidial shapes that include sterile cells. From a phylogenetic perspective, while *Apiospora dematiacea* shares a sister relationship with *A*. *hydei*, it constitutes a distinct lineage. A comparison of nucleotide base pairs between the ex-type strain of *A*. *hydei* (CBS 114990) and our newly isolated strain of *Apiospora dematiacea* (KUNCC 23-14202) reveals differences of 1183/1185 bp (99%), 578/579 (99%, including 1 gap), 411/432 bp (95%, including 12 bp gaps), and 778/794 bp (98%, including 2 bp gaps) in the LSU, ITS, TEF1-α, and TUB2 sequences, respectively. This confirms that they are distinct species.



Note a, b Cultures on PDA from above and below. c colonies on PDA. d–g conidiogenous cells with conidia. h–j conidia. d 20 µm, e–j 10 µm

Figure 4.76 *Apiospora aseptata* (HKAS 129875, holotype)

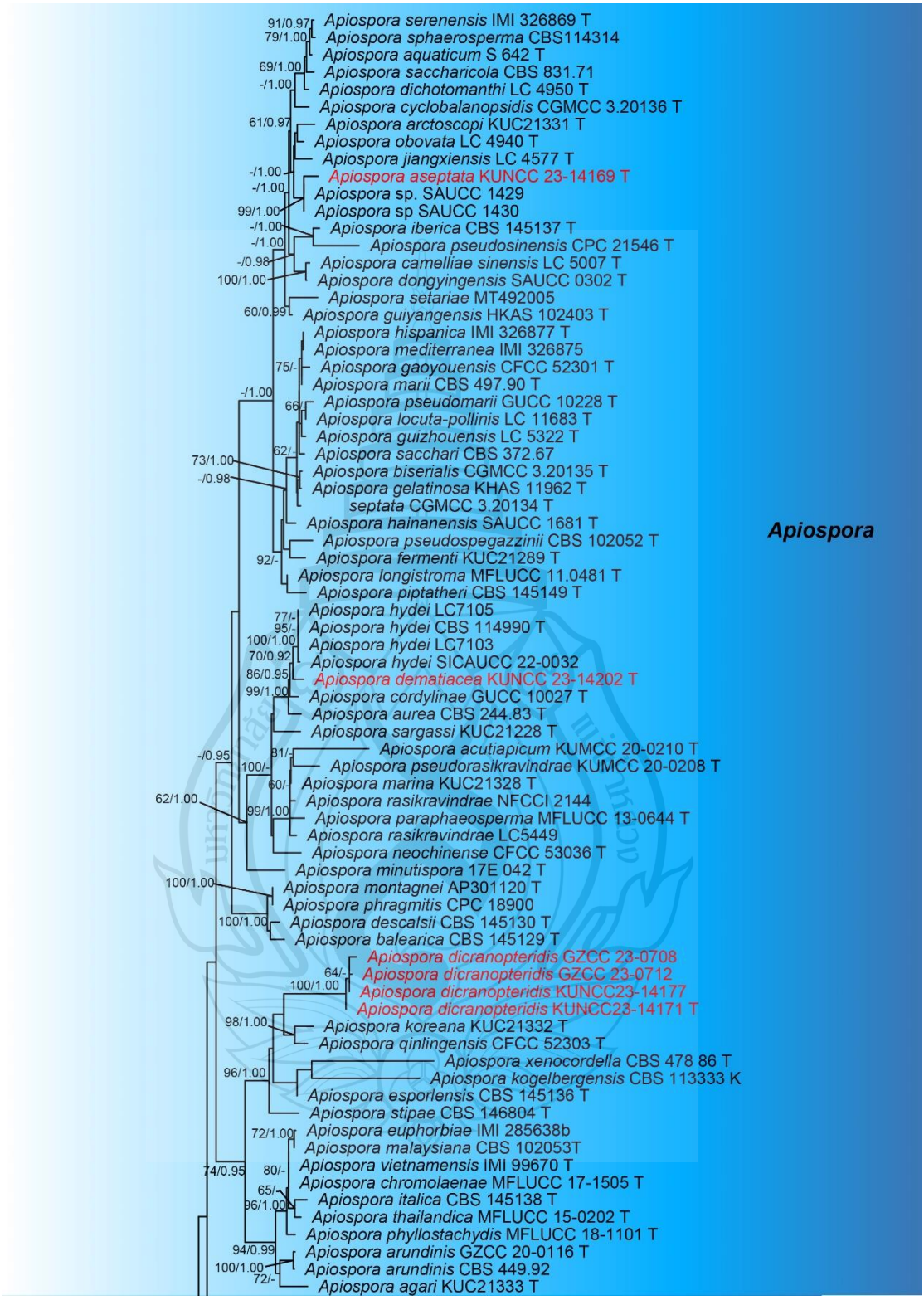
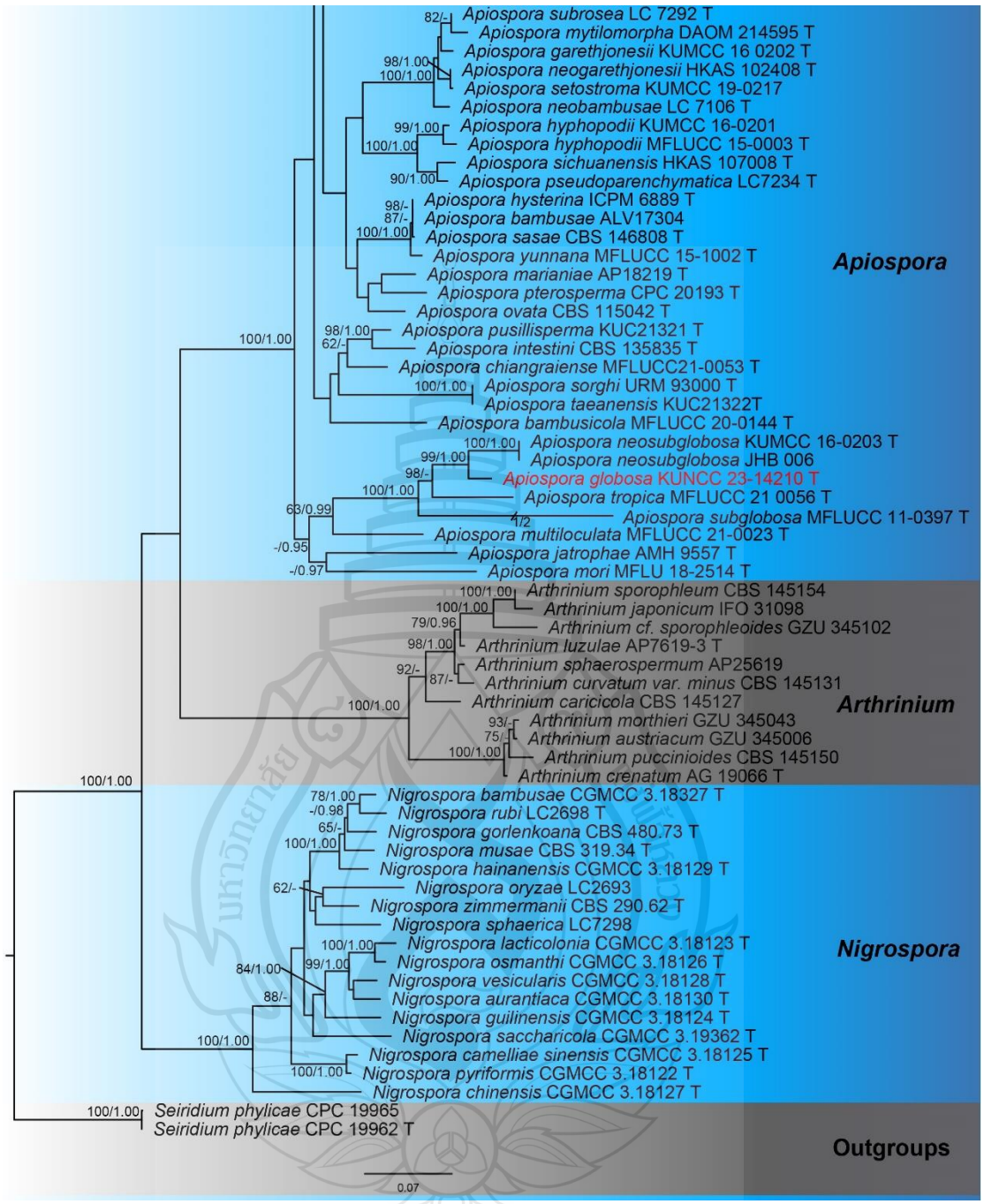
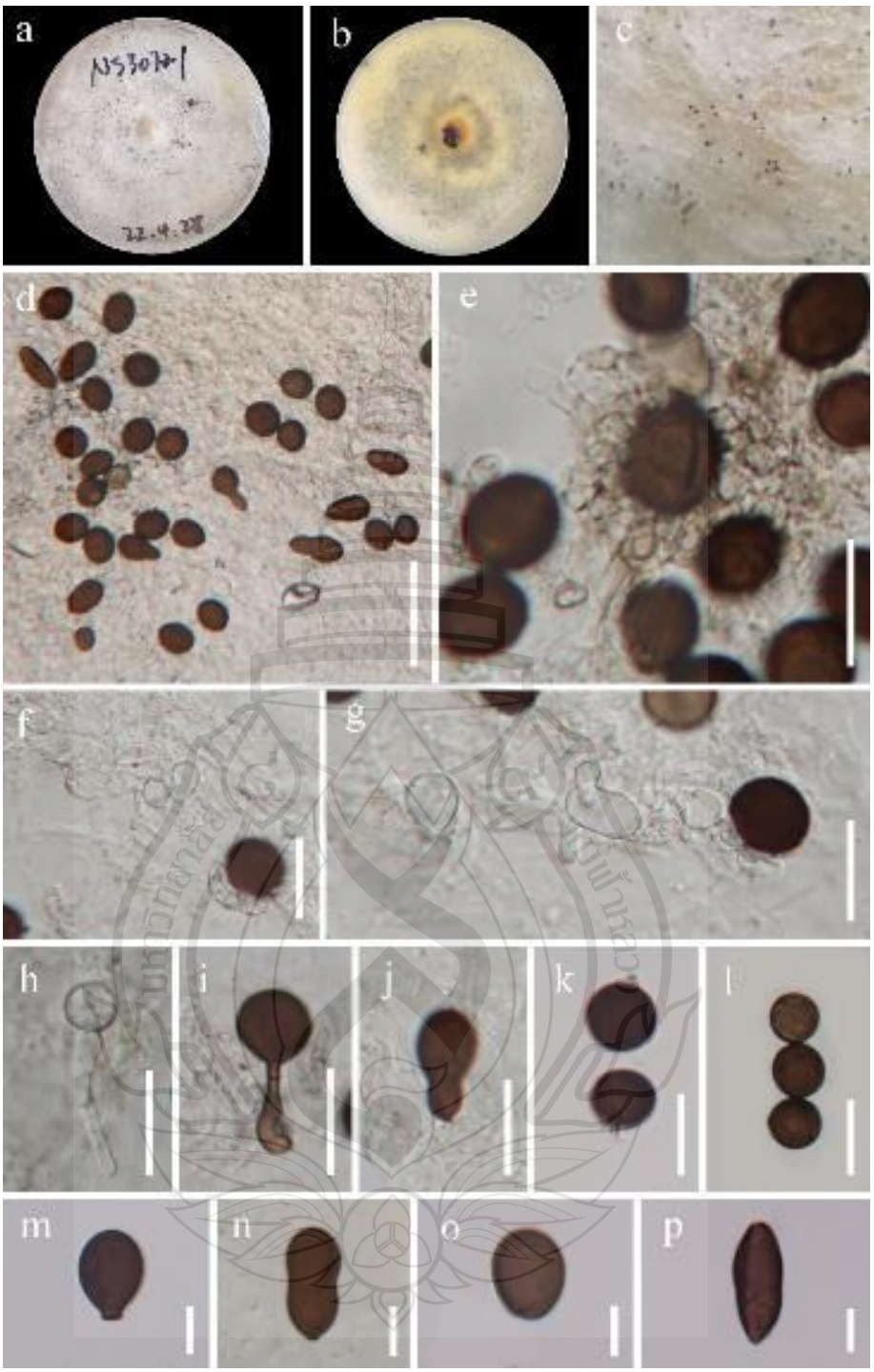


Figure 4.77 Phylogenetic tree of *Apiospora*



Note The phylogenetic tree generated from ML analysis is based on a concatenated LSU–ITS–*tef-α*–*tub2* dataset for the family Apiosporaceae. Bootstrap support values for ML greater than 60% and Bayesian posterior probabilities (PPs) greater than 0.95 were indicated above or below the nodes as ML/PP.

Figure 4.77 (continued)



Note a, b Cultures on PDA from above and below. c colonies on PDA. d–i conidiogenous cells with conidia. j–p conidia Scale bars: d = 50 µm, e–l = 20 µm, m–p = 10 µm

Figure 4.78 *Apiospora dematiacea* (HKAS 129910, Holotype)

Apiospora dicranopteridis J.Y. Zhang and Y.Z. Lu, *sp. nov.*, Figure 4.79

Index Fungorum number: IF901117; *Facesoffungi number*: FoF14875

Etymology: referring to the fungal host genus, *Dicranopteris*.

Holotype: HKAS 129877

Culture characteristics: Colonies on PDA medium circular, edge entire, floccose at the surface with dense, white aerial mycelia, growly fast, reaching 55 mm diam after 10 day at 25°C, cottony, velvety, loose, white from above, yellow to yellowish whites in reverse. Vegetative hypha: septate, branched, sometimes coiled, guttulate, hyaline to pale brown.

Description: *Endophytic* in the stems of *Dicranopteris pedata*. Sexual morph: Undetermined. Asexual morph: *Conidiophores* are cylindrical, septate, branched, smooth-walled, and often reduced to conidiogenous cells. *Conidiogenous cells* 6–15 × 3.5–10 µm ($\overline{x}$ = 10 × 6 µm, n = 25) µm, solitary to aggregated in clusters arising from dense aerial hyphae, mono- to polybasic, sympodial, sub-globose to doliiform to cylindrical, smooth, subhyaline. *Conidia* amerospores, aseptate, globose or sub globose, 10.5–13 µm diam. ($\overline{x}$ = 11.5 µm, n = 15), cylindrical to broadly clavate 14–17(–22) × (6–)8–10.5 µm ($\overline{x}$ = 16 × 9 µm, n = 8), with rounded at the apex and a slightly narrower and truncate base, smooth to finely roughened guttules, without an equatorial germ slit, hyaline to pale brown.

Material examined: China, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Ceheng County (24°59′44″ N 105°50′16″ E), isolated from the healthy stems of *Dicranopteris pedata* nearby the roadside, 16 March 2022, J.Y. Zhang, 139-2 (HKAS 129877, holotype), ex-type living cultures, KUNCC23-14171; Ibid., isolated from the root of *D. pedate*, 16 March 2022, J.Y. Zhang, 170-4 (GZAAS 23-0780, paratype), living cultures, KUNCC 23-14177; Ibid, Anlong County, Jia Jia Ya Kou (24°59′23″ N; 105°35′20″ E), isolated from the healthy leaf of *D. pedate*, 16 March 2022, J.Y. Zhang, 223-4 (HKAS 129895, paratype), living cultures, GZCC 23-0712; Ibid, isolated from the healthy rhizome of *D. ampla*, 16 March 2022, J.Y. Zhang, 225-1 (HKAS 129898, paratype), living cultures, GZCC 23-0708.

GenBank accession numbers: KUNCC23-14171: (LSU) OR590336, (ITS) OR590342, (TEF1-a) OR634950, (TUB2) OR634944; KUNCC 23-14177: (LSU) OR590337, (ITS) OR590343, (TEF1-a) OR634951, (TUB2) OR634945; GZCC 23-0712: (LSU) OR590338, (ITS) OR590345, (TEF1-a) OR634952, (TUB2) OR634947; GZCC

23-0708: (ITS) OR590344, (TUB2) OR634946.

Notes: *Apiospora dicranopteridis* is morphologically distinct from other *Apiospora* species by its mono- or polyblastic, elongated cylindrical conidiogenous cells and globose to cylindrical to broadly clavate, hyaline to pale brown conidia. Phylogenetically, four strains (GZCC 23-0708, GZCC 23-0712, KUNCC23-14177, and KUNCC23-14171) representing *Apiospora dicranopteridis* sp. nov. formed a distinct clade. They share a sister relationship with *A. koreana* (KUC21332) and *A. qinlingensis* (CFCC 52303), reinforcing the notion that they are separate species.

Apiospora globosa J.Y. Zhang and Y.Z. Lu, *sp. nov.*, Figure 4.80

Index Fungorum number: IF901402; *Facesoffungi number*: FoF14658.

Etymology: referring to the globose to subglobose conidia

Holotype: HKAS 129921

Culture characteristics: *Colonies* on WA medium irregulate, with several dark spots, flat with undulate edge, reaching 33 mm diam after 15 d at 25°C, hyaline to light brown. *Vegetative hyphae are* thin, sparse, septate, branched, guttulate, and hyaline, some curled in a ring structure.

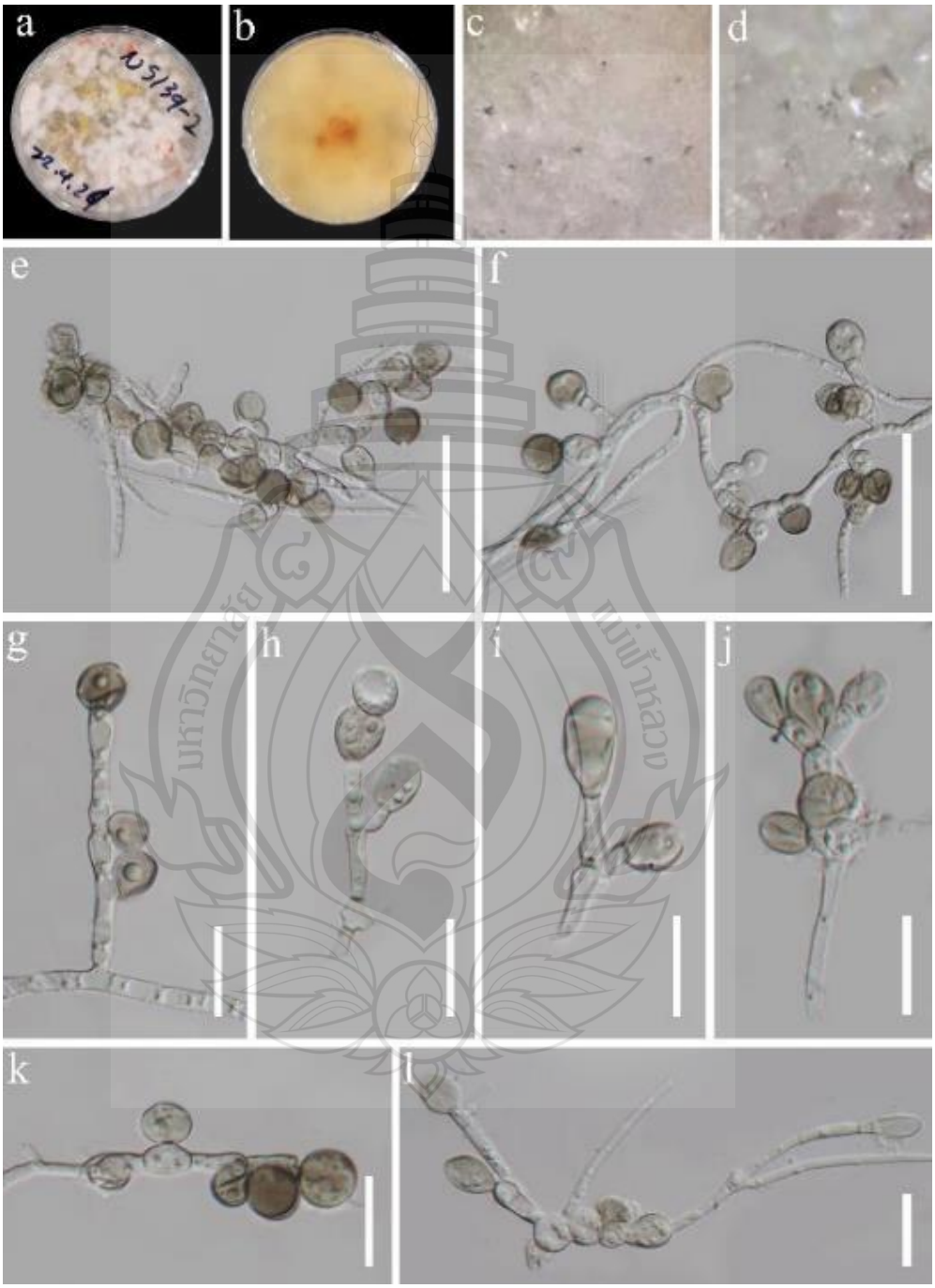
Description: *Endophytic* in the stems of *Dicranopteris linearis*. Sexual morph: Undetermined. Asexual morph: *Conidiophores* undistinguishable, hyphae-like. *Conidiogenous cells* are undistinguishable and hyphae-like. *Conidia* produced directly from vegetative hypha inside the WA culture, 4.5–8.5 µm diam ($\bar{x}$ = 6 µm, n = 20), aseptate, globose to subglobose, smooth to finely roughened, light yellow to gold to black.

Material examined: China, Guizhou Province, Anshun City, Ziyun Miao Buyi Autonomous County, Getu River Scenic Spot (25°48′26″ N 106°4′24″ E), isolated from the healthy stem of *Dicranopteris linearis* in a disturbed forest, 2 August 2022, J.Y. Zhang, S4-1 (dry WA culture, HKAS 129921, holotype; dry culture of WA-carrot mixture, GZAAS 23-0790), ex-type living cultures, KUNCC 23-14210.

GenBank accession numbers: (LSU) OR590340, (ITS) OR590347, and (TEF1-α) OR634954.

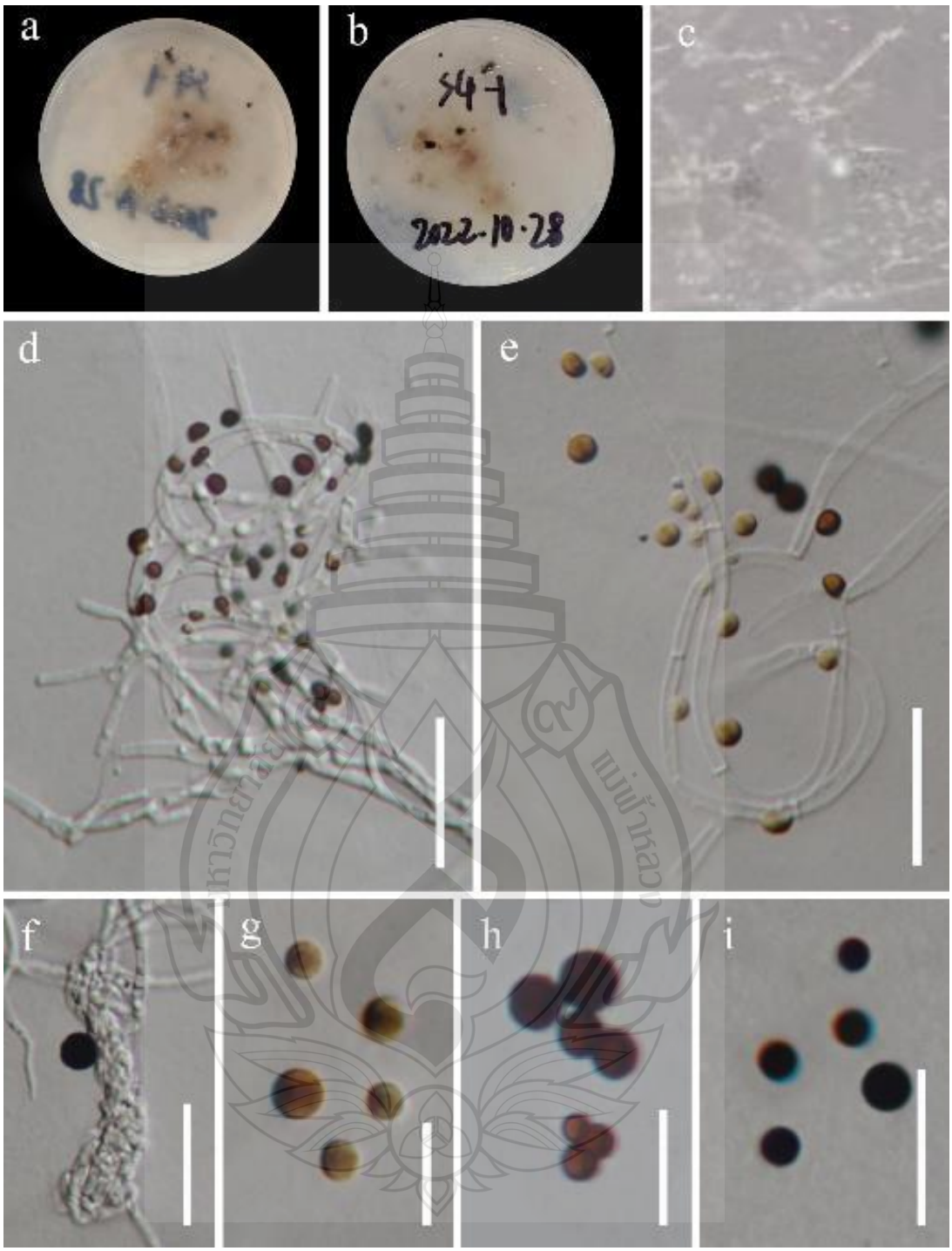
Notes: Phylogenetically, *Apiospora globosa* forms a distinct clade that is sister to the species *Apiospora neosubglobosa* (KUMCC 16-0203 and JHB 006). While *Apiospora neosubglobosa* has been described with only a sexual morph (Dai et al., 2016; Zeng et al., 2022), our new species produces an asexual morph in culture. Morphologically, *Apiospora*

globosa resembles *A*. *xenocordella* in conidial shape but has notably different conidiogenous cells and conidial size (4.5–8.5 µm diam. vs. 9–10 µm diam.) a*piospora globosa* possesses indistinct, hyphae-like conidiogenous cells, whereas *A*. *xenocordella* features globose to clavate to doliiform conidiogenous cells (Crous & Groenewald, 2013).



Note a, b Cultures on PDA from above and below. c, d colonies on PDA. d–l conidiophores, conidiogenous cells with conidia. Scale bars: e, f = 50 µm; g–l = 20 µm

Figure 4.79 *Apiospora dicranopteridis* (HKAS 129877, holotype)



Note a, b Cultures on WA from above and below. c colonies on WA. d–f conidiophores with conidia. g–i conidia. Scale bars: d–f = 20 µm, g–I = 10 µm

Figure 4.80 *Apiospora globosa* (HKAS 129921, holotype)

Nigrospora Zimm.

Nigrospora is an ecologically highly diverse genus with species found as pathogens, endophytes, and saprobes from a diverse host range around the world (Mason, 1927; Wu et al., 2009; Thalavaipandian et al., 2011; Uzor et al., 2015; Wang et al., 2017; Rashmi et al., 2019). The taxonomy of *Nigrospora* is controversial and has been successively placed in *Dematiaceae* (*Moniliales*) and *Trichosphaeriaceae* (*Trichosphaeriales*) by Barnett and Hunter (1998) and Kirk et al. (2008), respectively based on morphology. Wang et al. (2017) reassessed the genus based on a multi-locus (ITS, *tef*1-α, and *tub*2) phylogeny which was significantly stabilized the taxonomy of the genus overlapping morphological characteristics of *Nigrospora* species and they confirmed the genus belongs to *Apiosporaceae* (*Xylariales*, *Sordariomycetes*), as well as 27 species have been accepted in the genus. Afterwards, several new species have been introduced (Raza et al., 2019; Tennakoon et al., 2021; Tan et al., 2022; Brito et al., 2023; Zhang et al., 2024d). Currently, 49 *Nigrospora* species have been recorded in the Index Fungorum 2024. *Nigrospora* is characterized by spherical to subspherical conidiogenous cells and black and globose to subglobose conidia (Wang et al., 2017). In this study, we reported seven endophytic *Nigrospora* species from *Dicranopteris*, which is the first report of *Nigrospora* isolated from *Dicranopteris*

Nigrospora aurantiaca Mei Wang & L. Cai (2017)

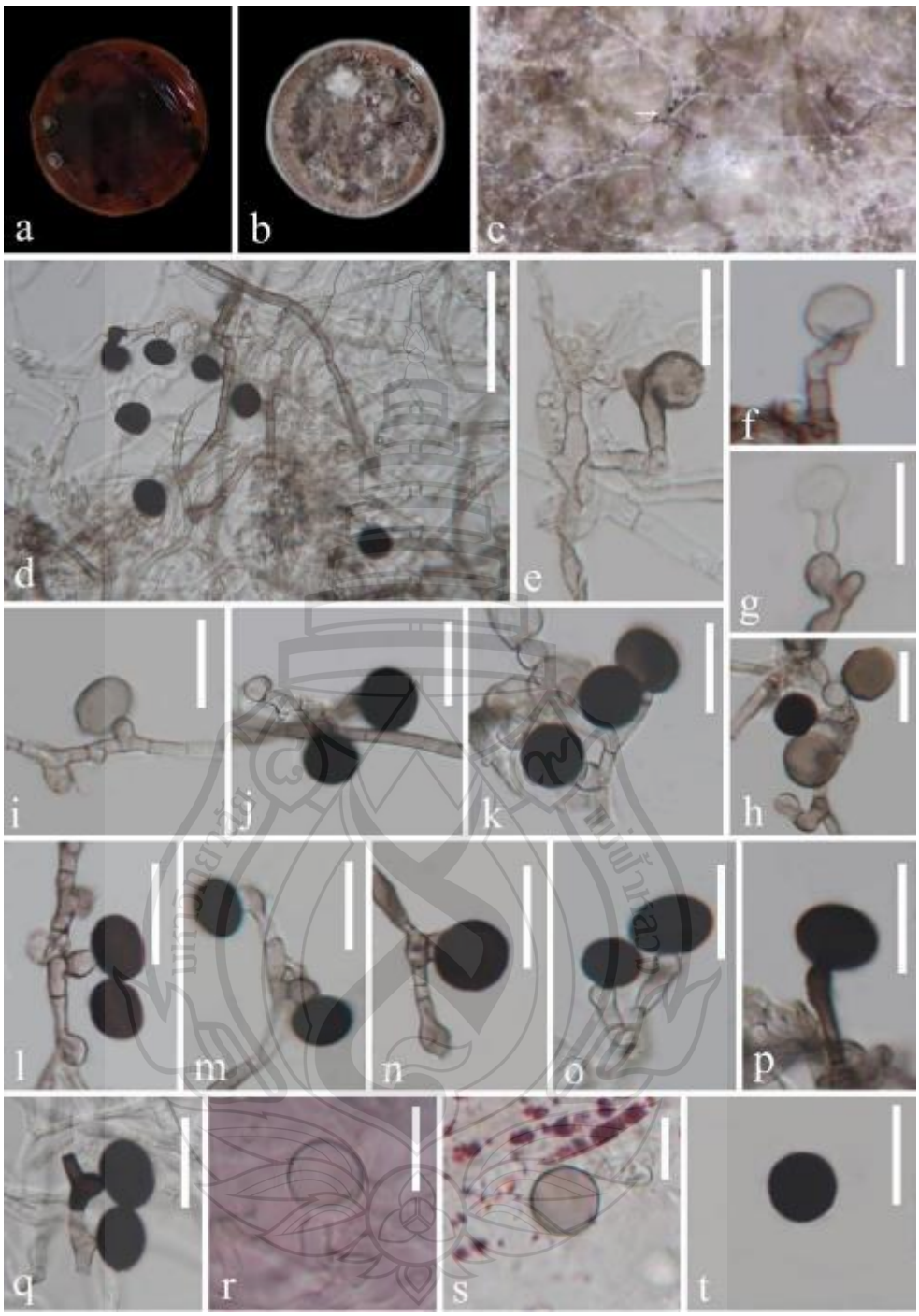
Fungal Names number: FN 820730; Figure 4.81

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* superficial, hyaline to brown, septate, branched, aerial mycelium. *Conidiophores* reduced to conidiogenous cells, hyaline to slightly brownish, branched, smooth. *Conidiogenous cells* 5.7–13.8 × 4.2–14.3 µm ($\bar{x}$ = 5.2 × 12.5 µm, n = 20), monoblastic, discrete, doliiform, smooth, hyaline to pale brown, cylindrical to subcylindrical, aggregated in clusters on hyphae. *Conidia* 9.8–16.4 × 10.8–16.3 µm ($\bar{x}$ = 12.6 × 13.7 µm, n = 30), solitary, globose to ellipsoidal, aseptate, light brown to black, smooth-walled.

Culture characteristics: Colonies on PDA medium, low, plat, with aerial mycelium, cottony, brown with white; reverse black, pigment spots.

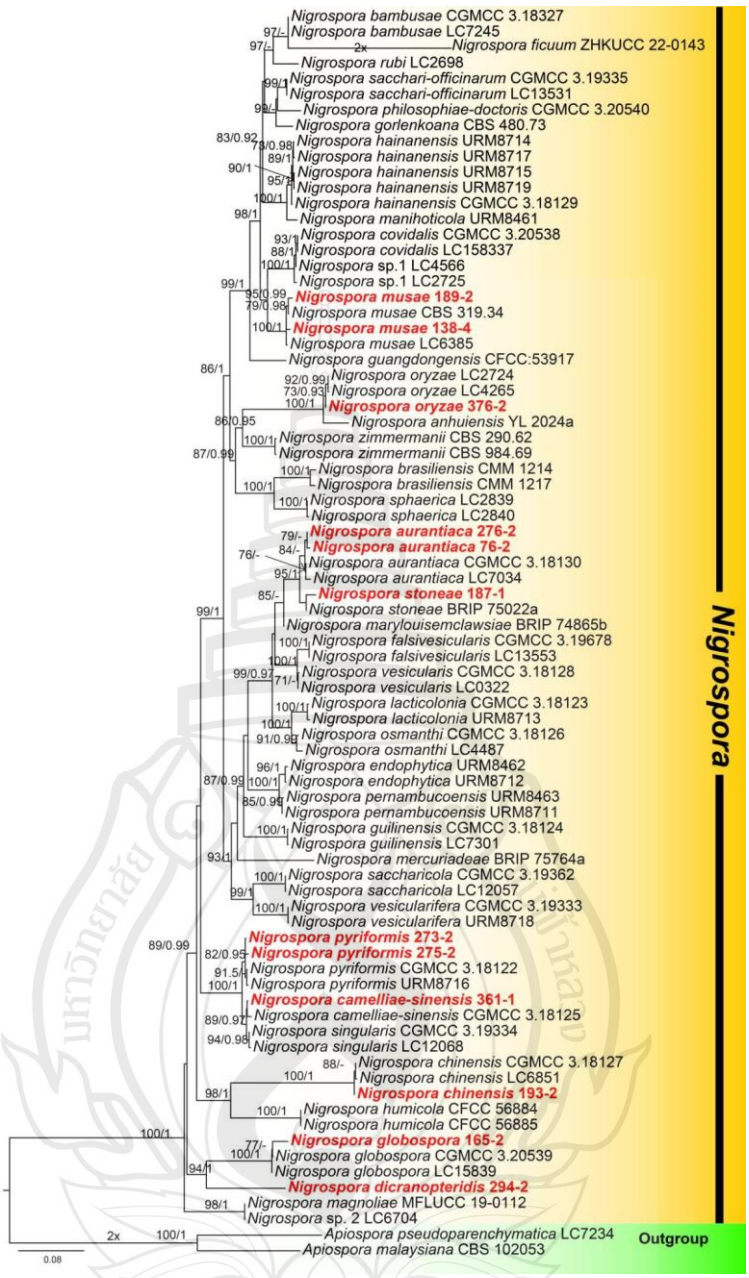
Material examined: CHINA, Guizhou Province, Tongren City, from the leaves of *D. pedata*, 21 February 2022, J.Y. Zhang, NS76–2 (KUN-HKAS 129919). CHINA, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the root of *D. linearis*, 16 March 2022, J.Y. Zhang, 276–2 (KUN-HKAS 129907), living culture KUNCC 24–17930.

Notes: *Nigrospora aurantiaca* was introduced by Wang et al. (2017) based on phylogenetic and morphological characteristics (Wang et al., 2017). Our new isolates (KUN-HKAS 129919 and KUNCC 24–17930) are similar to the Holotype: of *N. aurantiaca* in having monoblastic, discrete, doliiform, hyaline to pale brown, cylindrical conidiogenous cells and globose to ellipsoidal, aseptate, light brown to black, smooth-walled conidia. In our phylogenetic analysis, the new isolates (KUN-HKAS 129919 and KUNCC 24–17930) clustered with *N. aurantiaca* (Figure 4.82). Both phylogeny and morphology of our isolates are not significantly different from *N. aurantiaca*. We, therefore, identified our new isolates as *N. aurantiaca*. *Nigrospora aurantiaca* is reported here from *Dicranopteris pedata* for the first time.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–r Conidiogenous cells and conidia. s, t Conidia. Scale bar: d = 50µm, e–q = 20µm, r, s = 10µm, t = 20 µm

Figure 4.81 *Nigrospora aurantiaca* (KUN-HKAS 129919)



Note Phylogram generated from maximum likelihood analysis based on combined ITS, *tef*1-α, and *tub*2 sequence data. 80 taxa were included in the combined analyses, which comprised 1438 characters after alignment. The best scoring RAxML tree with a final likelihood value of -13747.020 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Apiospora malaysiana* (CBS 102053) and *A. pseudoparenchymatica* (LC7234). The newly obtained strains are in red and bold.

Figure 4.82 Phylogenetic tree of *Nigrospora*

Nigrospora camelliae-sinensis Mei Wang & L. Cai, Persoonia 39: 127 (2017)

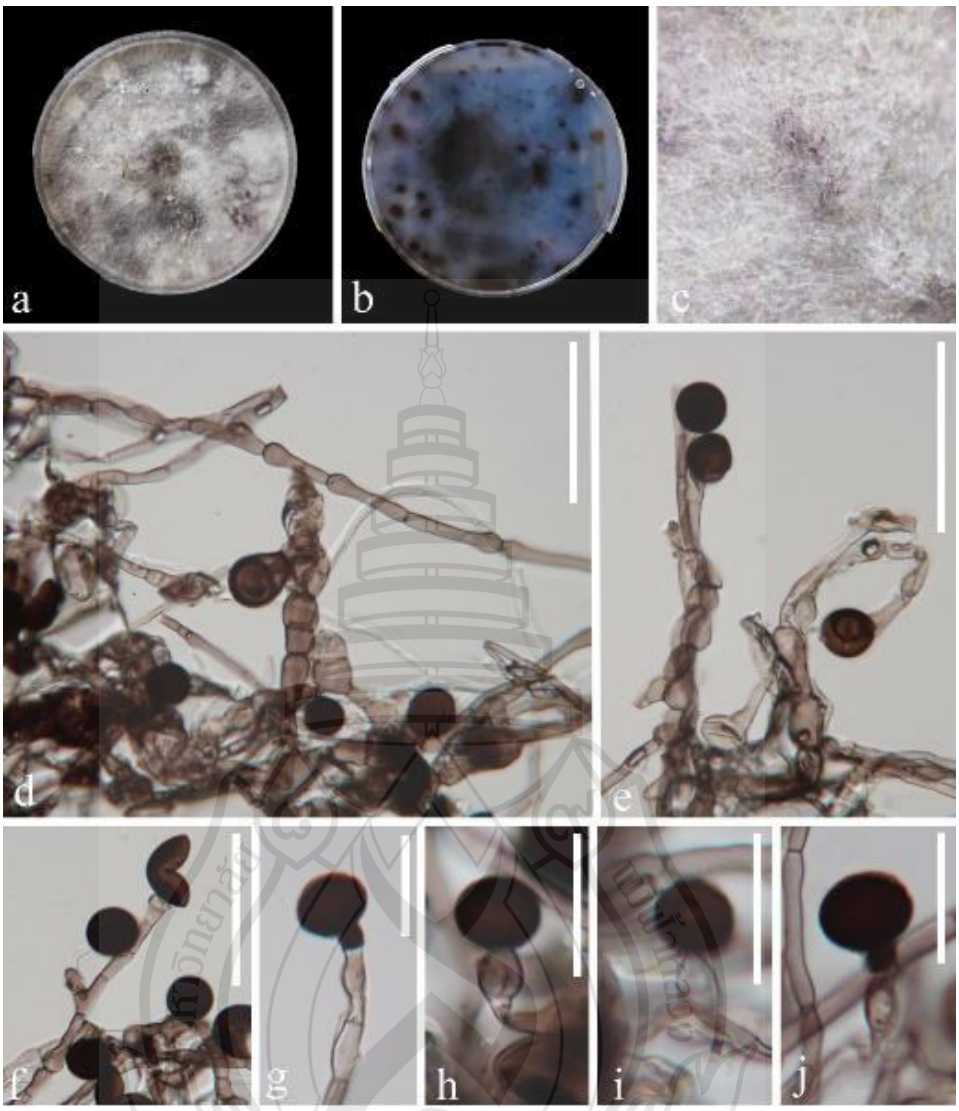
Fungal Names number: FN 820731; Figure 4.82

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* superficial, hyaline to brown, septate, branched, aerial mycelium, smooth. *Conidiogenous* reduced to conidiogenous cells. *Conidiogenous cells* 7.5–14.5 × 4.5–8.5 µm, smooth, brown, cylindrical to subcylindrical. *Conidia* 10.5–17.0 × 9.5–17.5µm ($\bar{x}$ = 13.5 × 13.5 µm, n = 18), aseptate, globose to ellipsoidal, brown to black, smooth-walled.

Culture characteristics: Colonies on PDA medium, grey, plat, thin with aerial mycelium, cottony; reverse black, pigment spots.

Material examined: CHINA, Guizhou Province, Yaoshan Yao Township, Libo County, Qiannan Buyi and Miao Autonomous Prefecture, from the healthy leaves of *Dicranopteris pedata*, 8 April 2022, J.Y. Zhang, NS361–1 (KUN-HKAS 129915).

Notes: *Nigrospora camelliae-sinensis* was introduced by Wang et al. (2017), isolated from *Camellia sinensis* in China. Later, *N. camelliae-sinensis* was reported on *Mangrove* plant (*Lumnitzera littorea*). Our isolate and the Holotype: of *N. camelliae-sinensis* are morphologically indistinguishable. The multi-locus phylogenetic analysis of ITS, LSU, *tef*1-α, and *tub*2 showed that the new isolate clustered with *N. camelliae-sinensis* with strong statistical support (Figure 4.82). We therefore reported this newly obtained strain as a new host record of *N. camelliae-sinensis* isolated from *Dicranopteris pedata* in China.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–j Conidiogenous cells and conidia. Scale bar: d–f = 50 μm; g–j = 20 μm

Figure 4.83 *Nigrospora camelliae-sinensis* (KUN-HKAS 129915)

Nigrospora chinensis Mei Wang & L. Cai (2017)

Fungal Names number: FN 820732; Figure 4.84

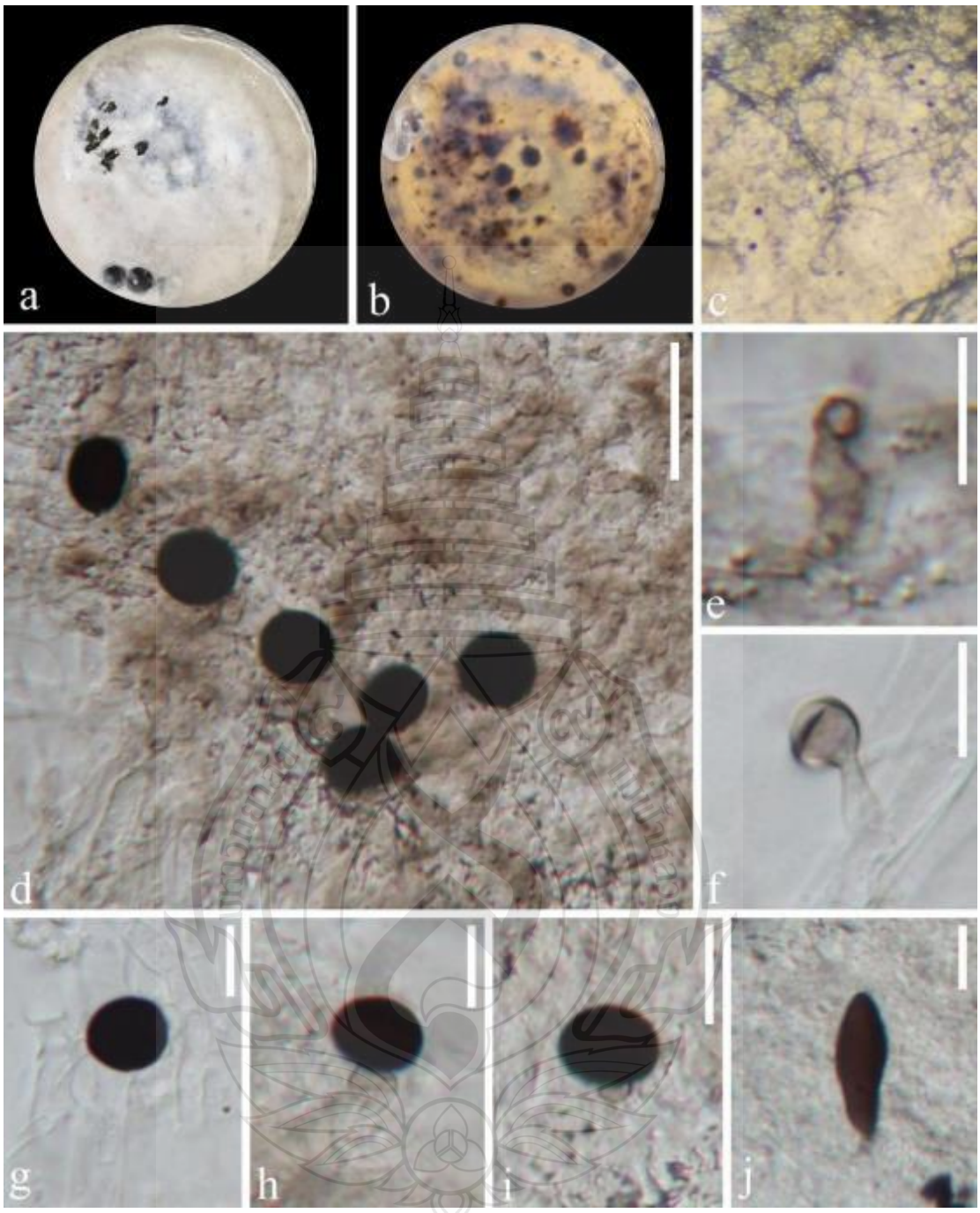
Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* dense, hyaline to light brown, branched. *Conidiophores* reduced to conidiogenous cells, hyaline to pale brown, smooth, branched. *Conidiogenous cells* 1.7 × 3.0–5.5 μm ($\bar{x}$ = 1.3 × 4.4, n = 20), monoblastic, discrete, solitary, ampulliform, smooth, hyaline to pale brown, ellipsoidal, subcylindrical. *Conidia* 8.9–12.4 × 10.5–13.4 μm ($\bar{x}$ = 10.6 × 11.7 μm, n = 30), aseptate, globose to

ellipsoidal, pale brown to black, shiny, smooth-walled.

Culture characteristics: Colonies on PDA medium, cottony, plat, spreading, with aerial mycelium, surface white; reverse orange with black spots.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi and Miao Autonomous County, from the leaves of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS193–2.

Notes: Phylogenetic analysis showed that the newly obtained strain (193–2) clustered with two strains of *N. chinensis* (CGMCC 3.18127 and LC6851) with 100%ML/1.00 PP statistical support (Figure 4.82). *Nigrospora chinensis* was introduced by Wang et al. (2017), and it is characterized by monoblastic, discrete, determinate, ampulliform, or subspherical conidiogenous cells and solitary, globose or subglobose, black, smooth, aseptate conidia. Our new isolate is morphologically indistinguishable from the type specimen of *N. chinensis* (CGMCC 3.18127) (Wang et al., 2017). The phylogeny and morphology of our new isolates are not significantly different from *N. chinensis*; thus, we identified our new isolates as *N. chinensis*. Since the new isolate was first found on *Dicranopteris pedata*, we identified it as a new record of endophytic fungus in *D. pedata*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–i Conidiogenous cells and conidia. j Conidia. Scale bar: d = 20µm; e–j = 10 µm

Figure 4.84 *Nigrospora chinensis* (193–2)

Nigrospora dicranopteridis J.Y. Zhang, D.F. Bao & K.D. Hyde, *sp. nov*., Figure 4.85

Etymology: The specific epithet dicranopterisis refers to the fern genus *Dicranopteris*.

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* smooth, septate, branched, hyaline to dark brown. *Conidiophores* reduced to conidiogenous cells, hyaline to dark brown, smooth. *Conidiogenous cells* monoblastic, solitary, discrete, sub-spherical or ampulliform, smooth, hyaline to dark brown. *Conidia* 10–13 × 10–11 µm ($\bar{x}$ = 12 × 10.8 µm, n = 20), aseptate, sparse, shiny, globose to subglobose, hyaline when young, becoming dark brown at maturity, smooth-walled. *Chlamydospore* 16–23 × 7–10 µm ($\bar{x}$ = 19.5 × 8.3 µm, n = 20), clavate, obclavate, truncate at the base, pale brown to dark brown, thick and smooth-walled.

Culture characteristics: Colonies on PDA medium circular, flat with entire edge, reaching 50 mm diam after 14 d at 25℃, cottony, velvety, grey to greyish pink or slight pale brown from above, dark brown to pink reverse.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi and Miao Autonomous County, from the leaves of *Dicranopteris ampla*, 17 March 2022, J.Y. Zhang, NS294–2, holotype, ex-type culture KUNCC 23–14199.

Notes: Morphologically, *Nigrospora* species are quite similar, making it difficult to identify species based solely on morphological characteristics. Therefore, species delimitation in this genus relies on multi-gene phylogenetic analysis. Our new isolate, *N. dicranopteridis*, aligns with the genus's morphological traits, having spherical to subspherical conidiogenous cells and black, globose to subglobose conidia. Phylogenetic analysis showed that *N. dicranopteridis* formed a sister clade to *N. globospora*, with 94% ML/1.00 BYPP statistical support (Figure 4.82). However, *N. dicranopteridis* differs from *N. globospora* in the color of its culture (initially grey to greyish pink in *N. dicranopteridis* vs. whitish black in *N. lacticolonia*) and in its globose to subglobose, hyaline to dark brown conidia and chlamydospores. In contrast, *N. globospora* has black, mostly ellipsoidal conidia, and no chlamydospores were observed (Chen et al., 2022). Based on both phylogenetic and morphological evidence, we introduce *N. dicranopteridis* as a new species.

Note a, b Culture on SNA from above and below. c, d Colonies on SNA. e, f mycelium. h–j Conidiogenous cells and Conidia. g, k Chlamydospore. Scale bar: d = 50µm, e–m = 20 µm

Figure 4.85 *Nigrospora dicranopteridis* (294–2, holotype)

Nigrospora globospora M. Raza, Qian Chen & L. Cai, (2022)

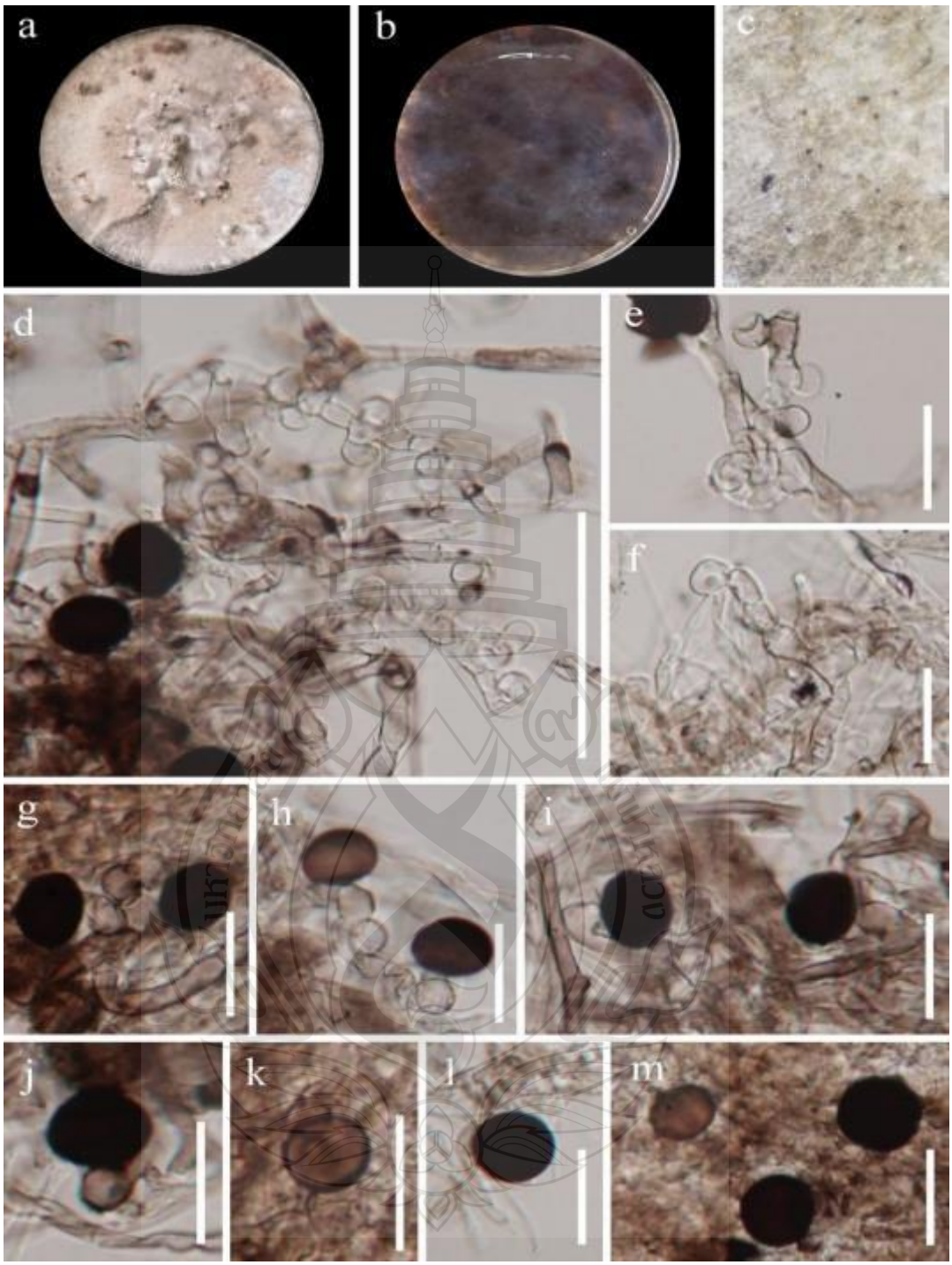
Fungal Names number: FN 840805; Figure 4.86

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* smooth, septate, branched, hyaline to pale brown. *Conidiophores* reduced to conidiogenous cells, hyaline to pale brown, smooth. *Conidiogenous cells* 6.5–9.9 × 3.8–7.3 µm ($\bar{x}$ = 7.8 × 6.0 µm, n = 7), monoblastic, solitary, discrete, sub-spherical or ampulliform, smooth, hyaline to pale brown. *Conidia* 10.7–15.8 × 11.7–16.3 µm ($\bar{x}$ = 12.6 × 14.2 µm, n = 24), aseptate, sparse, shiny, globose to ellipsoidal, pale brown to black, smooth.

Culture characteristics: Colonies on PDA medium circular, flat with entire edge, reaching 50 mm diam after 14 d at 25℃, cottony, velvety, white from above, yellow brown reverse. Vegetative hypha septate, branched, hyaline to brown.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leaves of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS165–2 (KUN-HKAS, 129881), living culture KUNCC 24–17939.

Notes: *Nigrospora globospora* was introduced on *Petasites hybridus* by Chen et al. (2022). Phylogenetic analysis showed that the new isolate clustered with two strains of *N. globospora* (Figure 4.82). The morphological characteristics are similar to the type specimen of *N. globospora* (CGMCC 3.20539), and the difference in DNA molecular data between our new isolate and the ex-type of *N. globospora* (CGMCC 3.20539) are not significant. Therefore, we identified the new isolate as *N. globospora*. This species is a new endophytic fungus report in *Dicranopteris pedata*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–j Conidiogenous cells and Conidia. k–m Conidia. Scale bar d = 50µm; e–m = 20 µm

Figure 4.86 *Nigrospora globospora* (KUN-HKAS, 129881)

Nigrospora musae McLennan & Hoëtte (1933)

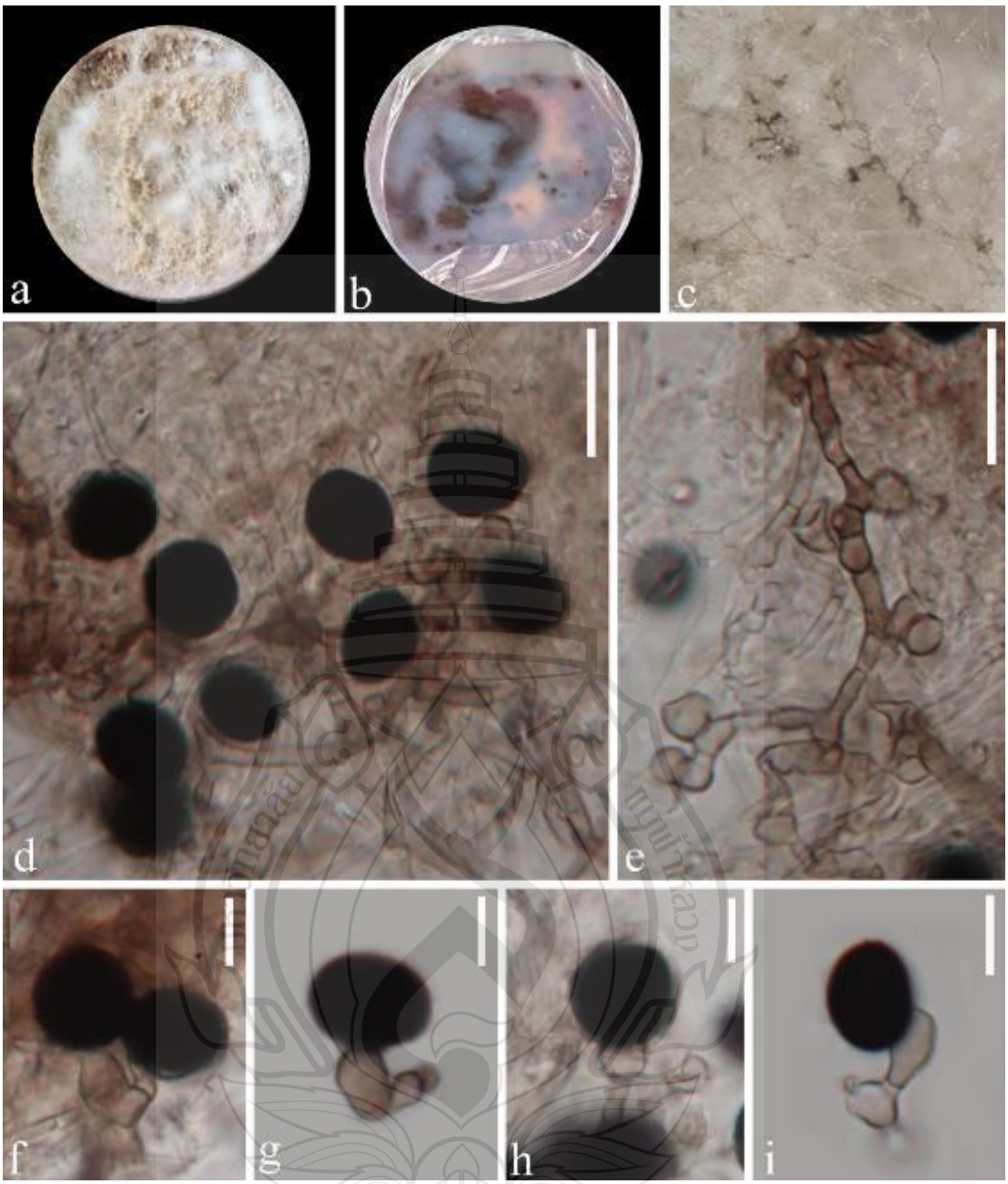
Fungal Names number: FN 271866; Figure 4.87

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* dense, hyaline to light brown, branched. *Conidiophores* aggregated in black sporodochia, micronematous or semi-macronematous, basauxic, hyaline to pale brown, smooth, branched. *Conidiogenous cells* 5.6–11.5 × 5.6–7.2 µm ($\bar{x}$ = 7.4 × 6.5 µm, n = 7), smooth, hyaline to pale brown, aggregated, monoblastic, subglobose to ampulliform. *Conidia* 10.3–16.1 × 13.4–17.2 µm ($\bar{x}$ = 13.3 × 15.6 µm, n = 20), sparse, solitary, globose or subglobose, black, shiny, aseptate, hyaline to black, smooth-walled.

Culture characteristics: Colonies on PDA medium, cottony, rough, spreading, with aerial mycelium, surface ivory-white; reverse brown and white alternate surface.

Material examined: CHINA, Guizhou Province, Ceheng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leaves of *Dicranopteris pedata*, 16 March 2022, J.Y. Zhang, NS138-4 (KUN-HKAS 129876), living culture KUNCC23–14170. CHINA, Zhenfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leaves of *D. pedata*, 17 March 2022, J.Y. Zhang, 189–2 (KUN-HKAS, 129889), living culture KUNCC 23–14185.

Notes: *Nigrospora musae* isolated from banana leaves in Australia, was introduced by Mclennan et al. (1933). *Nigrospora musae* have been reported on various hosts, such as *Camellia sinensis*, *Musa paradisiaca*, and the leaves of *Basella alba*. The morphological features indicated that our isolates (KUNCC23–14170 and KUNCC23–14185) were identical to *N. musae*. Phylogenetically, the newly obtained strains (KUNCC23–14170 and KUNCC23–14185) clustered with two strains of *N. musae* (CBS 319.34 and LC6385) with 100%ML/1.00 PP statistical support (Figure 4.82) as a result, we reported our new isolates as a new host record for *N. musae* from *Dicranopteris pedata* in China.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–i Conidiogenous cells and conidia. Scale bar: d, e = 20µm, f–i = 10 µm

Figure 4.87 *Nigrospora musae* (KUN-HKAS 129876)

Nigrospora oryzae (Berk. & Broome) Petch (1924)

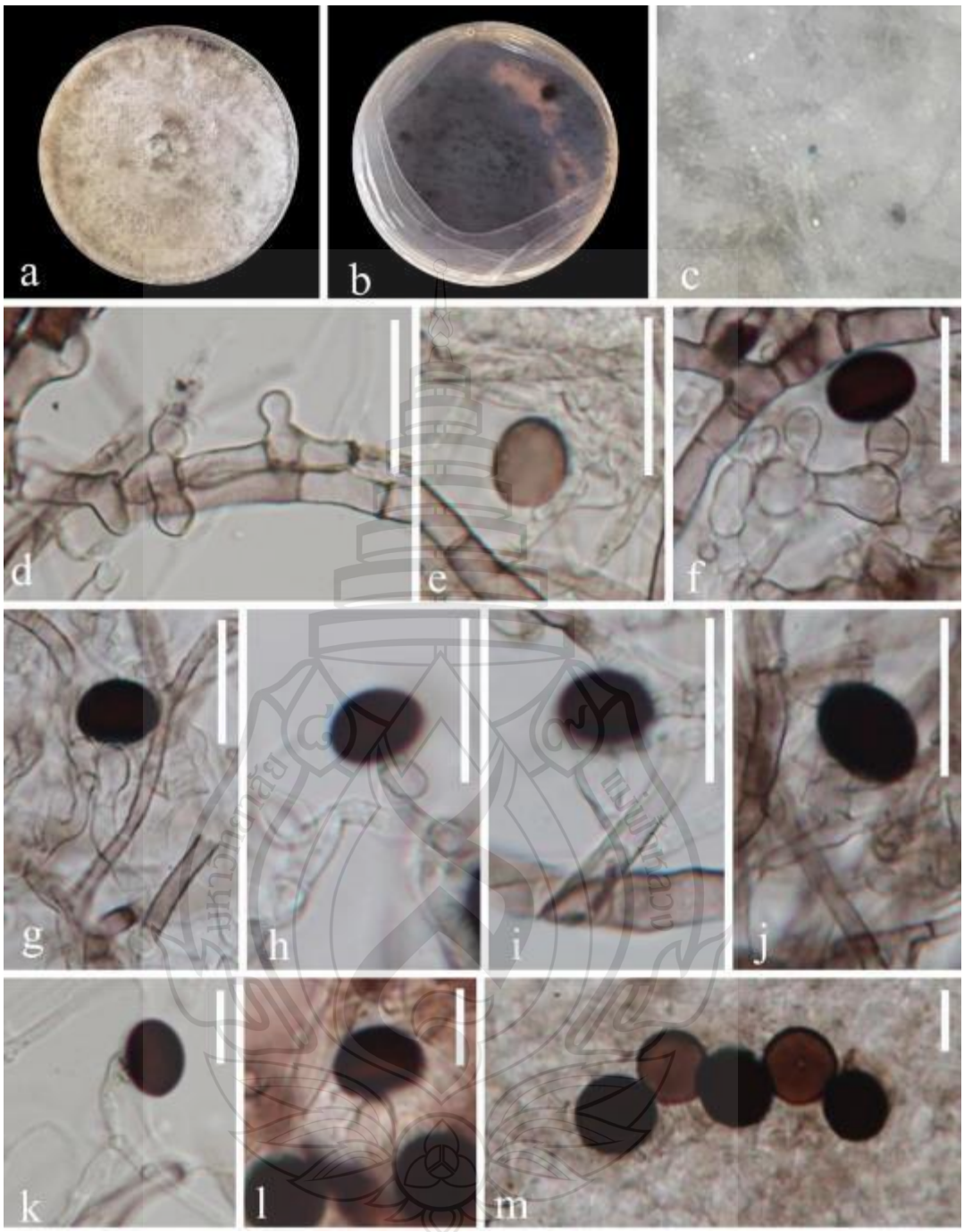
Fungal Names number: FN 253729; Figure 4.88

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* dense, hyaline to brown, branched. *Conidiophores* basauxic, hyaline to pale brown, smooth, branched. *Conidiogenous cells* 5.2–9.9 × 4.1–6 µm ($\bar{x}$ = 7.8 × 5.3 µm, n = 20), smooth, hyaline to pale brown, elliptical to subcylindrical. *Conidia* 9.2–13.7 × 9.6–15.4 µm ($\bar{x}$ = 12 × 13 µm, n = 30), aseptate, globose to ellipsoidal, hyaline to black, smooth.

Culture characteristics: Colonies on PDA medium, flat, with aerial mycelium, grey, cottony; reverse black.

Material examined: CHINA, Guizhou Province, Yaoshan Yao Township, Libo County, Qiannan Buyi and Miao Autonomous Prefecture, from the healthy leaves of *Dicranopteris pedata*, 11 April 2022, J.Y. Zhang, NS376–2 (KUN-HKAS 129917), living culture KUNCC 23–14204.

Notes: The multigene phylogenetic analysis showed that our new isolate (KUNCC23–14204) with *Nigrospora oryzae* with 100%ML/1.00 PP support (Figure 4.82). Morphology of our new isolate is similar to *N. oryzae* in having micronematous or semi-macronematous, septate, flexuous or straight, pale brown, smooth-walled conidiophores, monoblastic, determinate conidiogenous cells, and globose or subglobose, black, smooth, aseptate conidia, and there was no significant difference in DNA molecular data between the two strains. Therefore, the new isolate was identified as *Nigrospora oryzae*. *Nigrospora oryzae* was introduced by Petch (1924). This species has been found on a wide range of hosts with a worldwide distribution (Tian et al., 2024). However, this is the first time, *N. oryzae* is reported from *Dicranopteris pedata*.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–l Conidiogenous cells and conidia. m Conidia. Scale bar: d–j = 20µm; k–m = 10 µm

Figure 4.88 *Nigrospora oryzae* (KUN-HKAS 129917)

Nigrospora pyriformis Mei Wang & L. Cai (2017)

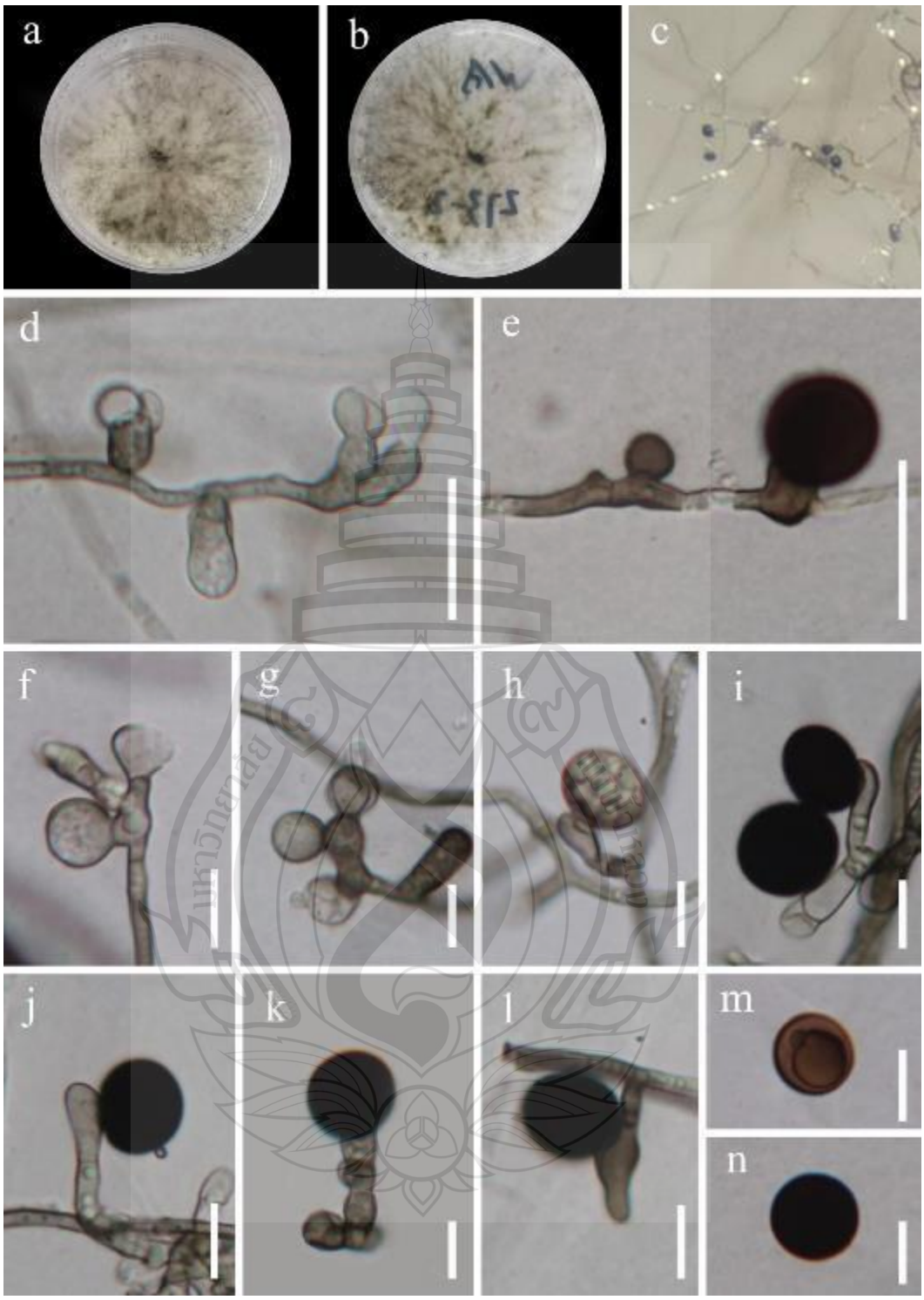
*Fungal Names numbe*r: FN 820737; Figure 4.89

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* sparse, light brown, branched. *Conidiophores* basauxic, brown, smooth, branched, thin-walled, short, septate. *Conidiogenous cells* 4.4–10.6 × 2.7–6.5 µm ($\bar{x}$ = 8.5 × 5.4 µm, n = 15) polyblastic, smooth, brown, subcylindrical. *Conidia* 8.0–15.9 × 8.8–16.6 µm ($\bar{x}$ = 13.1 × 13.6 µm, n = 30), pleuroacrogenous, aseptate, globose to ellipsoidal, hyaline to black, smooth, guttulate.

Culture *characteristics*: Colonies on WA medium, plat, rhizoid, filiform, brown; reverse brown, filiform.

Material examined: CHINA, Guizhou Province, Zhenfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the leaves of *Dicranopteris pedata*, 17 March 2022, J.Y. Zhang, NS273–2 (KUN-HKAS 129903), living culture KUNCC23–14195. *ibid* NS275–2 (KUN-HKAS 129904), living culture KUNCC 23–14196

Notes: Wang et al. (2017) introduced *Nigrospora pyriformis*, isolated from *Citrus reticulata* in China. Phylogenetic analysis of multiple genes showed that our new isolates (KUNCC23–14195 and KUNCC23–14196) and *N. pyriformis* clustered together with 91%ML/1.00 support (Figure 4.82). The morphological characteristics of the new isolates are similar to those of *N. pyriformis* (Wang et al., 2017), and the differences of the molecular data between our new isolates and ex-type strain of *N. pyriformis* (CGMCC3.18122) are not significant. Therefore, we identified the new isolates as *N. pyriformis*. *Nigrospora pyriformis* is a new record for *Dicranopteris pedata*.



Note a, b Culture on WA from above and below. c Colonies on WA. d–l Conidiogenous cells and conidia. m, n Conidia. Scale bar: d, e = 20µm; f–n = 10 µm

Figure 4.89 *Nigrospora pyriformis* (KUN-HKAS 129903)

Nigrospora stoneae Y.P. Tan, Bishop-Hurley & R.G. Shivas, in Tan & Shivas, Index of Australian Fungi 17: 5 (2023)

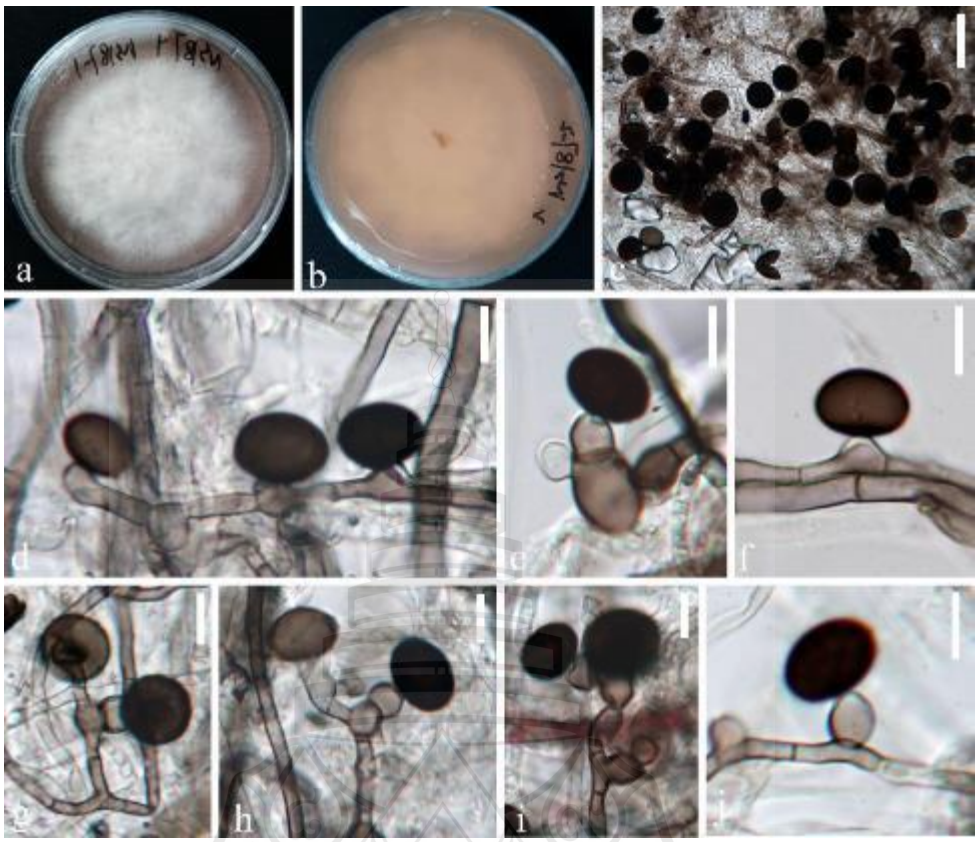
Fungal Names number: FN 901169; Figure 4.90

Endophytic in the leaves of *Dicranopteris pedata*. Sexual morph: unknown. Asexual morph: *Hyphae* sparse, brown to dark brown or greyish brown, branched, smooth-walled. *Conidiophores* basauxic, smooth, branched, thin-walled, short, septate, brown to dark brown. *Conidiogenous cells* 8.5–16 × 5–8 µm ($\bar{x}$ = 12.4 × 6.4 µm, n = 15) polyblastic, brown, smooth, subcylindrical, oval. *Conidia* 10–15 × 11–15 µm ($\bar{x}$ = 12.8 × 132 µm, n = 30), pleuroacrogenous, aseptate, globose to ellipsoidal, Hyaline when young, dark brown to black at maturity, smooth-walled.

Culture characteristics: Colonies on WA medium, circular, margin entire, flat, white mycelia, colony from above: white; reverse: cream. Produces pink or lavender pigment in the medium plate.

Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the stem of *D. pedata*, 16 March 2022, J.Y Zhang 187–1 (KUN-HKAS 129887), living culture KUNCC 24–17932.

Notes: *Nigrospora stoneae* was recently introduced by Tan et al. (2023) based on phylogenetic analysis, showing 99% identity (455/456) and 95% identity (401/420) to its phylogenetically close species, *N. aurantiaca*. Our phylogenetic analysis revealed that the new isolate KUNCC 24–17932 clustered with the ex-type strain of *N. stoneae* (BRIP 75019a) and was sister to *N. aurantiaca* (Figure 4.82). No morphological description was provided for this species in the original study. In this study, we provide a detailed morphological description and illustration of *N. stoneae.* This species was previously collected from leaf spots on *Cyperus aromaticus* in Queensland, we herein reported it as a new host and country record for D. pedata in China.



Note a, b Culture on WA from above and below. c Conidia with mycelium. d–j Conidiogenous cells and conidia. Scale bar: c = 30µm; d–j = 10 µm

Figure 4.90 *Nigrospora stoneae* (KUN-HKAS 129887)

Castanediellaceae Hern.-Restr., Guarro & Crous

Castanediellaceae was established by Hernández-Restrepo et al. (2017) to accommodate *Castanediella* within *Xylariales*. Currently, the family contians a single genus with 19 species (Hernández-Restrepo et al., 2017; Costa et al., 2018; Wanasinghe et al., 2018; Lin et al., 2019; Crous et al., 2021c).

Castanediella Hern.-Restr., Crous & M.J. Wingf.

Castanediella was introduced by Crous et al. (2015b) with three species *C. acaciae* (type), *C. cagnizari*i and *C. ramosa*. Subsequently, several new species were added to the genus, up to now 19 species are accepted in this genus (Crous et al., 2016, 2021c; Costa et al., 2018; Wanasinghe et al., 2018; Hernández-Restrepo et al., 2016; Lin et al., 2019). *Castanediella* is characterized by branched, hyaline to pale brown conidiophores, holoblastic, sympodial conidiogenous cells and falcate, cylindrical or fusiform, 0–3-sepate,

hyaline conidia (Crous et al., 2015).

Castanediella dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov.*, Figure 4.91

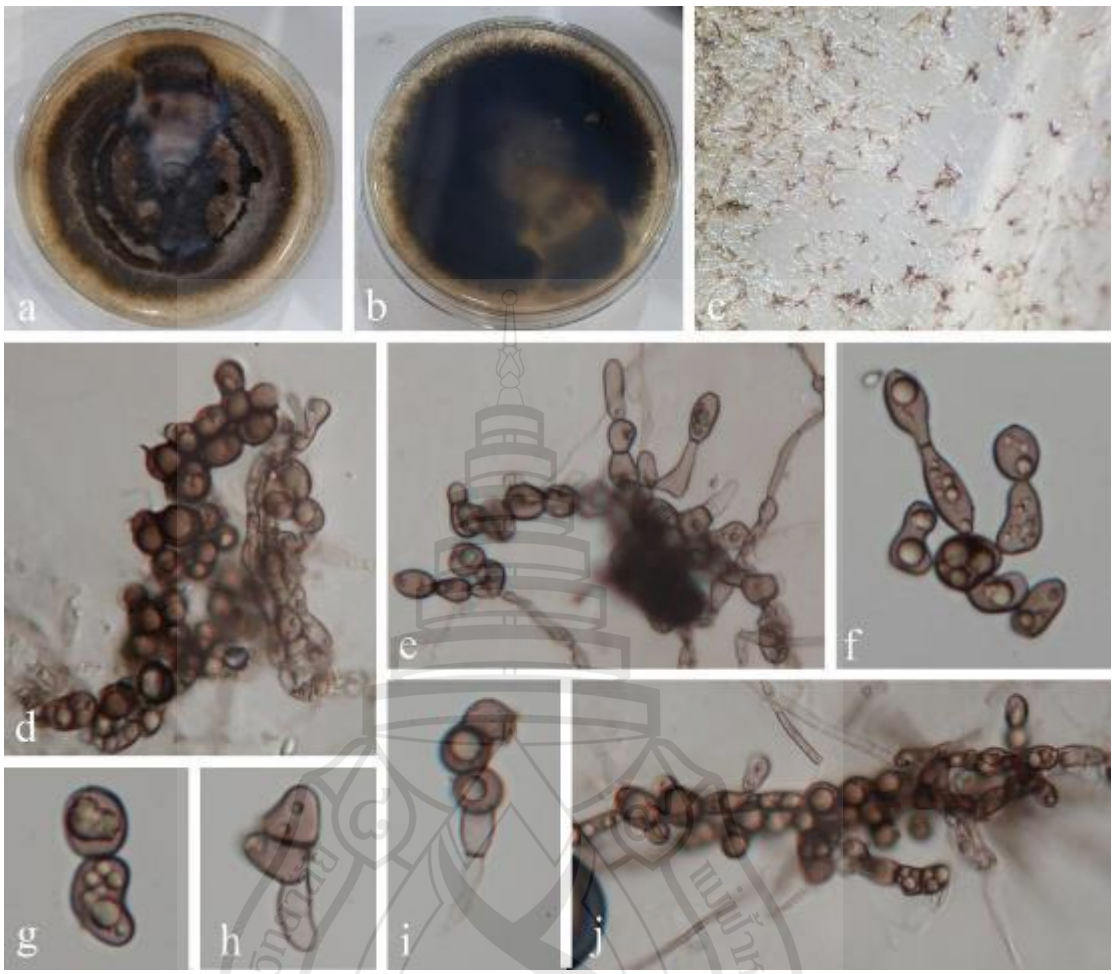
Etymology: The specific epithet dicranopterisis refers to the fern genus *Dicranopteri*.

Endophytic in the rhizome of *Dicranopteris ampla*. *Mycelium* superficial and immersed composed of septate, branched, hyaline to pale brown, with smooth and thick-walled hyphae. Chlamydospores 9–12 × 7–8.5 µm ($\bar{x}$ = 10.3 × 7.2 µm, n = 30), n = 30), in chains, globose, subglobose, clavate, irregular, brown to dark brown, septate, guttulate.

Culture characteristics: Colonies on PDA, 55–60 mm diam. After one month, colonies from above, medium dense, flat, circular, entire edge, margin well-defined, cottony to fairly fluffy with sparse aspects, light brown to dark brown; reverse dark brown.

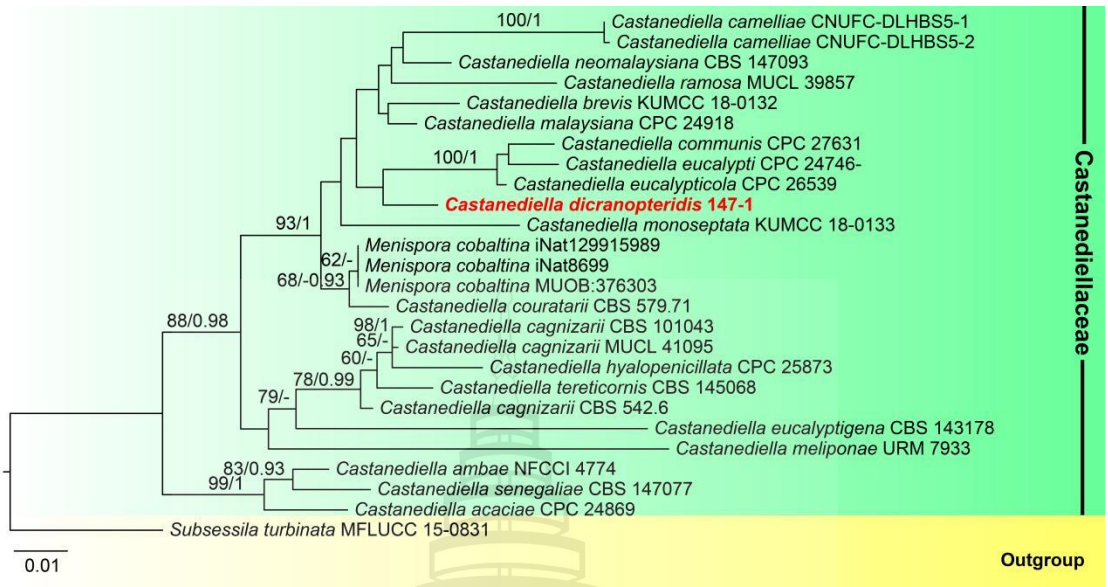
Material examined: CHINA, Guizhou Province, Zhengfeng County, Southwest Guizhou Buyi, and Miao Autonomous County, from the rhizome of *Dicranopteris ampla*, 17 March 2022, Y. Yang, 147–1.

Notes: Based on a sequence similarity search against in the NCBI's GenBank nucleotide database using the ITS sequence of our new strain *Castanediella dicranopteridi*s (147-1), the closest hits include *Menispora cobaltina* (98.47% similarity) and *Castanediella brevis* (98.08% similarity). The closest match with the LSU sequences with 98.51% similarity was *Castanediella neomalaysiana* (CPC:39275). Phylogenetic analysis showed that *C. dicranopteridi*s clustered with *C. communis*, *C. eucalypti* and *C. eucalypticola,* but in a distinct basal clade (Figure 4.92). Morphologically, unlike other *Castanediella species*, *C. dicranopteridis* does not produce conidiophores, or conidia and only Chlamydospores was observed. Thus, based on both phylogeny and morphology, *Castanediella dicranopteridi*s is introduced as a new species.



Note a, b Cultures on PDA from above and below. C Colonies on the PDA. d–j Hyphae with chlamydospores.

Figure 4.91 *Castanediella dicranopteridis* (Y147-1, holotype)



Note Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data. A total of 26 taxa were included in the combined analyses, which comprised 1405 characters after alignment. The best scoring RAxML tree with a final likelihood value of -4535.505314 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Subsessila turbinata* (MFLUCC 15-0831). The newly generated sequences are shown in red.

Figure 4.92 Phylogenetic tree of Castanediellaceae

Graphostromataceae M.E. Barr, J.D. Rogers & Y.M. Ju

Graphostromataceae was validly introduced by Barr et al. (1993) to accommodate *Graphostroma platystomum* based on the morphology of stromal characters andthe asexual morph (Barr et al., 1993). However, some studies show that *Graphostromataceae* is close to *Xylariaceae* in phylogeny (Stadler et al., 2013, Maharachchikumbura et al., 2015). Based on molecular and morphological studies, Maharachchikumbura et al. (2016) consider *Graphostromataceae* is synonymous with *Xylariaceae*. However, with further molecular support, *Graphostromataceae* was treated as a distinct family (Daranagama et al., 2018). Currently, *Graphostromataceae* contains five genera, namely *Biscogniauxia*, *Camillea*, *Graphostroma*, *Obolarina* and *Vivantia* (Hyde et al., 2020).

Biscogniauxia Kuntz

Biscogniauxia Kuntze. (1891) was established under *Xylariaceae* for the sexual morph of *Nummularia* Tul. & C. Tul. (Pouzar, 1979). Later, Ju et al. (1998) revised *Biscogniauxia*, adding six new species and 11 combinations. In addition, Tang et al. (2009) re-evaluated the genetic relationships within *Xylariaceae*, revealing that the phylogenetic positions between *Biscogniauxia* and other xylariaceous genera are rather ambiguous. Wendt et al. (2018) relocated *Biscogniauxia*, which clustered with *Graphostroma platystomum*, from *Xylariaceae* to *Graphostromataceae*, along with three other genera (*Camillea*, *Vivantia*, and *Obolarina*). In this study, a updated tree of *Biscogniauxia* is provided (Figure 4.93)

Biscogniauxia dicranopteridis M.L. Chen, J.Y. Zhang & Y.Z. Lu, *sp. nov.* Figure 4.94

Index Fungorum number: IF900479; *Facesoffungi number*: FoF 14894

Etymology: the specific epithet '*dicranopteridis'* refers to *Dicranopteris*, the plant genus from which the type of strain was isolated.

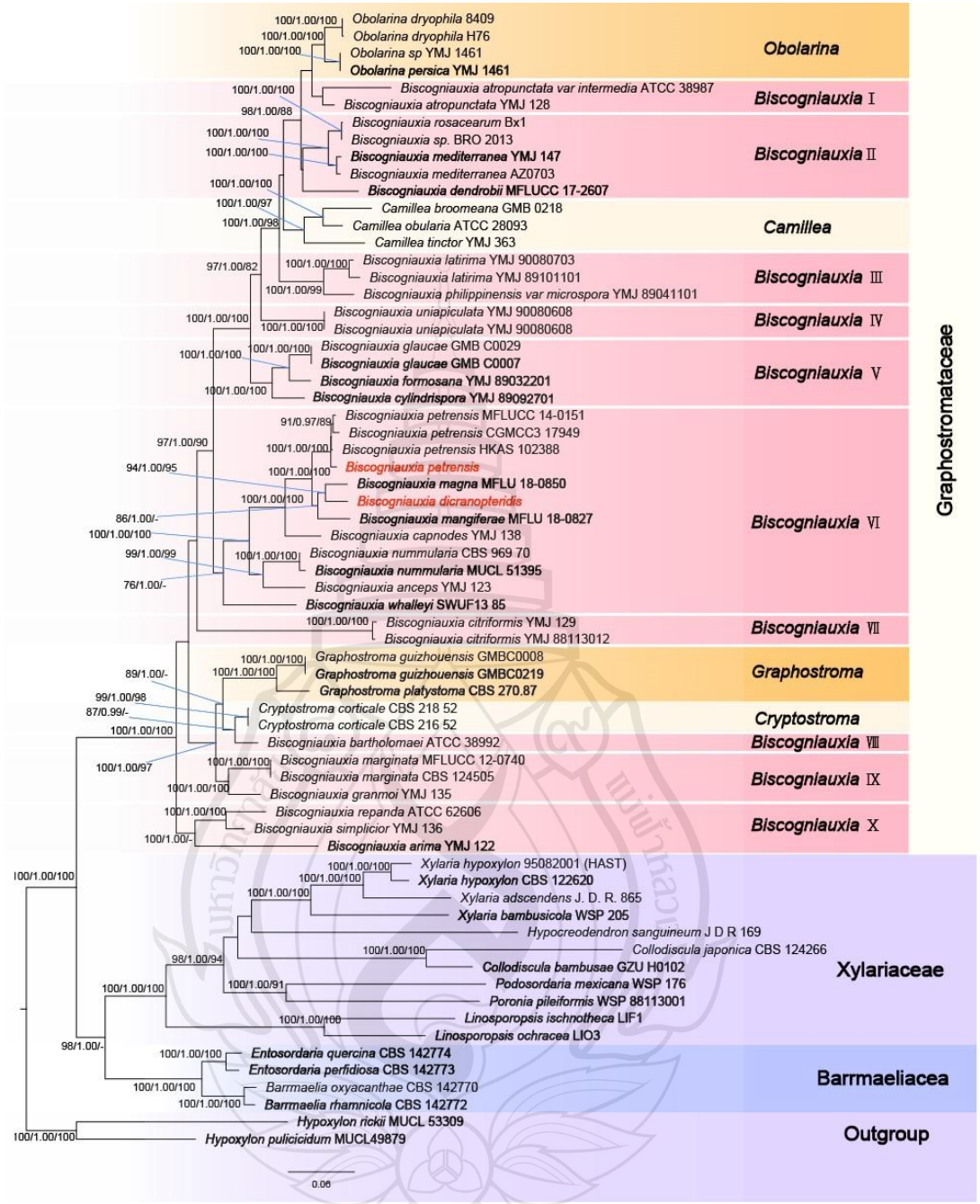
Holotype: HKAS 124928

Endophytic in the leaves of *Dicranopteris dichotoma*. **Sexual morph**: Undetermined. **Asexual morph**: nodulisporium-like. *Hyphae* hyaline to brown, septate, branched, thin wall, smooth, mycelia abundant. *Conidiophores* 3.5–5.5 µm ($\bar{x}$ = 4.5 µm, n = 17) wide, macronematous, mononematous, immersed or semi-immersed, light brown to dark brown, septate, branched at the apex, thin-walled, rough-walled, straight or slightly flexuous, with conidiogenous cells arising terminally or laterally. *Conidiogenous cells* 6–13 × 3–4.5 µm ($\bar{x}$ = 9 × 3.5 µm, n = 28), holoblastic, hyaline to brown, terminal on branches, swollen at the apex, thin–walled, verrucous, oblong to ellipsoid. *Conidia* 5–9 × 2–3.5 µm ($\bar{x}$ = 6.5 × 2.5 µm, n = 40), aggregated, pleuroacrogenous, hyaline, aseptate, thin-walled, smooth, small guttulate, base bluntly rounded, apex obtuse, obovoid.

Culture characteristics: Colonies grow rapidly on PDA at 25°C, reaching 50 mm in diameter within 7 days, circular, flat, covered with abundant, lilac grey, lanose aerial mycelia, margin entire; dark brown to orange from center to edge in reverse. Colonies on water agar (WA) medium at 25°C exhibit thin mycelia with sporulation, slow growth, and branched mycelia at the margin, white from both above and reverse.

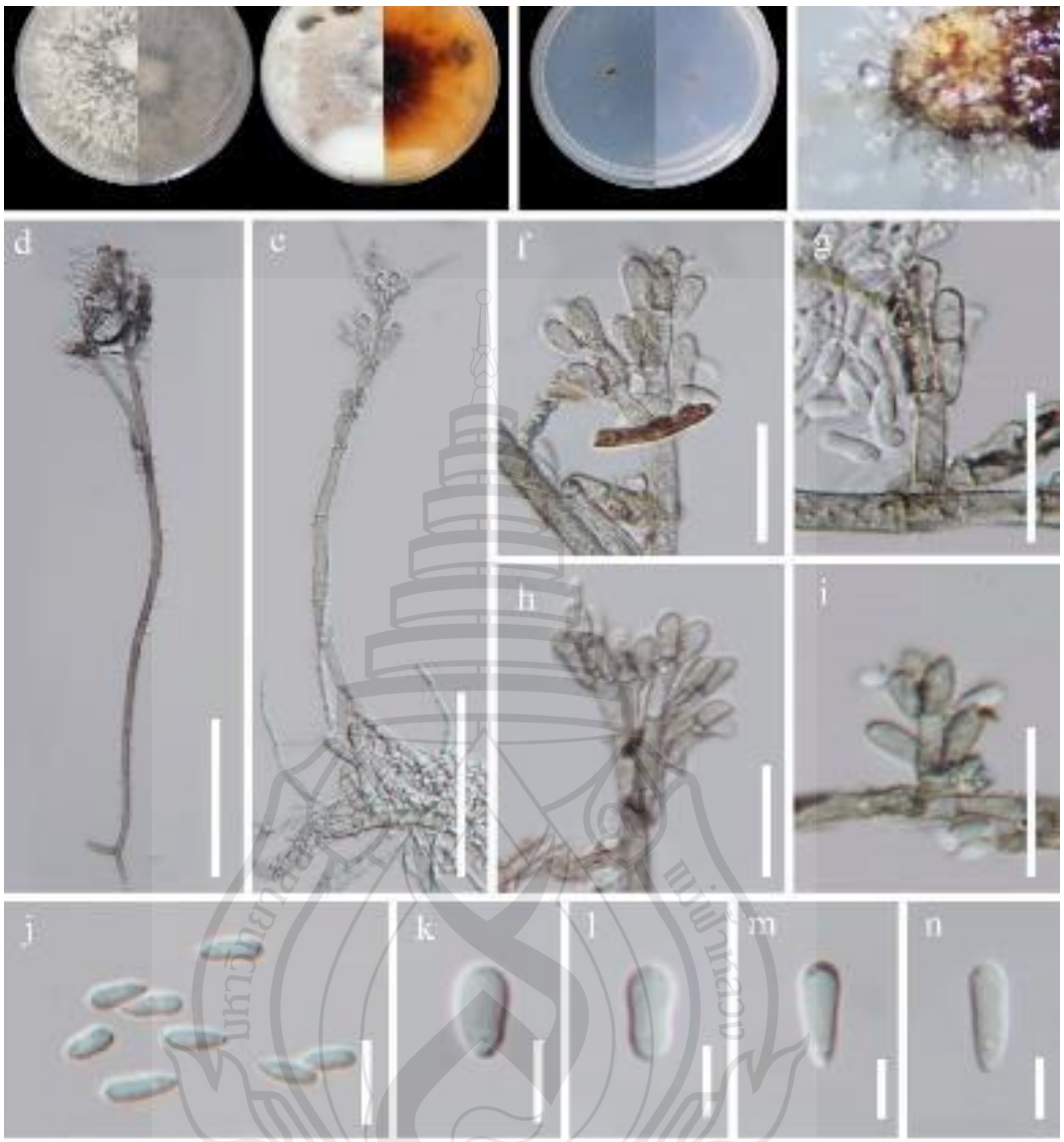
Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, from the healthy leaves of *Dicranopteris dichotoma*, 13 December 2021, J.Y. Zhang, NS50-11 (dried culture: HKAS 124928, holotype; GZAAS 22–2040, isotype), ex-type culture: KUNCC 23–12692.

Notes: Phylogenetically, *Biscogniauxia dicranopteridis* clusters within *Biscogniauxia* VI, forming a distinct sister clade to *B. magna* with high support value (94% ML-bs/1.00 BYPP/94% MP-bs) a comparison of ITS sequences data between *B. dicranopteridis* and *B. magna* reveals a 29 bp (4.80%) difference out of 604 bp. Morphologically, *B. dicranopteridis* and *B. magna* are very similar. The difference between *B. dicranopteridis* and *B. magna* is that the conidiogenous cells of *B. dicranopteridis* are pale brown and verrucose, while the conidiogenous cells of *B. magna* have thin- and rough-walled and hyaline. On the other hand, *B. dicranopteridis* has small guttulate conidia compared to *B. magna* (Samarakoon et al., 2022).



Note Phylogenetic tree generated from maximum likelihood analysis of a combined LSU, ITS, RPB2 and *β*-TUB sequence dataset. Bootstrap support values for ML and MP of at least 75% and Bayesian posterior probabilities of at least 0.95 are shown near the nodes as ML/PP/MP.

Figure 4.93 Phylogenetic tree of Graphostromataceae



Note a Culture on PDA from above and below. b Culture on WA from above and below. c Conidiophores on WA. d, e Conidiophores with conidiogenous cells and conidia. f–i Conidiogenous cells. j–n Conidia. Scale bar: d = 100μm, e = 50μm, f–i = 20μm, j =10μm, k–n = 5μm

Figure 4.94 *Biscogniauxia dicranopteridis* (HKAS 124928, Holotype)

Biscogniauxia petrensis Z.F. Zhang, F. Liu & L. Cai, Persoonia 39: 11 (2017), Figure. 4.95

Index Fungorum number: IF818247; *Facesoffungi number*: FoF 10201

Endophytic in the leaves of *Dicranopteris dichotoma*. **Sexual morph**: Undetermined. **Asexual morph**: *Hyphae* hyaline to brown, septate, branched, aerial mycelium, thin-walled. *Conidiophores* 4.3–7.5 μm ($\bar{x}$ = 5.5 μm, n = 22) wide, immersed or semi-immersed, macronematous, mononematous, hyaline to slightly brownish, septate, branched, slightly flexuous, finely roughened, with conidiogenous cell arising terminally or laterally. *Conidiogenous cells* 6.6–11.8 × 3.5–5.7 μm ($\bar{x}$ = 7.9 × 4.2 μm, n = 21), holoblastic, hyaline to light brownish, thin- and rough-walled, cylindrical to oblong, slightly swollen at the apex with conidial secession scars. *Conidia* 3.8–6.3 × 2.1–3.7 μm ($\bar{x}$ = 5.1 × 3.2 μm, n = 40), unicellular, hyaline, 0-septate, thin-walled, smooth, obovoid to clavate.

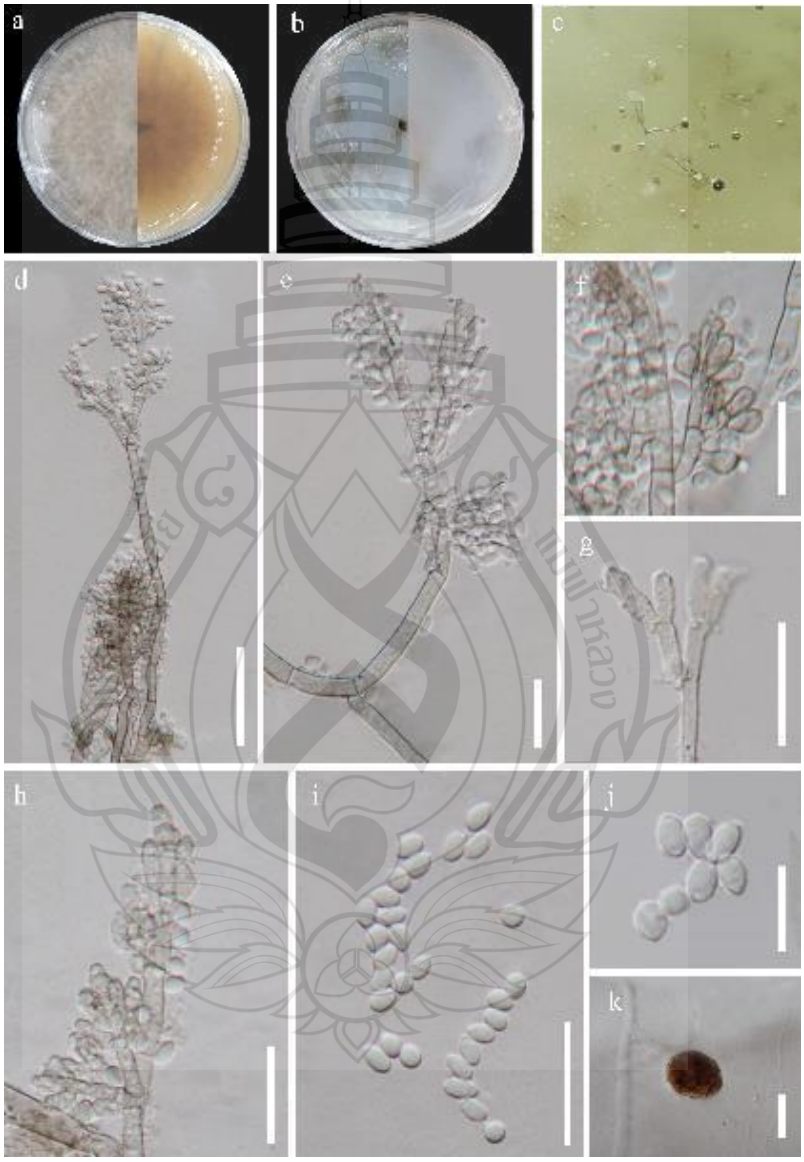
Culture characters: Colonies on PDA medium grow rapidly, reaching over 90 mm diameter in 7 days at 25°C, dense, circular, covered with abundant, brownish grey, cottony to woolly aerial mycelia, margin entire; reverse dark brown at center with light brown edges. Colonies on WA medium exhibit sporulation, slow growth, planar, mycelia sparse, white from above and reverse.

Known distribution and hosts: Rock in China (Zhang et al., 2017), Mnium heterophyllum in Korea (Choi et al., 2020), adult mosquitoes in Korea (Das et al., 2020), Dendrobium orchids in Thailand (Ma et al., 2020), marine algae in India (Sahoo et al., 2021), Osmanthus fragrans in China (Samarakoon et al., 2022), lichen on pine trees in South Korea (Yang et al., 2022), *Dicranopteris dichotoma* in China (this study).

Material examined: CHINA, Guizhou Province, Guiyang City, Guiyang Medicinal Botanical Garden, from the healthy leaves of *Dicranopteris dichotoma*, 13 December 2021, J.Y. Zhang, NS50-3 (dried culture: HKAS 124929; living culture: GZCC 22–2040).

Notes: Zhang et al. (2017) introduced *Biscogniauxia petrensis* isolated from rock in China. Subsequently, *B. petrensis* has been reported on various hosts, including *Mnium heterophyllum* (Choi et al., 2020), adult mosquitoes (Das et al., 2020), *Dendrobium orchids* (Ma et al., 2020), marine algae (Sahoo et al., 2021), lichen on pine trees (Yang et al., 2022), and dead branch of *Osmanthus fragrans* (Samarakoon et al., 2022). Our isolate is morphologically indistinguishable from the Holotype: of *B. petrensis* (HMAS 246921)

(Zhang et al., 2017). The newly obtained strain is phylogenetically clustered together with three strains of *Biscogniauxia petrensis* (MFLUCC 14–0151, CGMCC 3.17949 and HKAS 102388) with strong statistical support (100% ML-bs/1.00 BYPP/ 100% MP-bs). We therefore identify our new isolate as *Biscogniauxia petrensis* based on morphology and phylogeny. This is the first report of *Biscogniauxia petrensis* associated with *Dicranopteris dichotoma*.



Note a Culture on PDA from above and below. b Culture on WA from above and below. c Conidiophores on WA. d–e Conidiophores with conidiogenous cells and conidia. f–h Conidiogenous cells. i, j conidia. k pigmentation. Scale bar: d = 50 µm, e–i = 20 µm, j = 10 µm, k = 50 µm

Figure. 4.95 *Biscogniauxia petrensis* (HKAS 124929)

Hypoxylaceae DC.

Hypoxylaceae belongs to *Xylariales*, this family was formally introduced by Wendt et al. (2018) to accommodate *Annulohypoxylon*, *Hypoxylon*, *Daldinia*, and several related genera that have stomatal pigments and a nodulisporium-like anamorph and they accepted 13 genera in the family based on a multi-locus phylogeny and morphology. Subsequently, several studies have constantly revised and updated the classification of the family (Daranagama et al., 2018; Voglmayr et al., 2018; Hyde et al., 2020a; Cedeño-Sanchez et al., 2024; Karimi et al., 2024). To date, 18 genera have been accepted in this family (Wijayawardene et al., 2022).

Hypoxylon Bull.

Hypoxylon species are primarily saprobes and endophytes with a global distribution, however, they exhibit higher diversity in the tropics and subtropics (Ju & Rogers, 1996; Daranagama et al., 2018; Ma et al., 2022; Song et al., 2022, Fournier et al., 2024). This species-rich genus was established by Bulliard (1791) with 1218 epithets in the Index Fungorum (http://www.indexfungorum.org/names/names.asp, accessed on 11 October 2024). Previously, the identification of *Hypoxylon* based on only morphological characteristics, however, which is not sufficient to distinguish *Hypoxylon* species (Rogers, 1980, 1981; Ju & Rogers, 1996; Daranagama et al., 2018; Ma et al., 2022; Song et al., 2022), the use of a multi-locus phylogenetic analysis has been a major advantage to obtain a greater resolution in *Hypoxylon* (Daranagama et al., 2018). Recent studies showed that *Hypoxylon* is polyphyletic and species of *Hypoxylon* clustered into eight clades (Song et al., 2022). Hence, the taxonomy of this group needs further studies to resolve the taxonomic problems of this group.

Hypoxylon dicranopteridis J.Y. Zhang, D.F. Bao, K.D. Hyde & Y.Z. Lu, *sp. nov*., Figure 4.96

Etymology: Refers to the host fern genus *Dicranopteris*, on which the holotype was collected.

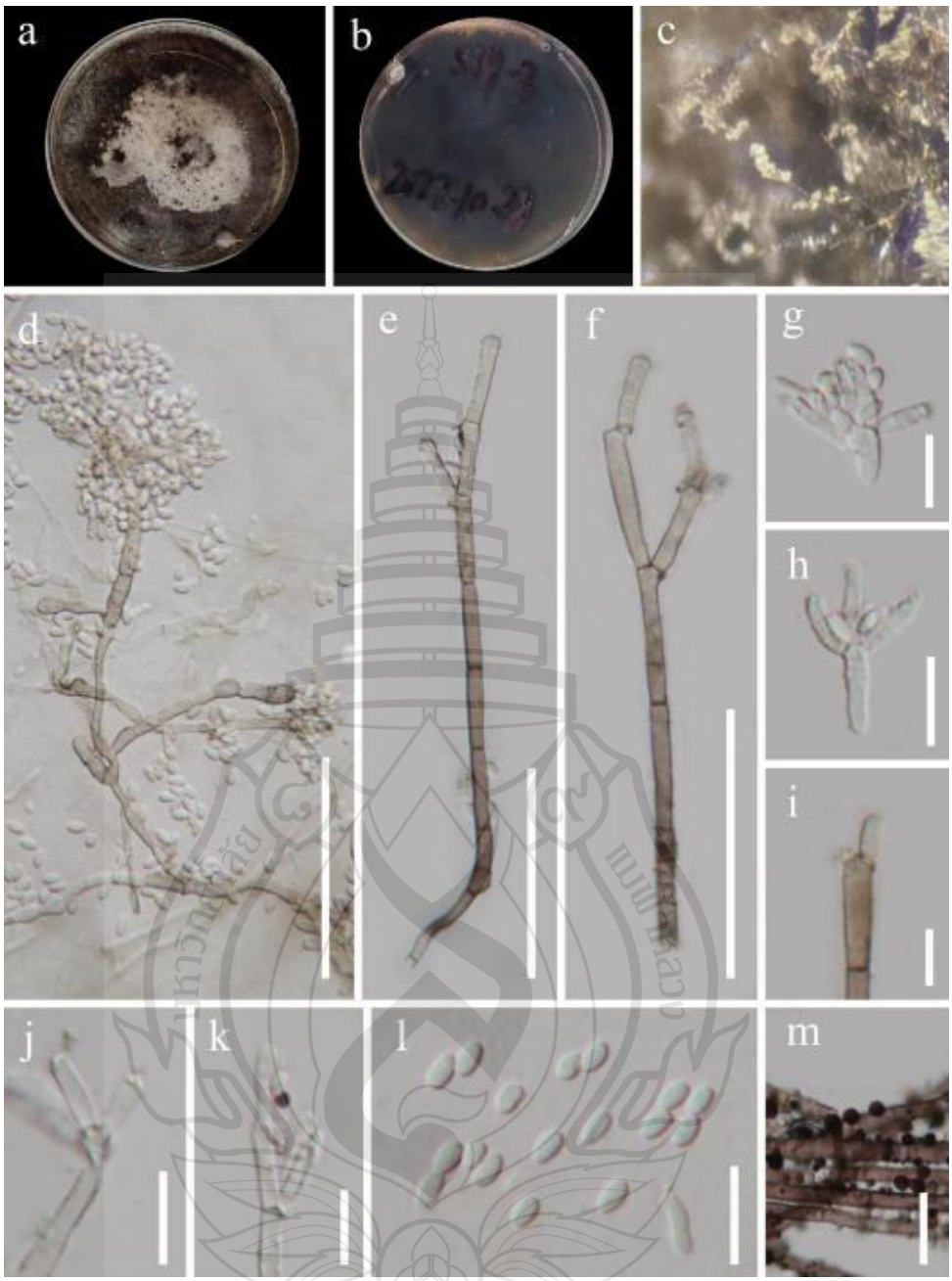
Endophytic in the rhizome of *Dicranopteris linearis*. Sexual morph: not observed. Asexual morph: *Hyphae* hyaline to brown, septate, branched, aerial mycelium, thin-walled. *Conidiophores* immersed or semi-immersed, macronematous, mononematous, hyaline to brownish, septate, branched, slightly flexuous, with conidiogenous cell arising terminally or laterally. *Conidiogenous cells* 7.8–21.1 × 1.7–

5.0 µm ($\bar{x}$ = 11.8× 2.8 µm, n = 13), hyaline to light brownish, rough-walled, cylindrical to oblong. *Conidia* 3.6–6.2 × 1.8–2.7 µm ($\bar{x}$ =4.2 ×2.4µm, n = 30), hyaline, 0-septate, thin-walled, smooth, obovoid to clavate.

Culture characters Colonies on PDA medium, growing fast, dense, covered with abundance, at center white with dark brown edges, cottony to woolly aerial mycelia; reverse black.

Material examined: CHINA, Guizhou Province, Ziyun Miao and Buyi Autonomous County, Anshun City, from the rhizome of *Dicranopteris linearis*, 2 August 2022, J.Y. Zhang, S19–3, living culture KUNCC 23–14209

Notes: Our phylogenetic analysis showed that *Hypoxylon* is polyphyletic and formed eight clades, which is consistent with the recent phylogenetic study of Cedeño-Sanchez et al. (2024). *Hypoxylon dicranopteridis* nested within the clade of *Hypoxylon* 1 and sister to *H. investiens* (Figure 4.97). Due to the lack of an asexual morph of *H. investiens* (Curtis et al., 1864), we were unable to compare the morphology between *H. dicranopteridis* and *H. investiens*. Phylogenetically they are distinct, and the comparisons of nucleosides of *rpb*2 and *tub*2 gene regions between *H. dicranopteridis* and *H. investiens* showed 41 bp and 31 bp differences, which strongly support our new isolate as a new species.



Note a, b Culture on PDA from above and below. c Colonies on PDA. d–k Conidiophores, conidiogenous cells, and conidia. l Conidia. m Pigmentation. Scale bar: d–f = 50µm, g–l = 10µm, m = 20 µm

Figure 4.96 *Hypoxylon dicranopteridis* (S19–3)

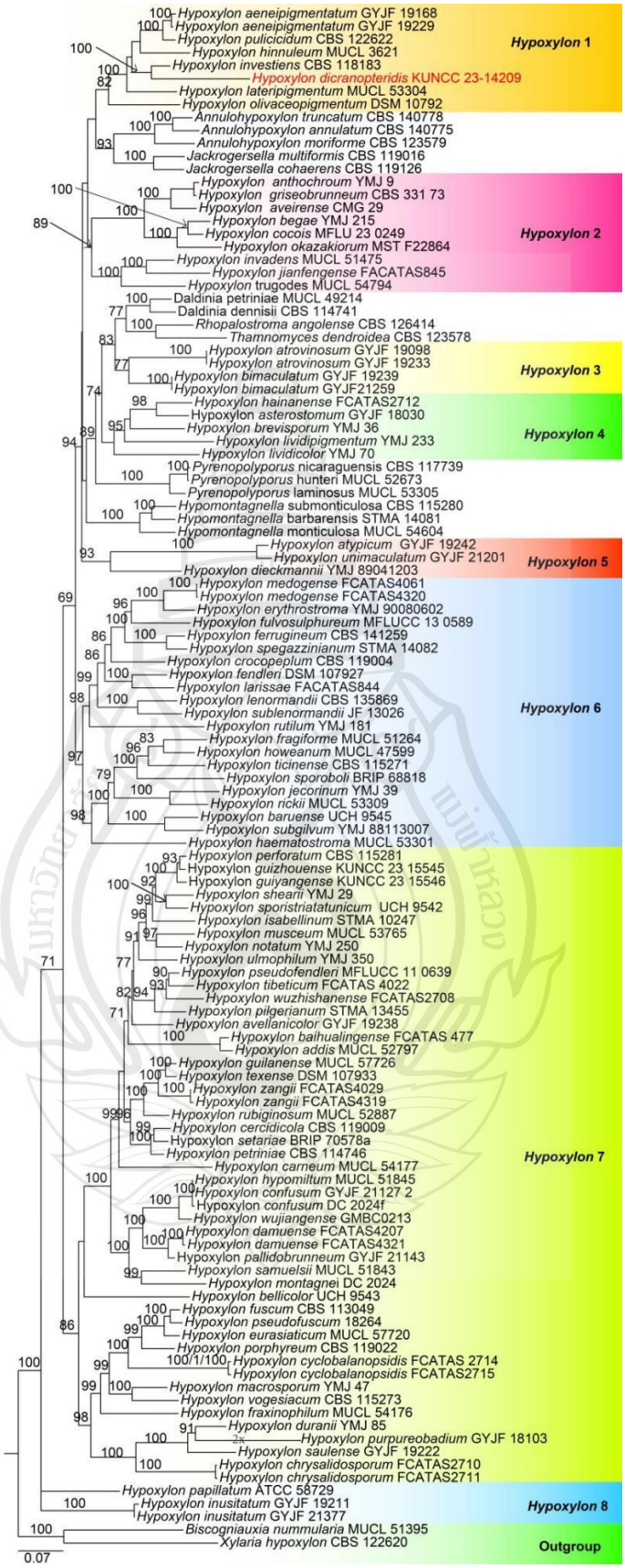


Figure 4.97 Phylogenetic tree of *Hypoxylon*

Figure 4.97 Note: Phylogram generated from maximum likelihood analysis based on combined ITS, LSU, *tub*2, and *rpb*2 sequence data. A total of 4280 taxa were included in the combined analyses, which comprised 1981 characters after alignment. The best scoring RAxML tree with a final likelihood value of -86424.379482 is presented. Bootstrap support values for maximum likelihood (ML) equal to or greater than 70% and Bayesian posterior probabilities equal to or greater than 0.90 are indicated above branches as ML BS/PP. The tree was rooted to *Xylaria hypoxylon* (CBS 122620) and *Biscogniauxia nummularia* (MUCL 51395). The newly generated sequences are shown in red.

4.4 Conclusion and Discussion

The fungi associated with *Dicranopteris* have been a relatively unexplored area of research, with only a handful of species documented so far (Kirschner & Liu, 2014; Kirschner & Wang, 2015; Guatimosim et al., 2016; Zhang et al., 2023b; Chen et al., 2024; Zhang et al., 2025). In this study, we present a comprehensive checklist of fungi associated with *Dicranopteris*, unveiling a total of 23 species from 17 genera (Table 4.4). Our research systematically investigated endophytic fungi associated with *Dicranopteris* in Guizhou Province, China, and has led to the isolation of 93 fungal strains from *D. ampla*, *D. pedata*, and *D. linearis*. Through meticulous analysis of their morphological characteristics and phylogenetic relationships, we have identified 65 species belonging to 36 genera, 29 families, 18 orders, and four classes within the *Ascomycota*. Notably, 29 of these species are entirely new to science, as are two genera, one family, and 26 are new host records for *Dicranopteris*. This study unveils a remarkably high species diversity of endophytic fungi in *Dicranopteris*, with approximately half of the identified species being previously unknown. These findings not only underscore the vast and underexplored diversity of endophytic fungi but also significantly enhance our understanding of fungal biodiversity. Moreover, they highlight the potential of these fungi to contribute to their host plants' medicinal properties, offering promising new directions for research in medicinal and environmental mycology.

Our identification of 65 species from various ascomycete classes (*Dothideomycetes*, *Leotiomycetes*, and *Sordariomycetes*) as endophytes further supports the idea that most

ascomycetes have an endophytic phase in their life cycle. Bhunjun et al. (2024) discussed this in detail, suggesting that many ascomycetes, whether saprobes or pathogens, likely evolved from endophytic lifestyles. Similarly, Rathnayaka et al. (2023) and Wang et al. (2024) proposed that *Botryosphaeriaceae* ancestors may have originated as endophytes and then switched into saprobes or pathogens. Promputtha et al. (2007) found that fungal species like *Colletotrichum*, *Fusarium*, *Phyllosticta* (as *Guignardia*), and *Phomopsis*, which are common endophytes, share genetic similarities with saprotrophic fungi. This indicates that these endophytes may transition to a saprotrophic lifestyle under certain conditions. Further supporting this idea, Demir et al. (2024) demonstrated that *Lachnum* species once thought to be exclusively saprobes, also exhibit multiple life cycle phases, including appressoria formation. Appressoria are specialized cells or adhesion structures from which a penetration peg emerges to pierce the host tissues and function in pathogen and endophyte infection of their hosts (Chethana et al., 2021b; Konta et al., 2023). This reinforces the concept that endophytes can switch lifestyles, becoming pathogens or saprobes. The potential of endophytes to switch lifestyles is truly impressive, and numerous studies have documented such shifts, including in genera like *Diaporthe* and *Colletotrichum*, which include both endophytes and pathogens across a wide range of plant hosts. For example, *Colletotrichum coccodes*, identified as an endophyte in symptom less plants of potato, cabbage, white mustard, lettuce, and chrysanthemum (Chesters & Hornby, 1965; Chang et al., 2014), causes black dot disease on potato tubers. However, Chang et al. (2014) observed no symptoms in potato leaves inoculated with *C. coccodes* from infected tubers despite appressoria and infection hyphae. A similar phenomenon was observed in our study with *Diaporthe arecae*, identified as an endophyte and a pathogen causing dieback in Chinese Olive (*Canarium album*) (Lai et al., 2024). Likewise, *Colletotrichum fioriniae*, another endophyte, has been reported to cause postharvest bitter rot of apples in South Tyrol (Carneiro & Baric, 2021). In addition to these examples, our study identified several other endophytic species that are significant pathogens infecting various plants, including *Alternaria longipes*, *Phyllosticta capitalensis*, and *Stagonospora tainanensis*. Additionally, *Tainosphaeria phialogeniculata* and *Cladosporium benschiae*, both reported as endophytes in our study, are also known as saprobes (Wu & Diao, 2022; Costa et al., 2022). Furthermore, the genus *Pseudodactylaria* has been recognized exclusively as saprobes from freshwater habitats (Crous et al., 2017; Crous et al., 2017; Lin et al., 2018b;

Hyde et al., 2020b; Lu et al., 2020b; Bao et al., 2021; Boonmee et al., 2021; Yang et al., 2023b), our study discovered a new species of *Pseudodactylaria* as an endophyte in the healthy rhizome of *Dicranopteris pedata*. Thus, our study provides strong evidence that many saprobes have an endophytic phase and that endophytes can switch between lifestyles, adapting to various ecological niches.

In this study, the analysis of the fungal genera associated with *Dicranopteris* reveals a significant pattern of dominance and habitat-specific distribution. The dominant genera, *Nigrospora* (nine species), *Colletotrichum* (six species), *Neopestalotiopsis* (five species), *Cladosporium* (four species), and *Diaporthe* (four species) (Figure 4.98), suggest a strong association with *Dicranopteris*. This dominance could indicate a potential symbiotic relationship or a specific adaptation to the *Dicranopteris*'s environment. In contrast, other genera were represented by only one species (Figure 4.98), indicating that some fungi may have a more specialized or limited occurrence.

Fungal distribution varied across the plant tissues (roots, stems, rhizomes, and leaves). *Colletotrichum*, *Neopestalotiopsis*, and *Nigrospora* were predominantly found in the leaves (Table 4.2), highlighting their potential specialization or preference for leaf tissue. Conversely, several genera with only one species, such as *Periconia dicranopterisis*, *Amorocoelophoma dicranopterisis*, and *Massicellispora globosa*, were isolated exclusively from roots (Table 4.2), suggesting a unique relationship with root structures. Additionally, some species were distributed across leaves, stems, and roots (e.g., *Phyllosticta capitalensis*), although these plant tissues appeared to harbor fewer diverse fungi compared to leaves and roots. Interestingly, most of the newly discovered species were found in the root (nine new species) and rhizome (seven new species), indicating these parts are under-explored fungal niches with high potential for discovering novel species. In contrast, only two and one new species were identified from the leaves and stems, respectively, and a new species occur in both leaves and stems (Figure 4.99), suggesting that the leaves and stems may be more commonly studied or may have less fungal diversity than the subterranean parts. This pattern reinforces those roots and rhizomes might be reservoirs for previously unknown fungal diversity, underscoring the urgent need for further investigation.

In this study, we emphasize a morpho-molecular taxonomic approach to investigate culturable endophytic fungi, leading to the identification of 59 species based on

phylogenetic analysis and morphological characteristics. However, we encountered challenges in species definition, a common issue in taxonomic studies. For example, *Colletotrichum gracile*, *C. oblongisporum*, and *C. nullisetosum* were introduced as new species by Yu et al. (2020) based on minor morphological differences. Their phylogenetic analysis indicated that these three species clustered closely with *C. jiangxiense*, showing no significant sequence variation among them. Our re-evaluation suggests that these four taxa are not distinct species but rather represent the same species due to the lack of significant differences in their sequence data. These findings highlight the need for integrative taxonomic approaches and underscore the complexity of species delimitation in endophytic fungi.

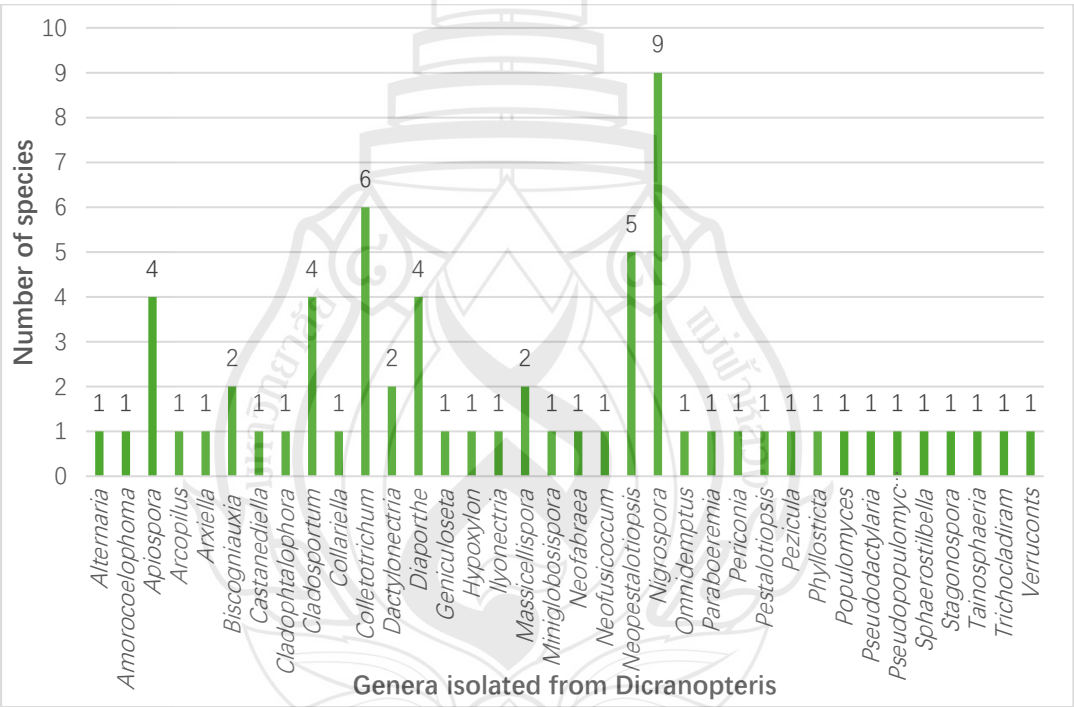


Figure 4.98 The number of species in each fungal genus isolated from *Dicranopteris*

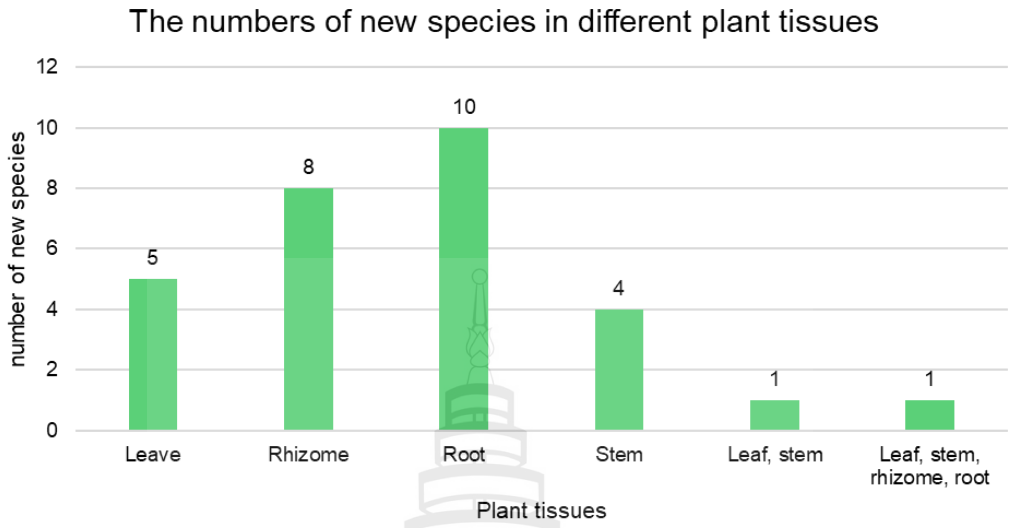


Figure 4.99 The number of new species isolated from different plant tissues of *Dicranopteris*

Table 4.4 Checklist of fungi reported on *Dicranopteris* spp.

Species	Host	Location	References
Apiospora aseptata	*D. pedata*	China	Zhang et al. (2023b)
A. dematiacea	*D. ampla*	China	Zhang et al. (2023b)
A. dicranopteridi	*D. pedata*	China	Zhang et al. (2023b)
A. globosa	*D. linearis*	China	Zhang et al. (2023b)
Bifusella anomala	*D. dichotoma*	China	Lin (1994)
Biscogniauxia dicranopteridis	*D. dichotoma*	China	Chen et al. (2024)
B. petrensis	*D. dichotoma*	China	Chen et al. (2024)
Dothidella portoricensis	*D. flexuosa*	Colombia	Dennis (1970)
Helminthosporium gleicheniae	*D. linearis*	United States	Raabe (1981)
Lachnella gleicheniae	*Dicranopteris sp.*	United States	Haines (1980), Raabe (1981)
Lachnum ulei	*Dicranopteris sp.*	United States	Raabe (1981)
Lanzia cremea	*Dicranopteris sp.*	United States	Raabe (1981)
Leptothyrium gleicheniae	*Dicranopteris sp.*	United States	Raabe (1981)
Lophodermium dicranopteris	*D. dichotoma*	China	Liu et al. (1995)
Mycosphaerella gleicheniae	*D. linearis*	China (Taiwan province)	Kirschner and Liu (2014)
Oberwinklerozyma dicranopteridis	*D. dichotoma*	China	Li et al. (2020b)

Table 4.4 (continued)

Species	Host	Location	References
Paramycosphaerella dicranopteridis	*D. linearis*	China (Fujian, Taiwan, Wuyishan)	Kirschner and Wang (2015), Kirschner and Liu (2014), Guatimosim et al. (2016)
P. dicranopteridis-flexuosae	*D. flexuosa*	Brazil	Guatimosim et al. (2016)
P. gleicheniae	*D. linearis*	China (Fujian, Wuyishan, Taiwan), India, Malaysia	Kirschner and Liu (2014), Guatimosim et al. (2016)
Phytophthora cinnamomi	*D. linearis*	United States	Raabe (1981)
Pseudocercospora gleicheniae	*D. linearis*	Gabon	Braun et al. (2013)
Teratosperma dicranopteridis	*D. linearis*	China (Taiwan province)	Kirschne et al. (2019)
Zasmidium dicranopteridis	*D. linearis*	China (Taiwan province)	Kirschner and Liu (2014)

CHAPTER 5

CONCLUSION

5.1 Overall Conclusion

This study comprehensively explores fungi found on ferns and fern allies, with a global perspective. It covers three main components, offering a detailed checklist of fungi occurring on pteridophytes worldwide and their classification. Additionally, it provides notes and re-drawn photo plates for selected interesting fungal genera, showcasing host-specificity at the genus level (*Asterocalycella*, *Carrismyces*, *Completoria*, *Dangeardiella*, *Desmella*, *Equiseticola*, *Exoteliospora*, *Griggsia*, *Hyalopsora*, *Hysteropeltella*, *Lachnopsis*, *Massalongina*, *Melaniella*, *Milesina*, *Mixia*, *Nothodactylaria*, *Ophiodiaporthe*, *Paratrimmatostroma*, *Phacidina*, *Placothyrium*, *Platycarpa*, *Pleurothyrium*, *Poculopsis*, *Polycladium*, *Polycyclina*, *Polycyclus*, *Ptechetelium*, *Radiciseta*, *Repetobasidiellum*, *Rhagadolobiopsis*, *Rommelaarsia*, *Scolecoleotia*, *Uncol*, *Uredinopsis*, *Woldmaria* and *Zymochalara*) and the ten highest occurrence frequencies of fungal genera (*Cercospora*, *Hyalopsora*, *Lachnum*, *Milesina*, *Phaeosphaeria*, *Pseudocercospora*, *Ramularia*, *Taphrina*, *Uredinopsis* and *Uredo*). Furthermore, based on evidence from phylogeny and morphology, 124 species including 59 sarobic and 65 endophytic species isolated from ferns are identified, with introducing two new families, nine new genus, 67 new species, six new combinations, 57 new records. Notably, the study delves into the importance, diversity, numbers, regional distribution, lifestyle, host-specificity or preference, and host jumping of fungi associated with pteridophytes. This study offers valuable insights into the evolutionary dynamics and ecological implications of these fungal interactions with pteridophytes, connecting the scientific community with a global understanding of these phenomena.

5.1.1 Diversity of Fungi on Pteridophytes

China is among the countries with the highest diversity of pteridophyte species (Liu et al., 2012; Zhou et al., 2016; Qian et al., 2021), with approximately 2,130 species reported, spanning 230 genera, representing ca. 19% of the global pteridophyte flora (Lu, 2007; Liu et al., 2012; Lin et al., 2013; Zhou et al., 2016). Guizhou and Yunnan province in southwestern China, are home to an estimated 830 and 1,500 species of ferns and fern allies, marking them one of the richest pteridophyte habitats in the country (Li et al., 2015; Zhou et al., 2016). This significant diversity makes these areas suitable for studying the fungi associated with ferns and allies. However, research on fungi associated with pteridophytes in China has been substantially overlooked (Kirschner et al., 2019; Zhang et al., 2021). In this study, we conducted research in the pteridophytes-rich southwestern China to investigate the diversity of fungi, which holds significant research value. A total of 124 species including 59 sarobic and 65 endophytic species within Ascomycota were identified based on their morphological characteristics and multi-gene phylogenetic analyses (Table 5.1 and Table 5.2). The Composition of fungal communities of endophytic and saprobic fungi is shown in the Figure 5.1. Notably, among these newly identified species, Sordariomycetes dominated as the most prevalent class, accounting for nearly half of all species (52.5%–65/124), followed by Dothideomycetes (35.5%–44/124), Leotiomycetes (5.6%–7/124), Eurotiomycetes (5.6%–7/124), and Orbiliomycetes (0.8%–1/124). A bar chart shows these 124 species classifications at class level (Figure 5.2). It is worth noting that over half of these newly discovered fungi (67 species) are new to science; in contrast, the remaining species represent new records of existing species growing on fern substrates. The new taxa identified in this study are presented in Figure 5.3. This finding underscores the growing evidence that the fungal community varies significantly with different hosts, with little overlap (Hyde et al., 2018, 2020a). This suggests a high potential for undiscovered fungal diversity on new or unrelated hosts, such as ferns and their allies, as well as in new areas.

Table 5.1 The new taxa and new records of saprobic fungi associated with pteridophytes in this study

	Saprobic fungi/59 species			
	Dothideomycetes	**Eurotiomycetes**	**Orbiliomycetes**	**Sordariomycetes**
New family	1	0	0	0
New genera	6	0	0	0
New species	15	5	1	17
New combiantion	5	0	0	0
New records	16	1	0	4

Table 5.2 The new taxa and new records of endophytic fungi associated with pteridophytes in this study

	Endophytic fungi/65 species			
	Dothideomycetes	**Eurotiomycetes**	**Leotiomycetes**	**Sordariomycetes**
New family	0	0	1	0
New genera	0	0	3	0
New species	4	1	5	19
New combiantion	0	0	1	0
New records	9	0	2	25

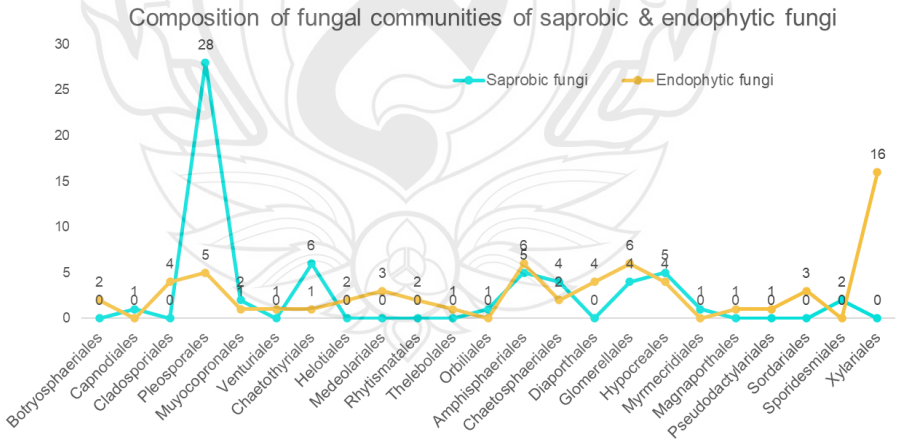


Figure 5.1 Composition of fungal communities of saprobic & endophytic fungi

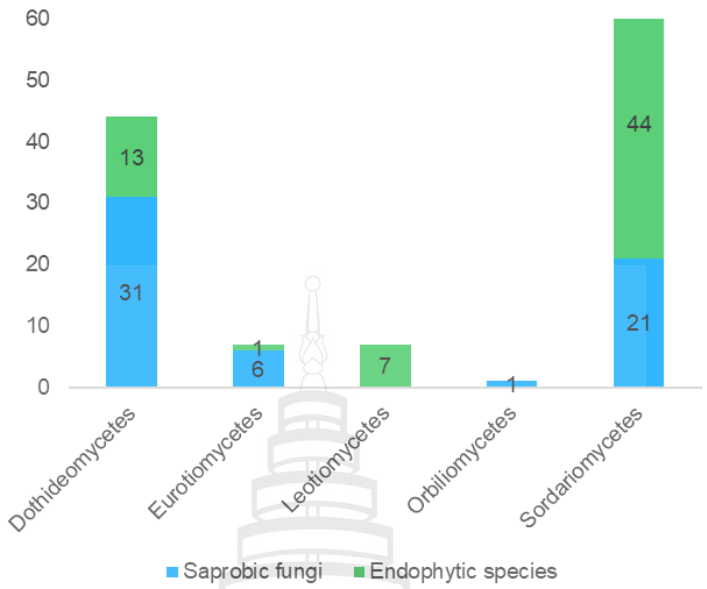


Figure 5.2 Species classifications at class level

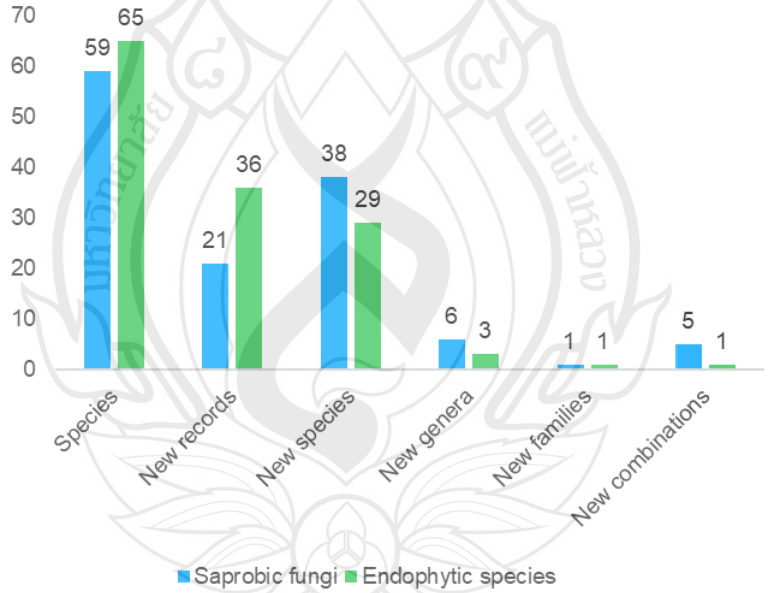


Figure 5.3 New taxa identified in this study

Based on the USDA dataset and literature review, the number of fungal species associated with pteridophytes is 1,648 species across 11 phyla, 34 classes, 100 orders, 240 families, and 611 genera (Chapter 2). Combined with the new additions in this study, the updated count of fungi associated with pteridophytes stands at 1,772 species, distributed across 11 phyla, 34 classes, 106 orders, 253 families, and 658 genera.

A snapshot of fungi associated with pteridophytes is provided (Table 5.3), along with a visual pie chart (Figure 5.4). The results illustrate that Ascomycota is the dominant group, accounting for 72% of pteridophyte-related fungi, followed by Basidiomycota, which accounts for 23% of the total. Moreover, Dothideomycetes and Sordariomycetes within Ascomycota are the most dominant fungal groups found on pteridophytes, not only within Ascomycota but also across all fungi on pteridophytes. A pie chart has been generated to depict the diversity of fungi in different classes (12 classes) of Ascomycota occurring on pteridophytes worldwide (Figure 5.5). The largest proportion of species belongs to Dothideomycetes, followed by Sordariomycetes, Leotiomycetes, and others. Our study further demonstrates that Dothideomycetes and Sordariomycetes exhibit high species richness on pteridophytes.

Table 5.3 Taxonomic classification of fungi associated with pteridophytes

Phylum	Class	Order	Family	Genus	Species
Ascomycota	12	62 (56+**6**)	163 (150+**13**)	483 (436+**47**)	1,279 (1,155+**124**)
Basidiomycota	8	24	61	135	396
Blastocladiomycota	1	1	1	1	1
Chytridiomycota	4	4	4	4	5
Entomophthoromycota	1	1	1	1	1
Entorrhizomycota	1	1	1	1	1
Eumycetozoa	1	5	7	8	9
Glomeromycota	1	3	3	5	5
Mortierellomycota	1	1	1	4	6
Mucoromycota	2	2	5	6	13
Oomycota	2	2	6	10	56
Total	**34**	**106**	**253**	**658**	**1,772**

Note Bold numbers representing the new generation in this study

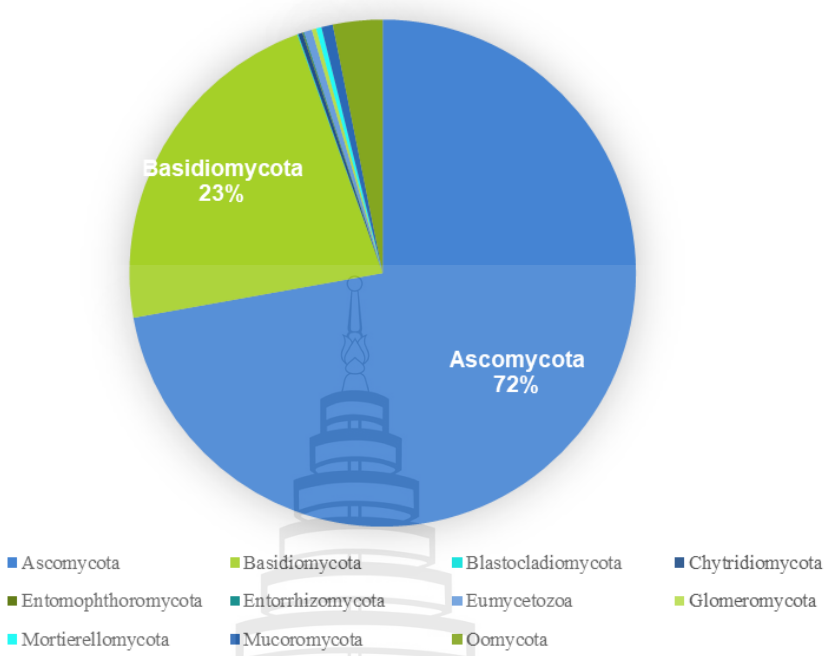


Figure 5.4 Diversity of fungi associated with pteridophytes in different phyla

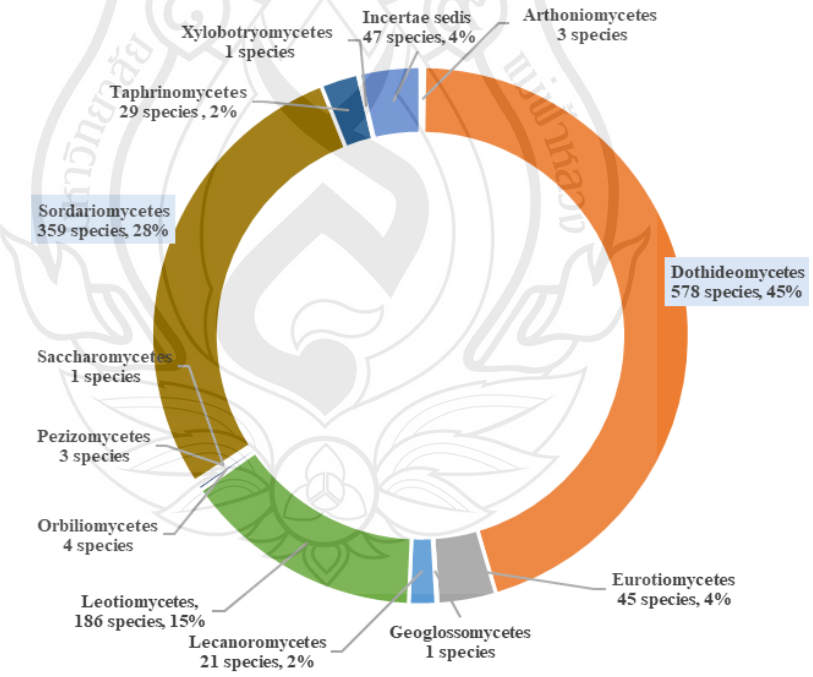


Figure 5.5 Pteridophytes-associated fungi in different classes of Ascomycota

5.1.2 Distribution of Fungi on Pteridophytes

Approximately 1,700 fungal species related to pteridophytes are distributed across over 100 countries, with some found in regions not tied to specific countries, such as scattered islands, mountains, and sea areas. This distribution highlights their extensive ecological adaptability. A checklist of the number of pteridophyte-associated fungal species recorded in each region is provided (Table 5.4), along with a bar chart visualizing the top 20 countries with the most fungi found on pteridophytes (Figure 5.6). Based on these results, fungal records are mainly concentrated in Europe, North America, and Asia. These areas span six continents, and the remaining three being South America, Oceania, and Africa. Europe hosts the highest number of countries (37) where fungi related to pteridophytes have been found (Figure 5.7). Furthermore, with 512 fungi recorded on pteridophytes, the United States has the highest number of pteridophyte-related fungi, followed by China and the United Kingdom. A deeper understanding of the distribution and diversity of pteridophyte-related fungi will help us better understand comprehend the ecological and evolutionary roles of these symbiotic relationships (Pressel et al., 2016; Hudson et al., 2019).

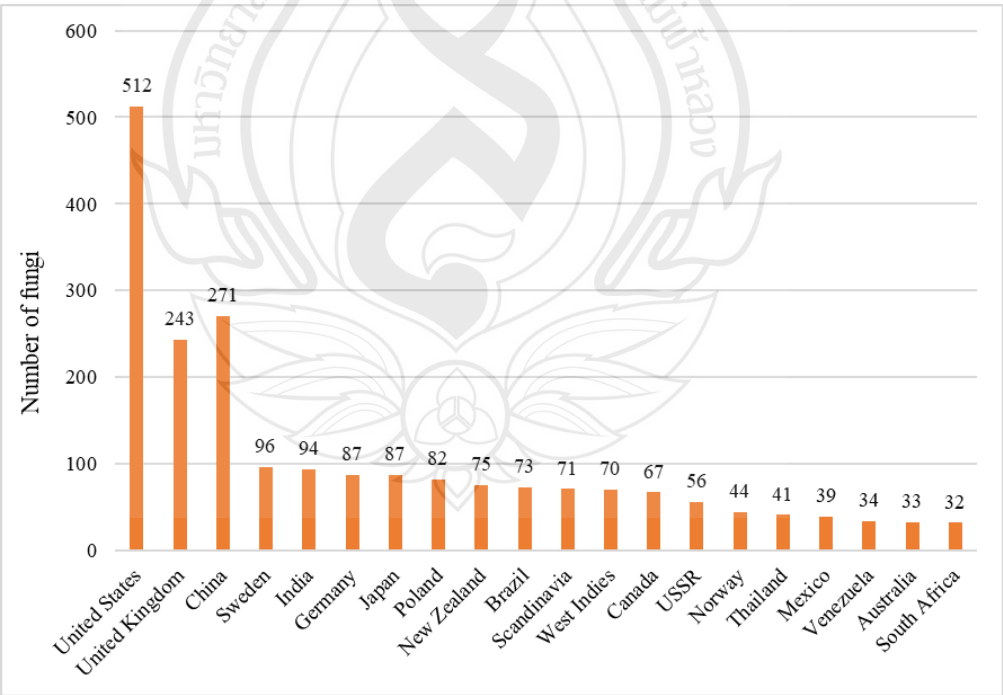


Figure 5.6 The top 20 countries with the most fungi found on pteridophytes

Table 5.4 The number of pteridophyte-associated fungal species recorded in each region

Unit	Area	Num.	Unit	Area	Num.	Unit	Area	Num.	Unit	Area	Num.
CNT	United States	512	CNT	Pakistan	18	CNT	Nepal	4	CNT	Micronesia	1
CNT	United Kingdom	243	CNT	Republic of Korea	17	CNT	Samoa	3	CNT	Tanzania	1
CNT	China	271	CNT	Portugal	17	CNT	Haiti	3	CNT	Kazakhstan	1
CNT	Sweden	96	CNT	Indonesia	17	CNT	Kenya	3	CNT	Uzbekistan	1
CNT	India	94	CNT	Finland	15	CNT	Paraguay	3	Mountain	Caucasus	1
CNT	Germany	87	CNT	Greece	14	CNT	Yugoslavia	3	CNT	Tonga	1
CNT	Japan	87	CNT	Romania	13	CNT	Singapore	3	CNT	Algeria	1
CNT	Poland	82	CNT	Dominican Republic	13	CNT	Cook Islands	3	Continents	Asia	1
CNT	New Zealand	75	CNT	Russia	13	CNT	Armenia	3	CNT	Azerbaijan	1
CNT	Brazil	73	CNT	Jamaica	11	CNT	Bolivia	3	CNT	Niue	1
Island	Scandinavia	71	CNT	Panama	10	CNT	French	3	CNT	Turkey	1
Island	West Indies	70	CNT	Argentina	10	CNT	Georgia	3	CNT	Madagascar	1
CNT	Canada	67	CNT	Costa Rica	9	CNT	Guyana	3	CNT	Peru	1
CNT	USSR	56	CNT	Netherlands	9	CNT	Morocco	3	Sea area	Caribbean	1
CNT	Norway	44	CNT	Trinidad-Tobago	8	Island	New Guinea	3	CNT	Cape Verde	1
CNT	Thailand	41	CNT	Ukraine	8	Continents	North America	3	CNT	Abkhazia	1
CNT	Mexico	39	CNT	Czechoslovakia	7	CNT	Zimbabwe	3	CNT	Malawi	1
CNT	Venezuela	34	CNT	Greenland	7	CNT	Barbados	2	CNT	Gabon	1
CNT	Australia	33	CNT	Bulgaria	7	CNT	Croatia	2	CNT	Brunei Darussalam	1
CNT	South Africa	32	CNT	Belgium	7	CNT	Estonia	2	CNT	Slovenia	1
CNT	Italy	28	CNT	Papua New Guinea	7	CNT	Kongeriget Danmark	2	Continents	Oceania (Australasia)	1
CNT	France	28	CNT	Myanmar	6	CNT	Fiji	2	CNT	Guatemala	1
CNT	Cuba	25	CNT	Hungary	6	CNT	Ghana	2	CNT	Solomon Islands	1
CNT	Philippines	25	CNT	Czech Republic	6	CNT	Iceland	2	Continents	Europe	1
CNT	Spain	25	CNT	Malaysia	6	CNT	Iran	2	CNT	El Salvador	1

Table 5.4 (continued)

Unit	Area	Num.	Unit	Area	Num.	Unit	Area	Num.	Unit	Area	Num.
CNT	Denmark	24	Island	Ireland	5	CNT	Latvia	2	CNT	Slovakia	1
CNT	Austria	22	CNT	Chile	5	CNT	Laos	2	CNT	Sierra Leone	1
CNT	Colombia	20	CNT	Sri Lanka	5	CNT	Luxembourg	2	CNT	Honduras	1
CNT	Ecuador	20	CNT	Mauritius	4	Continents	South America	2	CNT	Albania	1
CNT	Switzerland	18	Mountains	Himalaya	4	Island	Bermuda	3			

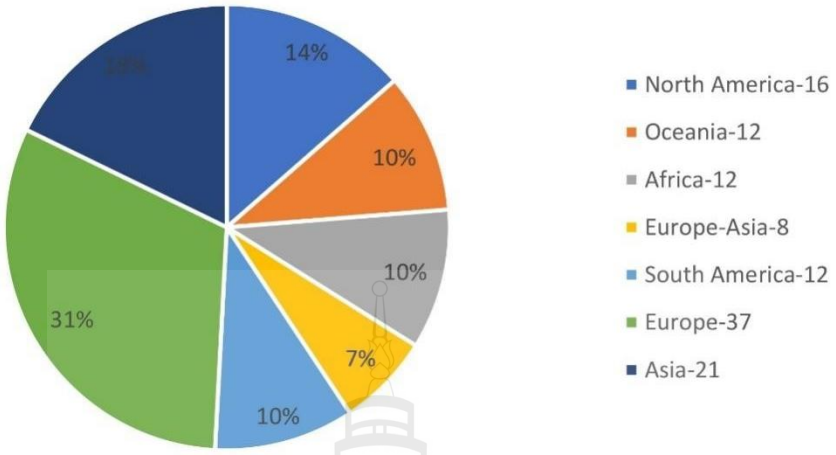


Figure 5.7 The number of countries where pteridophytes-related fungi have been found in each continent

5.1.3 Numbers of Fungi on Pteridophytes

How many fungi are associated with pteridophytes worldwide? Several studies have estimated global fungal species richness based on different extrapolation techniques, one of which is the fungus-to-plant ratio (Hawksworth, 2001; Kreft et al., 2010; Hawksworth & Lücking, 2017). Recent studies using updated fungus-to-plant ratios, obtained through field investigations and molecular methods, have produced ranges from 1.8 to 19.1 fungi per plant, with an average index of 10:1 used to estimate the number of fungi on vascular plants (Hawksworth & Lücking, 2017; Hyde et al., 2021, 2024a, 2024b). Considering that pteridophytes are also vascular plants, we similarly apply the average value of 10 fungal species per plant species to estimate the fungal richness associated with the 12,000 species of pteridophytes, resulting in an expectation of at least 120,000 fungi associated with pteridophytes. However, due to the relatively low host-specificity of ferns (Petrini, 1992; Cook & Taylor, 2023) and the fewer pathogenic fungi compared to other vascular plants, such as angiosperms (Antonovics, 2020, 2023), this estimate should be slightly reduced. When using the most conservative average ratio of pteridophytes to fungal species as 1:1.8, the diversity of pteridophyte-related fungi is estimated to be around 21,600 fungal species. However, this 1:1.8 plant-to-fungus ratio likely yields an overly conservative and underestimated figure for fungal abundance, based on two main considerations. First, the highest fungal richness is found in tropical regions, where ferns are also abundant, with 80% of pteridophyte species occurring in these areas (Uetanabaro

et al., 2009; Kreft et al., 2010; Kumaresan et al., 2013; Del Olmo-Ruiz & Arnold, 2017; Hawksworth & Lücking, 2017). It can, therefore, be expected that under similar host abundance, the fungal richness associated with tropical ferns exceeds that of other regions and hosts (Hawksworth, 2001). Second, abundant ferns exhibit varying degrees of host-specificity or host preference at the family, genus, and species levels, as well as organ- and tissue-specificity (Fisher, 1996; Mehltreter, 2010). Based on this, we estimate the range of pteridophyte-related fungi to be between 21,600 and 120,000 species. To date, about 1,700 fungi have been reported on ferns and their allies worldwide (Table 5.4). Even with the most generous estimation, over 98% of pteridophyte-related fungi remain undiscovered. Even with the most conservative estimates of the fungus-to-plant ratio, over 92% of pteridophyte-associated fungi are still awaiting discovery. This reiterates the highly understudied nature of fungi associated with pteridophytes (Kirschner et al., 2019; Younginger et al., 2023).

5.2 Highlights

5.2.1 We conducted a global review of fungi associated with pteridophytes, making our study the first comprehensive investigation of these fungi.

5.2.2 A first worldwide checklist of fungi related to pteridophytes was provided. To date, there are 1,772 fungal species, including 348 undetermined species, distributed among 11 phyla, 34 classes, 106 orders, 253 families, 658 genera.

5.2.3 We provided detailed notes and redrawn photoplates for interesting genera associated with pteridophytes, showcasing host-specificity at the genus level (36 genera) and the ten highest occurrence frequencies of fungal genera.

5.2.4 The diversity of microfungi related to pteridophytes has been investigated. Based on the morphological and phylogenetic species concepts, we identified 124 species distributed in five classes, 28 orders, 36 families and 69 genera within the phylum Ascomycota, including two new families, nine new genera, 67 new species, six new combiantions and 57 new records.

5.3 Research Advantages

5.3.1 Biodiversity Insight

This study will significantly contribute as a resource for scientists to address biological, ecological and evolutionary questions related to the role of fungi associated with pyeridopytes. It will also bridge the gaps in collections and understanding of the biodiversity of tthese fungi.

5.3.2 A Review of Fungi on Pteridophytes from a Global Perspective

The taxonomy, systematics, ecology, and secondary metabolites of fungi associated with ferns and fern allies offer unique insights into plant colonization of terrestrial environments and fungal symbiosis. We reviewed fungi associated with pteridophytes from a global perspective, focusing on their diversity, taxonomy, lifestyle, and ecological aspects and providing intriguing and engaging information to the readers.

5.3.3 A First Checklist of Fungi and Important and Interesting Fungal Groups

A first worldwide checklist of fungi associated with pteridophytes is provided, highlighting their remarkable diversity and broad distribution. This would serve as a valuable tool for researchers worldwide, facilitating data sharing, collaboration, and further studies on these fungal species.

Additionally, two major fungal groups: 1) 36 genera with likely pteridophytes host-specificity, and 2) 10 genera with most species reported on pteridophytes, are discussed, with providing generic notes and re-drawn photo plates. These selected groups are prioritized for further research to deepen our understanding of the interactions betwee pteridophytes and fungi, thereby shedding light on their roles and functions in ecosystems. Moreover, thoroughly understanding these fungal groups can lead to practical applications, such as improving soil quality and plant health.

5.3.4 The First Systematic Study on Endophytic Fungi Associated with Medicinal Ferns in China

We initiated a significant and systematic study of endophytic fungi associated with medicinal ferns from Guizhou Province, China. This pioneering study, the first in a series, is a crucial step toward understanding the role of endophytic fungi in medicinal

ferns, with a specific focus on *Dicranopteris*. Our findings not only contribute to the existing body of knowledge but also pave the way for several important future research directions in this field.

5.3.5 Abundant Strain Resources

We incorporated 124 species, including 67 new specie. Our achievement has enriched the fungal resources related ferns in China, drawing attention to this group.

5.4 Future Work

5.4.1 Co-evolution Between Pteridophytes and their Associated Fungi

Fungi isolated from pteridophytes are believed to help the transition of plants from aquatic to terrestrial environments. This suggests that the relationship between pteridophytes and fungi may represent the earliest symbiotic relationship between fungi and land plants. The co-evolution of ferns and their hosts has determined the mutual significance of their taxonomy.

5.4.2 Explore the Physiological and Molecular Processes of Pathogenicity

Compared to angiosperms, ferns harbor fewer pathogenic fungi. The exploration of underlying mechanisms holds great potential for plant protection in the future.

5.4.3 Recollect and Epitypify Species Lacking Sequence Data to Establish a Natural Group

Our compilation of data on fungi-related ferns and fern allies has revealed a critical gap: many older species lack molecular data, leading to an unclear taxonomic status. For instance, genera with potential pteridophytes host specificity, such as *Carrismyces*, *Massalongina*, *Placothyrium*, *Pleurothyrium*, *Polycladium* and *Radiciseta*, have been placed within Ascomycota genera *incertae sedis* due to the absence of molecular data. This underscores the urgent need to restudy these species with fresh collections and isolate them for further analysis. Equally crucial is the need to epitypify them and provide reference specimens in order to toward a natural group.

5.4.4 Collaboration Between Pteridophte Biologists and Mycologists

The prerequisite for studying fungi on pteridophytes in any aspect is to find and record these fungi, ensuring that well-preserved specimens are deposited in recognized

herbaria, accompanied by correct relevant metadata (date, locality and host). In previous studies, mycologists focused more on the fungus itself, often overlooking other information such as host identification or relationship with the host. Therefore, the crucial need for mycologists and pteridologists to collaborate provides reliable data and information to establish the foundation for future research.

5.4.5 Expand to Other Medicinal Fern Species

Our study explores endophytic fungi focused on *Dicranopteris* in Guizhou Province, revealed a high diversity of endophytic fungi, including more than 20 new species. The potential for future discoveries is vast, as we plan to extend our research to other medicinal fern species in this region. With the rich fern biodiversity in Guizhou, we anticipate that investigating different medicinal fern hosts will uncover additional fungal species, providing a more comprehensive understanding of the fungal diversity of medicinal ferns in this area.

5.4.6 Influence of Karst Ecosystems

Guizhou's unique karst formations create distinct and unparalleled ecological conditions that likely influence the distribution and diversity of endophytic fungi. Our future research will delve into how these karst landscapes impact the fungal communities in *Dicranopteris* and other ferns, potentially leading to insights into how environmental factors shape fungal diversity and distribution patterns.

5.4.7 Screening of Functional Strains and Exploration of Novel Metabolites

Endophytic fungi are known to produce bioactive metabolites with medicinal potential. Given that this study isolated 124 species, future research should focus on exploring the metabolic profiles of these fungi, particularly in medicinal plants like *Dicranopteris*. This could lead to the discovery of novel compounds with pharmaceutical applications, further emphasizing the importance of fungal diversity in drug discovery and medicinal research.

5.4.8 Establishment of an Online Database: Fern-Fungal Database

The establishment of an online database dedicated to the interactions between ferns and fungi is a crucial step towards enhancing our understanding of these two vital components of ecosystems. This database will serve as a centralized repository for information regarding various fern and fungal species, their ecological relationships, and their distributions.

5.5 Publications

List of publications

5.5.1 First Author

Bao, D. F., Zhang, J. Y., Tian, X. G., Liu, N. G., Xiao, Y. P., Hyde, K. D., . . . Kang, J. C. (2025). Endophytic fungi associated with medicinal fern plants in Guizhou Province, China: Morpho-molecular taxonomic study of culturable endophytic fungi associated with *Dicranopteris*. (Submitted). Mycosphere. (Co-first authors).

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Zhang, J. Y., Hyde, K. D., Ma, J., Wu, N., Al-Otibi, F., Zhang, L.J., . . . Lu, Y. Z. (2025). Morpho-phylogenetic evidence reveals *Pseudolomaantha thailandica* gen. et sp. nov. and *Submultiguttulispora multiseptata* gen. et sp. nov. in Chaetosphaeriaceae. *MycoKeys*, *113*, 123–146. https://doi.org/10.3897/mycokeys.113.142643

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APPENDIX A

MEDIA

1. Malt Extract Agar (MEA) used for fungal cultivation

Agar 15 g

Peptone 0.78 g

Glycerol 2.35 g

Dextrin 2.75 g

Maltose, Technical 12.75 g

Suspend 33.6 g of malt extract agar in distilled water and mix thoroughly. Heat with frequent agitation and boil for 1 minute to completely dissolve the power and bring volume to 1000 ml. Autoclave at 121ºC for 20 minutes.

2. Potato dextrose agar (PDA) used for fungal cultivation

Potato starch (from the infusion) 4 g

Dextrose 20 g

Agar 15 g

Suspend 39 g of Potato dextrose agar in distilled water and mix thoroughly. Heat with frequent agitation and boil for 1 minute to completely dissolve the powder and bring volume to 1000 ml. Autoclave at 121ºC for 20 minutes.

3. Water Agar (WA) Used for Fungal Isolation

Agar 15 g

Suspend 15 g of agar in distilled water and mix thoroughly. Heat with frequent agitation and boil for 1 minute to completely dissolve the powder and bring volume to 1000 ml. Autoclave at 121°C for 20 minutes.

4. Indian ink used for observing gelatinous appendages of ascospores in some species

APPENDIX B

ABSTRACT OF PUBLICATIONS

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Roussoella guttulata (Roussoellaceae, Pleosporales), a novel bambusicolous ascomycete from Thailand

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Abstract

Roussoella guttulata sp. nov. (Roussoellaceae) was found on bamboo culms collected in the northeast of Thailand. *Roussoella guttulata* differs from other species in having immersed, gregarious, black pseudoascostromata, single and central ostiole with periphyses, thin-walled peridium composed of cells of *textura angularis* to *textura prismatica* and yellowish brown ascospores. The multigene phylogenetic analysis shows that the new species forms a distinct lineage basal to *R. hysterioides*, *R. japanensis*, *R. scabrispora* and *R. verrucispora*. The new species is compared with closely related *Roussoella* species. A full description, color photo plates and a phylogenetic tree to show the placement of the new species are provided.

Keywords: 1 new taxon, Dothideomycetes, Phylogeny, Taxonomy, Thai mycobiota

Introduction

Roussoellaceae was introduced by Liu *et al.* (2014) to accommodate three genera *Neoroussoella* J.K. Liu, Phookamsak & K.D. Hyde, *Roussoella* Sacc. and *Roussoellopsis* I. Hino & Katum., which mainly occurs as saprophyte on decaying bamboo culms (Liu *et al.* 2014, Jiang *et al.* 2019). Jaklitsch & Voglmayr (2016) synonymized Roussoellaceae under Thyridariaceae based on phylogenetic analysis of limited taxa. However, Tibpromma *et al*. (2017) argued that Roussoellaceae and Thyridariaceae were separate families in Pleosporales, and this was conferred in later studies using more taxa coupled with morphology and DNA sequences (Hyde *et al*. 2018a, Jiang *et al.* 2019, Phookamsak *et al.* 2019, Mapook *et al.* 2020, Poli *et al.* 2020). Roussoellaceae is now recognized as a well-resolved family in Pleosporales (Hongsanan *et al*. 2020a). Wijayawardene *et al*. (2020) listed Roussoellaceae in the 'Outline of *Fungi* and fungus-like taxa' with 12 accepted genera, viz. *Appendispora* K.D. Hyde, *Cytoplea* Bizz. & Sacc., *Elongatopedicellata* J.F. Zhang *et al*., *Immotthia* M.E. Barr, *Neoroussoella* J.K. Liu *et al.*, *Pararoussoella* Wanas. *et al*., *Pseudoneoconiothyrium* Wanas. *et al*., *Pseudoroussoella* Mapook & K.D. Hyde, *Roussoella* Sacc., *Roussoellopsis* I. Hino & Katum., *Setoarthopyrenia* Mapook & K.D. Hyde and *Xenoroussoella* Mapook & K.D. Hyde.

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Taxonomic Paper

Monilochaetes pteridophytophila (Australiascaceae, Glomerellales), a new fungus from tree fern

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Abstract

Background

During taxonomic and phylogenetic studies of fungi on pteridophytes in Thailand, *Monilochaetes pteridophytophila* sp. nov. was collected from the frond stalks of a tree fern (*Alsophila costularis*, Cyatheaceae). The new species is introduced, based on evidence from morphology and phylogenetic analyses of a concatenated dataset of LSU, ITS, SSU and RPB2 sequences.

New information

Monilochaetes pteridophytophila differs from extant species of *Monilochaetes* in having darker conidiophores with fewer septae (1–4-septate). *Monilochaetes pteridophytophila*

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Article

Morphological and Phylogenetic Analyses Reveal Five New Species in Chaetosphaeriaceae

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Abstract: Chaetosphaeriaceae is a genera-rich and highly diverse group of fungi with a worldwide distribution in terrestrial and aquatic habitats. Eight fresh collections of Chaetosphaeriaceae were obtained during investigations of hyaline-spored hyphomycetes in China and Thailand. Based on morphological characteristics and phylogenetic analysis of a combined LSU and ITS sequence dataset, *Chaetosphaeria obovoidea*, *Codinaea aseptata*, *Codinaeella hyalina*, *Dictyochaeta guizhouensis* and *Paragaeumannomyces guttulatus* were introduced as new species, *Codinaea terminalis* was reported as new host record, and *Codinaea dwaya* and *Phialosporostilbe scutiformis* were introduced as new collections. Phylogenetic analysis in this study revealed that *Chaetosphaeria* was polyphyletic. Detailed descriptions and illustrations of new taxa and identified species are provided, as well as an updated phylogenetic tree to confirm the placements of these eight new collections.

Keywords: 8 taxa; asexual morph; Chaetosphaeriales; hyaline spore; taxonomy

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1. Introduction

Reblova et al. [1] validly established the Chaetosphaeriaceae to accommodate type species *Chaetosphaeria* Tul. and C. Tul. and their relatives, including *Ascocodinaea*, *Melanochaeta*, *Melanopsammella*, *Porosphaerella*, *Porosphaerellopsis* and *Striatosphaeria*. Subsequently, more new taxa were added to this family [2–10]. Reviews of Chaetosphaeriaceae were provided by Lin et al. [9] and Hyde et al. [11]. Forty-three genera were accepted in Chaetosphaeriaceae by Hyde et al. [11]. In recent studies, Zheng et al. [12] included a new genus *Phialolunulospora* in the family. Réblová et al. [13,14] introduced six new genera namely *Arcuatospora*, *Achrochaeta*, *Ericiosphaeria*, *Flectospora*, *Phialoturbella* and *Tubulicolla*. The lineages of "*Catenularia*"-like taxa were recognized as a genus *Fuscocatenula* by Réblová et al. [15]. Five lineages, *Codinaeella*, *Nimesporella*, *Stilbochaeta*, *Tainosphaeriella* and *Xyladelphia*, were proposed for "*Codinaea*"-like fungi by Réblová et al. [16]. Meanwhile, the key to asexual genera of Chaetosphaeriaceae was provided by Maharachchikumbura et al. [17].

Chaetosphaeria (Chaetosphaeriaceae, Chaetosphaeriales), was established by Tulasne and Tulasne [18] with the type species *C. innumera* Berk. and Broome ex Tul. and C. Tul. It has simple and homogeneous sexual morphs, and complex and diverse asexual morphs [3–5,9–11,19,20]. Its members have been shown to link with several asexual genera in Chaetosphaeriaceae, including *Chloridium*, *Codinaea*, *Dictyochaeta* and *Menispora* [9,21,22]. Following the "One Fungus One Name" (1F1N) principle, some *Chaetosphaeria* species were

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Article

Four New Endophytic *Apiospora* Species Isolated from Three *Dicranopteris* Species in Guizhou, China

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Abstract: Endophytic fungi isolated from medicinal ferns serve as significant natural resources for drug precursors or bioactive metabolites. During our survey on the diversity of endophytic fungi from *Dicranopteris* species (a genus of medicinal ferns) in Guizhou, *Apoiospora* was observed as a dominant fungal group. In this study, seven *Apiospora* strains, representing four new species, were obtained from the healthy plant tissues of three *Dicranopteris* species—*D. ampla*, *D. linearis*, and *D. pedata*. The four new species, namely *Apiospora aseptata*, *A. dematiacea*, *A. dicranopteridis*, and *A. globosa*, were described in detail with color photographs and subjected to phylogenetic analyses using combined LSU, ITS, TEF1-α, and TUB2 sequence data. This study also documented three new hosts for *Apiospora* species.

Keywords: seven taxa; asexual morph; dematiaceous conidia; medicinal ferns; phylogeny; taxonomy

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1. Introduction

Apiosporaceae, typified by *Apiospora* Sacc., was established by Hyde et al. [1] to accommodate *Arthrinium*-like taxa characterized by a basauxic, *arthrinium*-like conidiogenesis producing apiospores [2,3]. Currently, only three genera, *Apiospora*, *Arthrinium* Kunze, and *Nigrospora* Zimm, are accepted in this family [4,5]. *Apiospora* Sacc. was introduced by Saccardo, P. A. [6] within the family Apiosporaceae (Amphisphaeriales, Sordariomycetes), with *A. montagnei* Sacc. as the type species. Due to the morphological similarities between the genera *Apiospora* and *Arthrinium*, they were long considered synonymous based on the one fungus one name principle [7–11]. It was not until the study by Pintos, Á. & P. Alvarado [12] that they were clarified as separate genera based on genetic, ecological, and morphological evidence. This delineation was confirmed and supported by subsequent studies [13–20]. Evidence of genome draft was employed within the fungal group *Arthrinium*/*Apiospora* for the first time, which also supported them into two separate genera [21]. Currently, 157 epithets under the genus *Apiospora* are listed in Index Fungorum (September 2023), while 116 epithets are listed in Species Fungorum. Out of these, molecular data have confirmed 91 *Apiospora* species [12–15,17–20,22].

The sexual morph of *Apiospora* is characterized by immersed to erumpent, multiloculate, perithecial ascostromata, unitunicate, broadly clavate to cylindric–clavate asci, and hyaline, ellipsoidal, inequilaterally 2-celled ascospores with or without a gelatinous sheath [5,9,10,14,22,23]. The asexual morphs of *Apiospora* include hyphomycetes and coelomycetes. The hyphomycetous asexual morphs feature septate, subhyaline, or brown conidiophores emerging from basal cells or reduced to conidiogenous cells, basauxic conidiogenous cells, and typically globose to subglobose, aseptate conidia that appear lenticular or obovoid from side view [11,13,16,18,19,24]. The coelomycetous asexual morph

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Research Article

Morpho-phylogenetic evidence reveals *Pseudolomaantha thailandica* gen. et sp. nov. and *Submultiguttulispora multiseptata* gen. et sp. nov. in Chaetosphaeriaceae

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Abstract

Anamorphic chaetosphaeriaceous fungi exhibit high morphological variability and are distributed worldwide across terrestrial and aquatic habitats. During an ongoing taxonomic study of microfungi, two intriguing chaetosphaeriaceous hyphomycetes were collected from dead wood and dead bamboo stems in China and Thailand. A polyphasic approach, combining morphological characteristics and phylogenetic analysis of LSU and ITS sequence data, revealed that these fungi represent two new genera within Chaetosphaeriaceae. *Pseudolomaantha* and *Submultiguttulispora* are proposed for these new genera, and they exhibit non-phialidic and phialidic asexual morphs, respectively. *Pseudolomaantha thailandica* **gen. et sp. nov.** is characterized by a sporidesmium-like asexual morph with macronematous, mononematous conidiophores; monoblastic conidiogenous cells, and pyriform to obclavate, rostrate conidia bearing an apical appendage. *Submultiguttulispora multiseptata* **gen. et sp. nov.** is distinguished by macronematous, mononematous conidiophores, mono- to polyphialidic conidiogenous cells, and fusiform or ellipsoidal-fusiform, pale brown to olive green to brown conidia with filiform, hyaline appendages at both ends. Detailed descriptions, illustrations, and notes on the new collections are provided, along with a key to non-phialidic hyphomycetous genera in Chaetosphaeriaceae.

Key words: 4 new taxa, asexual morph, Sordariomycetes, sporidesmium-like fungus, taxonomy

Introduction

Chaetosphaeriales was established by Huhndorf et al. (2004) to accommodate the family Chaetosphaeriaceae based on morphological characteristics and phylogenetic analysis of LSU sequence data. Currently, four families, *viz.*, Chaetosphaeriaceae, Helminthosphaeriaceae, Leptosporellaceae, and

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Research Article

Two novel hyphomycetes associated with ferns from China

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Abstract

During an ongoing investigation of fungi associated with ferns in southwestern China, three hyphomycetes were discovered on the dead rachises of *Angiopteris fokiensis* and an unidentified fern. Based on morphology and multi-gene phylogenetic analyses, *Arthrobotrys angiopteridis* and *Corynespora septata* are introduced as new species. *Arthrobotrys angiopteridis* is a nematode-trapping fungus characterized by macronematous, mononematous, hyaline conidiophores, conidiogenous cells with polyblastic denticles at each node, and 0–1-septate, clavate to elongate pyriform, hyaline conidia. *Corynespora septata* features macronematous, mononematous, pale brown to dark brown conidiophores, integrated, monotretic conidiogenous cells and up to 7-distoseptate with one true septum, subcylindrical to obclavate, hyaline to pale brown conidia. Detailed descriptions and illustrations of these two new species are provided, along with morphological comparisons of the new taxa with closely related species.

Key words: Asexual morph, new species, phylogeny, pteridophytes, taxonomy

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Introduction

Fungi associated with ferns have historically been overlooked and have received insufficient research attention, despite being an immensely promising and diverse group (Kirschner and Liu 2014; Kirschner et al. 2019; Medel-Ortiz et al. 2020). Recent studies have provided evidence supporting this perspective, with many new species of fern-associated fungi being discovered (Guatimosim et al. 2016a; Guatimosim et al. 2016b; Li et al. 2023a; Wu and Diao 2023; Zhang et al. 2023b). China has the highest fern species, with about 2,130 species, accounting for 19% of the total global fern and fern-allies species (Lin et al. 2013; Zhou et al. 2016). Notably, the Yunnan region houses approximately 1,500 fern species, while Guizhou has about 800, ranking them as the first and third most diverse regions for fern species in China (Li et al. 2015; Zhou et al. 2016). These

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