

## **Fuscosporellales, a new order of aquatic and terrestrial Hypocreomycetidae (Sordariomycetes)**

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**Abstract** – Five new dematiaceous hyphomycetes isolated from decaying wood submerged in freshwater in northern Thailand are described. Phylogenetic analyses of combined LSU, SSU and RPB2 sequence data place these hitherto unidentified taxa close to *Ascotaiwania* and *Bactrodesmiastrum*. A robust clade containing a new combination *Pseudoascotaiwania personii*, *Bactrodesmiastrum* species, *Plagiascoma frondosum* and three new species, are introduced in the new order Fuscosporellales (Hypocreomycetidae, Sordariomycetes). A sister relationship for Fuscosporellales with Conioscyphales, Pleurotheciales and Savoryellales is strongly supported by sequence data. Taxonomic novelties introduced in Fuscosporellales are four monotypic genera, viz. *Fuscosporella*, *Mucispora*, *Parafuscosporella* and *Pseudoascotaiwania*. A new taxon in its asexual morph is proposed in *Ascotaiwania* based on molecular data and cultural characters.

**Asexual fungi / new species / phylogeny / taxonomy**

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## INTRODUCTION

The subclass Hypocreomycetidae (Sordariomycetes) was introduced by Eriksson and Winka (1997) and, in the recent classification by Réblová *et al.* (2016), it comprises ten orders, i.e. the wood inhabiting Coronophorales (Mugambi & Huhndorf, 2010), the monotypic Falcocladiales (Maharachchikumbura *et al.*, 2015), Glomerellales (Réblová *et al.*, 2011), Hypocreales, Melanosporales (Hibbett *et al.*, 2007; Zhang *et al.*, 2006), Microascales (Réblová *et al.*, 2011), Savoryellales (Boonyuen *et al.*, 2011), Torpedosporales (Jones *et al.*, 2014, 2015; Schoch *et al.*, 2007), and the recently introduced orders Conioscyphales and Pleurotheciales. Most taxa in the Hypocreomycetidae have unitunicate asci with non-amyloid apical rings when present, and lack true paraphyses (Maharachchikumbura *et al.*, 2015, 2016). Species in Conioscyphales, Pleurotheciales and Savoryellales have filiform paraphyses (Réblová *et al.*, 2016).

The genus *Bactrodesmiastrum* is characterized by solitary or aggregated conidiophores, mostly reduced to brown, monoblastic, conidiogenous cells, arising from pulvinate to subpustulate sporodochial conidiomata, and moniliform or beaded hyphoid cells (Hernández-Restrepo *et al.*, 2015). Recent phylogenies based on analysis of LSU, SSU and RPB2 sequence data inferred *Bactrodesmiastrum* within Sordariomycetes incertae sedis together with *Plagiascoma frondosum* and *Ascotaiwania persoonii*. The group nests in a strongly supported clade sister to the Conioscyphales, Pleurotheciales and Savoryellales (Réblová *et al.*, 2016). However, DNA sequence data are unavailable for the type species of *Bactrodesmiastrum* and the sexual morph of *Bactrodesmiastrum* is undetermined (Hernández-Restrepo *et al.*, 2013, 2015; Holubová-Jechová, 1984). The relationships among taxa within the *Bactrodesmiastrum* clade therefore remain unresolved.

The genus *Ascotaiwania* has been connected with different hyphomycetous asexual morphs (Fallah *et al.*, 1999; Ranghoo & Hyde, 1998; Sivichai *et al.*, 1998) that suggest *Ascotaiwania* may not represent a monophyletic group. The polyphyletic nature of *Ascotaiwania* has also been shown by Réblová *et al.* (2016).

We have been carrying out a taxonomic survey of freshwater fungi on submerged wood along a north/south gradient in the Asian/Australasian region (Hyde *et al.*, 2016). In this study, descriptions and molecular data of several dematiaceous hyphomycetes are provided based on collections from Prachuap Khiri Khan Province, Thailand. The placement of *Bactrodesmiastrum* clade and *Ascotaiwania* is discussed.

## MATERIALS AND METHODS

### Collection and examination of specimen

Specimens of submerged, decaying wood were collected from streams in Prachuap Khiri Khan Province, Thailand, in December 2014. The material was brought to the laboratory in plastic bags and incubated in plastic boxes lined with moistened tissue paper at room temperature for one week. The samples were processed and examined following the method described in Taylor & Hyde (2003). Morphological observations were made using a Motic SMZ 168 Series dissecting

microscope for fungal fruiting bodies. The fungi were examined using a Nikon ECLIPSE 80i compound microscope and photographed with a Canon 600D digital camera fitted to the microscope. Measurements were made with the Tarosoft (R) Image Frame Work program and images used for figures were processed with Adobe Photoshop CS6 software. Single spore isolations were made on potato dextrose agar (PDA) and later transferred onto malt extract agar (MEA), following the method of Chomnunti *et al.* (2014). Specimens (dried wood with fungal material) are deposited in the herbarium of Mae Fah Luang University (MFLU), Chiang Rai, Thailand. Axenic cultures are deposited in Mae Fah Luang University Culture Collection (MFLUCC) and the Guizhou Culture Collection (GZCC). Facesoffungi and Index Fungorum numbers are registered as outlined in Jayasiri *et al.* (2015) and Index Fungorum (2016).

### DNA extraction, PCR amplification and sequencing

Total genomic DNA was extracted from fresh fungal mycelia (50 to 100 mg) scraped from the margin of a colony on a MEA plate, incubated at 25°C for 2 to 3 weeks (Wu *et al.*, 2001). The primer pairs LR0R and LR5 as defined by Vilgalys & Hester (1990) were used to amplify a segment of the large subunit rDNA (LSU), NS1 and NS4 (White *et al.*, 1990) for the nuclear ribosomal small subunit (SSU), fRPB2-5F and fRPB2-7cR (Liu *et al.*, 1999) for the amplification of the second largest subunit of RNA polymerase II (RPB2). The amplifications were performed in 25 µL of PCR mixtures containing 9.5 µL ddH<sub>2</sub>O, 12.5 µL 2 × PCR Master Mix (TIANGEN Co., China), 1 µL of DNA template and 1 µL of each primer (10 µM). Conditions of amplification for all regions consisted of an initial denaturation step of 5 min at 94°C and final extension step of 10 minutes at 72°C. For the SSU and LSU amplification, the 37 cycles consisted of denaturation at 94°C for 1 minute, annealing at 54°C for 50 seconds and elongation at 72°C for 1 minute; for the RPB2 amplification the 37 cycles consisted of denaturation at 95°C for 15 seconds, annealing at 56°C for 50 seconds and elongation at 72°C for 2 minutes. The PCR products were viewed on 1 % agarose electrophoresis gels stained with ethidium bromide. Purification and sequencing of PCR products were carried out at Invitrogen Biotechnology Co., Shanghai, China. DNASTAR Lasergene SeqMan Pro v.8.1.3 was used to obtain consensus sequences from sequences generated from forward and reverse primers and these were subsequently lodged with GenBank (Table 1).

### Phylogenetic analysis

Most of the taxa used in this study are derived from Réblová *et al.* (2016). The alignments were checked visually and improved manually where necessary with MEGA v.7 (Kumar *et al.*, 2012). Phylogenetic analyses of the sequence data consisted of maximum likelihood (ML) and maximum parsimony (MP) analyses of the combined aligned dataset.

A ML analysis was performed using raxmlGUI v.1.3 (Silvestro & Michalak, 2011). The optimal ML tree search was conducted with 1000 separate runs, using the default algorithm of the program from a random starting tree for each run. The final tree was selected among suboptimal trees from each run by comparing likelihood scores under the GTRGAMMA substitution model. The MP analysis was performed with PAUP (Phylogenetic Analysis Using Parsimony) v. 4.0b10 (Swofford, 2003). Trees were inferred by using the heuristic search option with TBR branch swapping

Table 1. GenBank accession numbers of isolates in the phylogenetic study. The newly generated sequences are indicated in black bold

<i>Species</i>	<i>Source</i>	<i>GenBank accession no.</i>		
		<i>LSU</i>	<i>SSU</i>	<i>RPB2</i>
<i>Achroceratosphaeria potamia</i>	JF 08139	GQ996538	GQ996541	–
<i>Adelosphaeria catenata</i>	CBS 138679	KT278707	KT278692	KT278743
<i>Anthostomella torosa</i>	AFTOL-ID 732	DQ836902	DQ836895	DQ836885
<b><i>Ascotaiwania fusiformis</i></b>	<b>MFLUCC 15-0621</b>	<b>KX550893</b>	–	<b>KX576871</b>
<b><i>Ascotaiwania fusiformis</i></b>	<b>MFLUCC 15-0625</b>	<b>KX550894</b>	<b>KX550898</b>	–
<i>Ascotaiwania hughesii</i>	P 2-6	AY094189	–	–
<i>Ascotaiwania lignicola</i>	NIL 00006	HQ446365	HQ446285	–
<i>Ascotaiwania lignicola</i>	NIL 00005	HQ446364	HQ446284	HQ446419
<i>Ascotaiwania limnetica</i>	CBS 126792	–	KT278690	–
<i>Ascotaiwania limnetica</i>	CBS 126576	–	KT278689	–
<i>Ascotaiwania mitriformis</i>	HKUCC 3706	AF132324	–	–
<i>Ascotaiwania sawadae</i>	SS 00051	HQ446363	HQ446283	HQ446418
<i>Bactrodesmiastrum monilioides</i>	FMR 10756	KF771879	–	–
<i>Bactrodesmiastrum obovatum</i>	FMR 6482	FR870266	–	–
<i>Bactrodesmiastrum pyriforme</i>	FMR 10747	FR870265	–	–
<i>Bactrodesmiastrum pyriforme</i>	FMR 11931	HE646637	–	–
<i>Bertia moriformis</i>	SMH 3344, SMH 4320	AY695261	–	AY780151
<i>Calosphaeria pulchella</i>	CBS 115999	AY761075	AY761071	GU180661
<i>Camaropella pugillus</i>	SMH 3846	EU481406	–	–
<i>Camarops microspora</i>	CBS 649.92	AY083821	DQ471036	DQ470937
<i>Canalisporium exiguum</i>	SS 00809	GQ390281	GQ390266	HQ446436
<i>Canalisporium grenadoidia</i>	BCC 20507	GQ390267	GQ390252	HQ446420
<i>Canalisporium pulchrum</i>	SS 03982	GQ390277	GQ390262	HQ446431
<i>Ceratocystis adiposa</i>	CCFC 212726, CBS 600.74	AY281101	EU984263	–
<i>Ceratocystis fimbriata</i>	C 89, CBS 374.83	U17401	HQ908495	DQ368641
<i>Ceratospaeria lampadophora</i>	CBS 117555	AY761084	AY761088	–
<i>Chaetosphaerella phaeostroma</i>	SMH 4585	AY346274	–	AY780172
<i>Chaetosphaeria ciliata</i>	ICMP 18253	GU180637	GU180614	GU180659
<i>Chaetosphaeria curvispora</i>	ICMP 18255, CBS 113644	GU180636	AY502933	GU180655
<i>Conioscypha lignicola</i>	CBS 33593	AY484513	JQ437439	JQ429260
<i>Conioscypha minutispora</i>	CBS 137253	KF924559	–	–
<i>Conioscypha peruviana</i>	ILL 41202	KF781539	–	–
<i>Conioscypha varia</i>	CBS 113653	AY484512	AY484512	AY484512
<i>Cornipulvina ellipsoides</i>	SMH 1378	DQ231441	–	–
<i>Corollospora maritima</i>	AFTOL-ID 5011, CBS 264.59	FJ176901	U46871	DQ368632

<i>Species</i>	<i>Source</i>	<i>GenBank accession no.</i>		
		<i>LSU</i>	<i>SSU</i>	<i>RPB2</i>
<i>Custingophora olivacea</i>	CBS 335.68,	AF178566	JX070460	GU180665
<i>Diaporthe phaseolorum</i>	FAU 458, NRRL 13736	U47830	L36985	AY641036
<i>Etheiophora blepharospora</i>	JK 5397A	EF027723	–	EF027731
<i>Falcocladium multivesiculatum</i>	CBS 120386	JF831932	JF831928	–
<i>Falcocladium sphaeropedunculatum</i>	CBS 111292	JF831933	JF831929	–
<i>Flammispora bioteca</i>	BCC 13367	–	AY722100	–
<i>Fulvocentrum aegyptiacus</i>	CY 2973	AY858950	AY858943	–
<i>Fulvocentrum clavatisporium</i>	LP 83	AY858952	AY858945	–
<b><i>Fuscosporella pyriformis</i></b>	<b>MFLUCC 16-0570</b>	<b>KX550896</b>	<b>KX550900</b>	<b>KX576872</b>
<i>Gaeumannomyces graminis</i>	AR 3401, M 57	AF362557	JF414874	–
<i>Gelasinospora tetrasperma</i>	CBS 178.33	DQ470980	DQ471032	DQ470932
<i>Glomerella cingulata</i>	MCA 2498, FAU 513	DQ286199	M55640	DQ858455
<i>Gnomonia gnomon</i>	CBS 199.53	AF408361	DQ471019	DQ470922
<i>Gondwanamyces proteae</i>	CBS 486.88	AF221011	AY271804	–
<i>Graphium penicillioides</i>	C 1505, AFTOL-ID 1415	AF222500	DQ471038	DQ470938
<i>Graphostroma platystoma</i>	CBS 270.87,	DQ836906	DQ836900	DQ836893
<i>Helicoon farinosum</i>	DAOM 241947	JQ429230	–	–
<i>Jattaea algeriensis</i>	STE-U 6399, STE-U 6201, CBS 120871	EU367457	EU367462	HQ878603
<i>Juncigena adarca</i>	JK 5235A	EF027726	EF027719	EF027734
<i>Kylindria peruamazonensis</i>	CBS 838.91	GU180638	GU180609	GU180656
<i>Lasiosphaeria ovina</i>	SMH 1538, CBS 958.72, SMH 3286	AF064643	AY083799	AY600292
<i>Leotia lubrica</i>	AFTOL-ID 1	AY544644	AY544746	DQ470876
<i>Lignincola laevis</i>	JK-5180A, A169-1D	U46890	AF050487	DQ836886
<i>Lindra thalassiae</i>	AFTOL-ID 413	DQ470947	DQ470994	–
<i>Lulwoana uniseptata</i>	AFTOL-ID 5014, CBS 16760	FJ176904	AY879034	–
<i>Lulworthia fucicola</i>	PP 1235, C 21-1	AF491270	AF05048	–
<i>Magnaporthe grisea</i>	Ina168	–	AB026819	DQ493955
<i>Magnisphaera stevemossago</i>	Unknown	JF14106	–	–
<i>Melanospora tiffanii</i>	ATCC 15515	AY015630	AY01561	AY015637
<i>Melanospora zamiae</i>	ATCC 12340	AY046579	AY046578	DQ368634
<i>Melanotrigonum ovale</i>	M.R. 3685	JQ429230	–	–
<i>Melanotrigonum ovale</i>	CBS 138815	KT278711	KT278698	KT278747
<i>Melanotrigonum ovale</i>	CBS 138742	KT278708	KT278695	KT278744
<i>Microascus trigonosporus</i>	CBS 218.31, ATCC 52470	DQ470958	DQ471006	AF107792
<i>Microglossum rufum</i>	AFTOL-ID 1292	DQ470981	DQ471033	DQ470933
<i>Monilochaetes infuscans</i>	CBS 379.77	GU180645	GU180619	GU180658

Table 1. GenBank accession numbers of isolates in the phylogenetic study. The newly generated sequences are indicated in black bold (*continued*)

Species	Source	GenBank accession no.		
		LSU	SSU	RPB2
<i>Mucispora obscuriseptata</i>	<b>MFLUCC 15-0618</b>	<b>KX550892</b>	<b>KX550897</b>	<b>KX576870</b>
<i>Muraeriata africana</i>	GKM 1084	EU527995	–	–
<i>Parafuscosporella moniliformis</i>	<b>MFLUCC 15-0626</b>	<b>KX550895</b>	<b>KX550899</b>	–
<i>Peethambara spirostriata</i>	CBS 110115	AY489724	AY489692	EF692516
<i>Petriella setifera</i>	CCFC 226737, CBS 385.87, CBS 110344	AY281100	U43908	DQ368640
<i>Phaeoisaria clematidis</i>	CBS 113340	EU552148	–	–
<i>Phaeoisaria fasciculata</i>	DAOM 230055	KT278706	KT278694	KT278742
<i>Phaeoisaria sedimenticola</i>	CGMCC 3.14949	JQ031561	–	–
<i>Phaeoisaria sparsa</i>	FMR 11939	HF677185	–	–
<i>Phragmocephala stemphylioides</i>	DAOM 673211	KT278717	–	–
<i>Pisorisporium cymbiforme</i>	PRM 924378	KM588902	KM588899	KM588905
<i>Pisorisporium cymbiforme</i>	PRM 924379	KM588903	KM588900	KM588906
<i>Plagiascoma frondosum</i>	CBS 127885	KT278705	KT278693	KT278741
<i>Pleurotheciella centenaria</i>	DAOM 229631	JQ429234	JQ429246	JQ429265
<i>Pleurotheciella rivularia</i>	CBS 125237	JQ429233	JQ429245	JQ429264
<i>Pleurotheciella uniseptata</i>	KAS 4459	KT278716	–	–
<i>Pleurothecium recurvatum</i>	CBS 131272	JQ429237	JQ429251	JQ429251
<i>Pleurothecium recurvatum</i>	CBS 138747	KT278714	KT278703	–
<i>Pleurothecium semifecundum</i>	CBS 131271	JQ429240	JQ429254	JQ429270
<i>Pleurothecium semifecundum</i>	CBS 131482	JQ429239	JQ429253	–
<i>Pontogeneia microdictyi</i>	JK 5748	–	EU863582	–
<i>Pseudoascotaiwania persoonii</i>	A57 14C	AY590295	–	–
<i>Reticulascus clavatus</i>	CBS 125296	GU180643	GU180622	–
<i>Rostrupiella danica</i>	BBH 16759	DQ394094	–	–
<i>Savoryella longispora</i>	SAT 00322	HQ446380	HQ446302	HQ446450
<i>Savoryella paucispora</i>	SAT 00866	HQ446381	HQ446303	HQ446451
<i>Savoryella verrucosa</i>	SS 00052	HQ446374	HQ446298	HQ446445
<i>Sordaria fimicola</i>	SMH 4106, MUCL 937, CBS 723.96	AY780079	X69851	DQ368647
<i>Sterigmatobotrys macrocarpa</i>	PRM 915682	GU017317	JQ429255	–
<i>Sterigmatobotrys macrocarpa</i>	CBS 113468	–	–	JQ429271
<i>Swampomyces armeniacus</i>	JK 5059C	EF027728	EF027721	–
<i>Swampomyces triseptatus</i>	CY 2802	AY858953	AY858942	–
<i>Taeniolella rudis</i>	DAOM 229838	JQ429241	JQ429256	JQ429272
<i>Togniniella microspora</i>	CBS 113648, ICMP 18256	AY761076	AY761073	GU180660
<i>Torpedospora ambispinosa</i>	CY 3386	AY858946	AY858941	–

Species	Source	GenBank accession no.		
		LSU	SSU	RPB2
<i>Torpedospora radiata</i>	JK 5252C	EF027730	EF027722	EF027737
<i>Triadelphia uniseptata</i>	DAOMC 250376	KT278718	–	–
<i>Trichoderma viride</i>	GJS 89-127, IFFI 13001, GJS 92-14	AY489726	AF525230	EU252006
<i>Valsa ambiens</i>	AFTOL-ID 2131	AF362564	DQ862056	DQ862025
<i>Xylaria hypoxylon</i>	AFTOL-ID 51	AY544648	AY544692	DQ470878

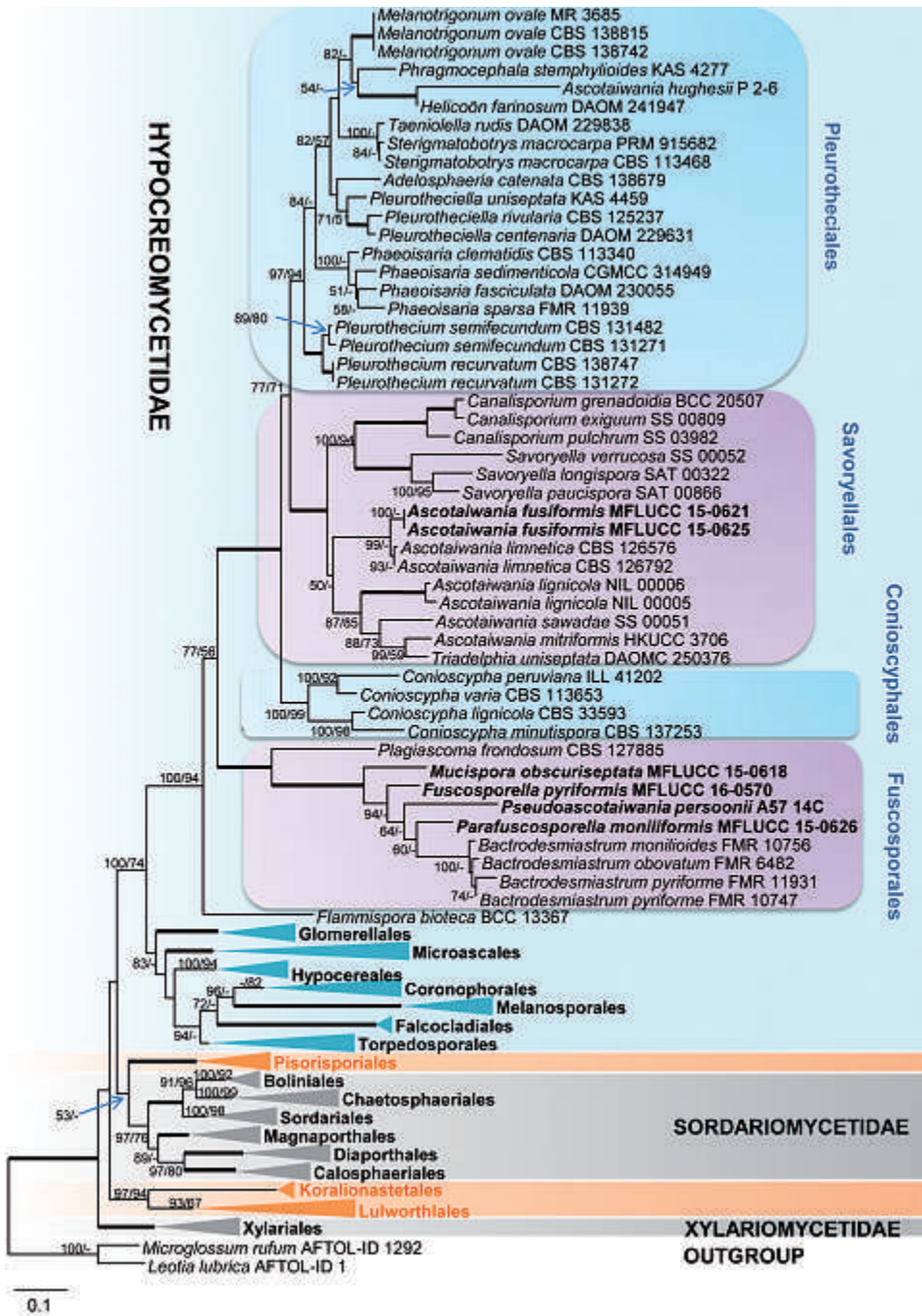
and 1 000 random sequence additions. The maximum number of retained trees were limited to 5 000, branches of zero length were collapsed and all multiple equally most parsimonious trees were saved. Tree length [TL], consistency index [CI], retention index [RI], rescaled consistency index [RC], homoplasy index [HI], and log likelihood [-ln L] (HKY model) values were calculated. The robustness of the equally most parsimonious trees was evaluated by 1 000 bootstrap replications (Felsenstein, 1985) resulting from a maximum parsimony analysis, each with 10 replicates of random stepwise addition of taxa. The Kishino-Hasegawa tests (Kishino & Hasegawa, 1989) were performed to determine whether the trees inferred under different optimality criteria were significantly different.

The resulting trees were printed with FigTree v. 1.4.0 (<http://tree.bio.ed.ac.uk/software/figtree/>), and the layout was created in Adobe Illustrator CS v. 6. The alignment of phylogenetic analysis was deposited in TreeBASE (20016).

## RESULTS

### Phylogenetic analyses

The final alignment consisted of combined LSU, SSU, RPB2 sequence data for 109 members in Sordariomycetes with *Leotia lubrica* and *Microglossum rufum* as the outgroup taxa. The parsimony analysis indicated that 1204 characters were constant, 456 variable characters parsimony-uninformative and 1706 characters parsimony-informative. After a heuristic search using PAUP, 24 equally most parsimonious trees were obtained (tree-length = 16293 steps, CI = 0.260, RI = 0.588, RC = 0.153, HI = 0.740). The ML resulted in a tree with the same topology and clades as the MP trees. The best scoring RAxML tree is shown in Figure 1. Phylogenetic analyses indicated that *Ascotaiwania* is polyphyletic. Therefore, a new genus *Pseudoascotaiwania* is established to accommodate the distinct taxon *Ascotaiwania persoonii* which clusters far away from the type species of *Ascotaiwania*. In Savoryellales, two strains of the unidentified taxa cluster together in *Ascotaiwania*. They are shown to be the same species based on both morphological and molecular data and named *Ascotaiwania fusiformis*. The other three strains are placed in a strongly supported monophyletic lineage containing *Pseudoascotaiwania persoonii*, three species from the dematiaceous hyphomycetous genus *Bactrodesmiastrum* and one recently introduced monotypic ascomycete genus





*Plagiascoma*. This clade is introduced as the new order Fuscosporellales, as a sister clade to Conioscyphales, Pleurotheciales and Savoryellales. Three strains represent three new genera as *Fuscosporella*, *Mucispora* and *Parafuscosporella*.

## Taxonomy

### Fuscosporellales J. Yang, J. Bhat & K.D. Hyde, **ord. nov.**

*Index Fungorum number*: IF552288

*Facesoffungi number*: FoF 02420

*Saprobic* on twigs in terrestrial or aquatic habitats. **Sexual morph** *Ascomata* perithecial, astromatic, immersed to semi-immersed, dark brown to black, papillate or with a neck. *Ostiole* periphysate. *Ascomatal wall* fragile, several layered. *Hamathecium* of true, septate paraphyses. *Asci* unitunicate, cylindrical to cylindrical-fusiform, stipitate, 8-spored, apex with a non-amyloid apical ring. *Ascospores* fusiform, uniseriate, hyaline or light brown, transversely septate. **Asexual morph** *Conidiomata* sporodochial. *Conidiophores* micronematous, macronematous, mononematous, usually reduced to conidiogenous cells. *Conidiogenous cells* blastic, hyaline, obovate to globose. *Conidia* brown, uniseptate, obovate to obpyriform.

*Type family*: Fuscosporellaceae

### Fuscosporellaceae J. Yang, J. Bhat & K.D. Hyde, **fam. nov.**

*Index Fungorum number*: IF552321

*Facesoffungi number*: FoF 02421

*Saprobic* on twigs from freshwater habitats. **Sexual morph** Undetermined. **Asexual morph** *Conidiophores* macronematous, mononematous, branched, hyaline or colourless. *Conidiogenous cells* blastic, globose to clavate. *Conidia* obovate to obpyriform, with a septum near the base, smooth, brown to dark brown; basal cell pale brown, trapeziform or triangular.

*Type genus*: *Fuscosporella*

### *Fuscosporella* J. Yang, J. Bhat & K.D. Hyde, **gen. nov.**

*Index Fungorum number*: IF552289

*Facesoffungi number*: FoF 02422

*Etymology*: “Fusca” meaning brown, referring to the dark brown conidia

*Saprobic* on twigs from freshwater habitats. **Sexual morph** Undetermined.

**Asexual morph** *Colonies* on natural substrate sporodochial, scattered, black. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophores* macronematous, mononematous, branched, hyaline or colourless, smooth-walled. *Conidiogenous cells* monoblastic, holoblastic, integrated, terminal, globose, subglobose, ellipsoidal or clavate, hyaline. *Conidia* acrogenous, obovate to

◀ Fig. 1. Maximum likelihood (ML) majority rule consensus tree for the analyzed Sordariomycetes isolates based on a dataset of combined LSU, SSU and RPB2 sequence data. RAxML bootstrap support values (ML) and maximum parsimony bootstrap support values (MP) more than 50 are given at the nodes (ML/MP). The scale bar represents the expected number of changes per site. The tree is rooted with *Leotia lubrica* and *Microglossum rufum*. The original isolate numbers are noted after the species names. The new strains are in bold. Branches with 100% bootstrap (100ML/100MP) are thickened. Orders and subclasses are indicated as coloured blocks.

obpyriform, with a septum near the base, smooth, brown to dark brown; basal cell pale brown, trapeziform or triangular.

*Type species: Fuscosporella pyriformis*

***Fuscosporella pyriformis*** J. Yang, J. Bhat & K.D. Hyde, *sp. nov.*

**Figs 2-3**

*Index Fungorum number:* IF552304

*Facesoffungi number:* FoF 02423

*Etymology:* Referring to the pyriform conidia.

*Holotype:* MFLU 16-1979

*Saprobic* on twigs from freshwater habitats. **Asexual morph** Colonies on natural substrate sporodochial, scattered, black. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophores* macronematous, mononematous, branched, hyaline or colourless, smooth-walled. *Conidiogenous cells* monoblastic, holoblastic, integrated, terminal, globose, subglobose, ellipsoidal or clavate, hyaline,  $7.5\text{-}23 \times 3.5\text{-}9 \mu\text{m}$ . *Conidia* acrogenous, obovate to obpyriform,  $23.5\text{-}36 \times 14\text{-}21 \mu\text{m}$  ( $\bar{x} = 29.5 \times 17 \mu\text{m}$ ,  $n = 45$ ), with a septum near the base, smooth, brown to dark brown; basal cell pale brown, trapeziform or triangular. **Sexual morph** Undetermined.

*Culture characteristics:* Conidia germinating on PDA within 24 h. Germ tubes produced from both ends. Colonies on PDA reaching 1-2 mm diam. after one month at 25°C, in natural light, circular, dark brown, with sparse aerial mycelium on the inner circle and mostly immersed hyphae on the outer ring surrounded by fragmentary hyphae, with entire margin on the surface, dark brown to black in reverse, concave in the middle. Conidial formation from single spore germination on PDA. Sporulation appear first in the center of the colony, later in the outer fragmentary immersed hyphae. *Conidiophores* reduced to a monoblastic conidiogenous cell, hyaline to greyish brown. *Conidiogenous cells* integrated, short,  $4\text{-}7 \times 2.5\text{-}7 \mu\text{m}$ . *Conidia* variedly-shaped, filamentous to helicoid, elongated and branched when uncoiled, septate, many-celled, with rectangular to elongate cells, smooth, dark brown, guttulate,  $19\text{-}38 \mu\text{m}$  diam.,  $22\text{-}74 \mu\text{m}$  long,  $9\text{-}18 \mu\text{m}$  wide.

*Habitat and distribution:* On submerged wood in freshwater, Thailand.

*Material examined:* THAILAND, Prachuap Khiri Khan Province, freshwater stream, on decaying submerged wood, 25 December 2014, Jaap van Strien, Site5-27-1 (MFLU 16-1979, **holotype**), ex-type living culture, MFLUCC 16-0570, GZCC 15-0081; *ibid.* (HKAS95050, **isotype**).

*Notes:* The morphology of sporulating structures of *Fuscosporella pyriformis* on wood is different from that developed on PDA. Obpyriform, uniseptate, dark conidia are found on natural substrates, while filamentous to helicoid, multi-septate conidia are produced on the media. Hyaline, subglobose conidiogenous cells are produced as small, colourless to brown cells. *Fuscosporella pyriformis* resembles *Vanakripa gigaspora* Bhat, W. B. Kendr. & Nag Raj in its sporodochial conidiomata, and brown, obpyriform, uniseptate conidia. However, the vermiform separating cells present in *Vanakripa gigaspora* are absent in *Fuscosporella pyriformis* (Tusi *et al.*, 2003).

***Parafuscosporella*** J. Yang, J. Bhat & K.D. Hyde, *gen. nov.*

*Index Fungorum number:* IF552292

*Facesoffungi number:* FoF 02424

*Etymology:* Referring to the similar genus *Fuscosporella*

*Saprobic* on twigs from freshwater habitats. **Asexual morph** Colonies on natural substratum effuse, scattered, sporodochial, erumpent, spherical, velvety,

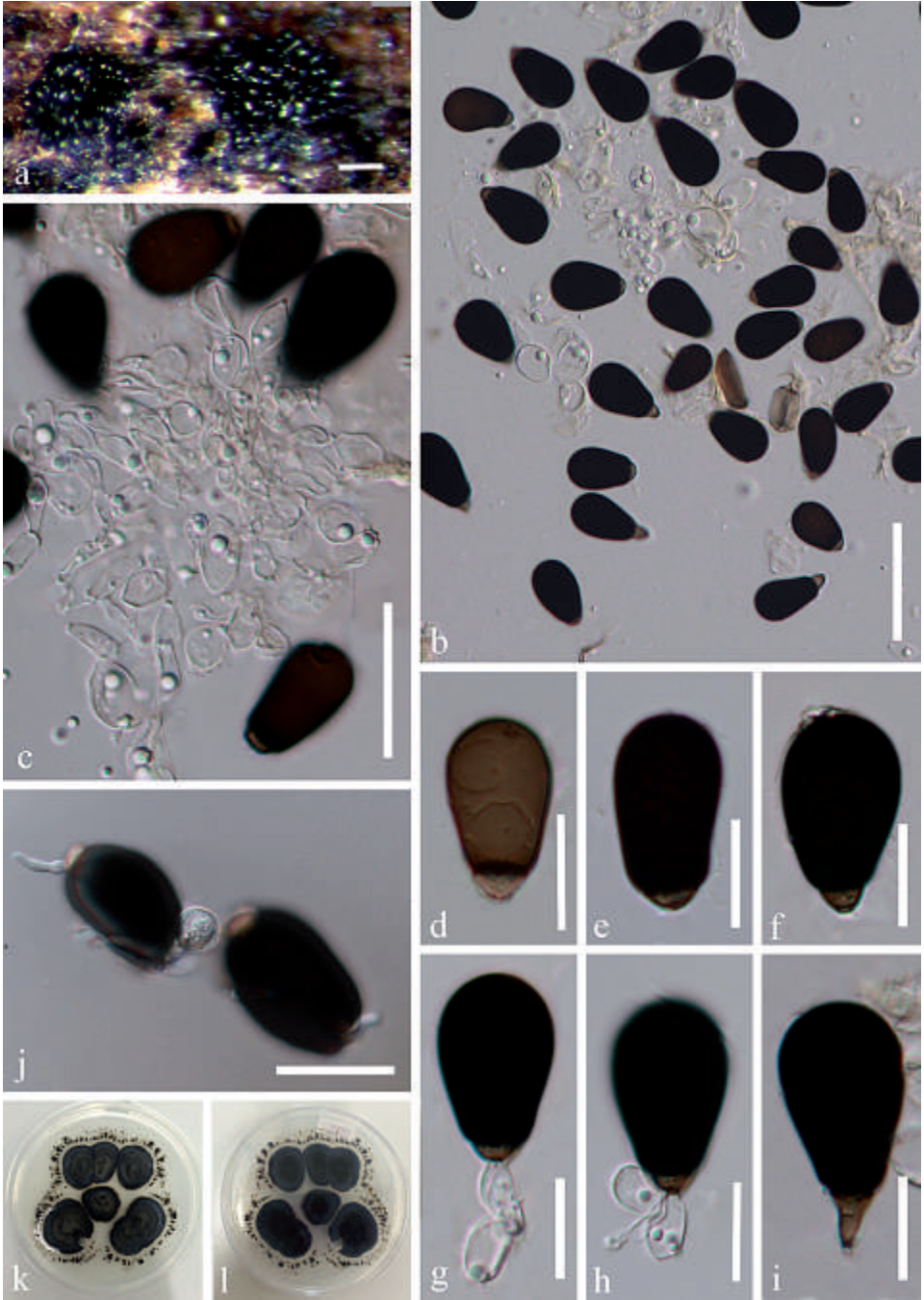


Fig. 2. *Fuscosporella pyriformis* (MFLU 16-1979, holotype) a. Sporodochia on wood. b. Squash mount of a sporodochium. c. Conidiogenous cells. d–i. Conidia. j. Germinated conidia on PDA. k, l. Culture, k from above, l from below. Scale bars: a = 100  $\mu$ m, b = 30  $\mu$ m, c, j = 20  $\mu$ m, d–i = 10  $\mu$ m.

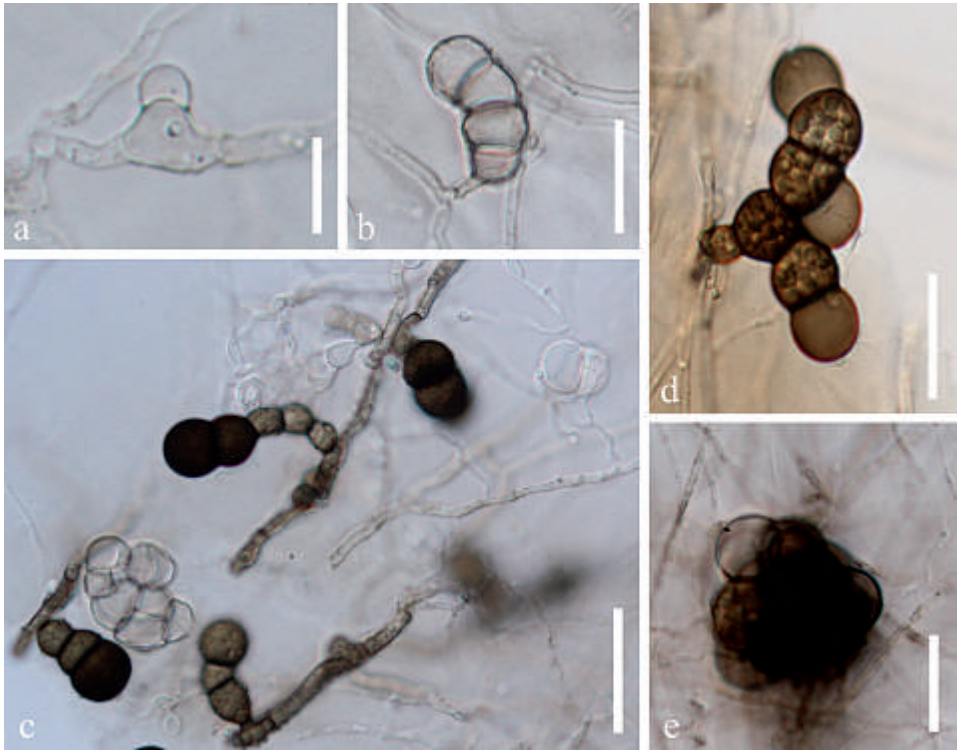


Fig. 3. Sporulation of *Fuscosporella pyriformis* on PDA. **a-c.** Conidia and conidiogenous cells on PDA. **d, e.** Conidia. Scale bars: a = 10  $\mu\text{m}$ , b, d, e = 20  $\mu\text{m}$ , c = 30  $\mu\text{m}$ .

black. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline to pale brown hyphae. *Conidiophores* semi-macronematous, mononematous, compact, flexuous, simple or branched, mostly moniliform, with globose to subglobose, ellipsoidal or clavate cells, hyaline, smooth-walled. *Conidiogenous cells* monoblastic, integrated, sometimes discrete, terminal, globose, subglobose, ellipsoidal or clavate, hyaline, smooth-walled. *Conidia* acrogenous, ellipsoidal to broadly obpyriform, with a septum near the base, sometimes with a small protuberance, smooth, dark brown to black, pale brown at basal cell. **Sexual morph** Undetermined.

*Type species:* *Parafuscosporella moniliformis*

***Parafuscosporella moniliformis*** J. Yang, J. Bhat & K.D. Hyde, **sp. nov.** Figs 4-5

*Index Fungorum number:* IF552290

*Facesoffungi number:* FoF 02425

*Etymology:* Referring to the moniliform conidiogenous cells.

*Holotype:* MFLU 15-1161

*Saprobic* on twigs from freshwater habitats. **Asexual morph** *Colonies* on natural substratum effuse, black. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline to pale brown hyphae. *Conidiomata* sporodochial, spherical, velvety, scattered. *Conidiophores* micronematous to macronematous,

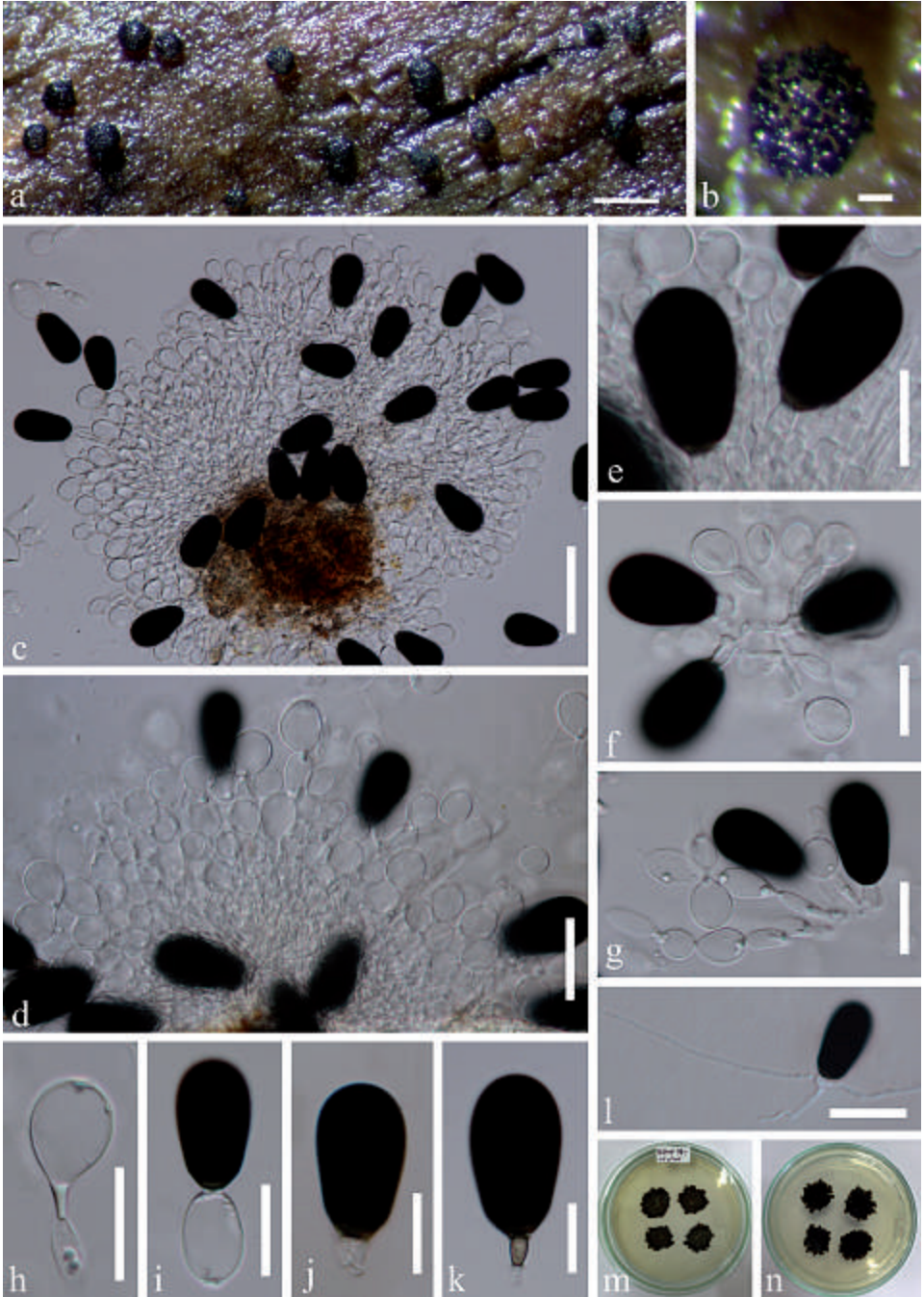


Fig. 4. *Parafuscosporella moniliformis* (MFLU15-1161, holotype) **a, b**. Sporodochia on submerged wood. **c, d**. Squash mount of a sporodochium. **e-g**. Conidiophores and conidia. **h-k**. Conidia. **l**. Germinated conidium on PDA. **m, n**. Culture on MEA, m from above, n from below. Scale bars: a = 500  $\mu$ m, b, c = 50  $\mu$ m, d, l = 30  $\mu$ m, e-i = 20  $\mu$ m, j, k = 15  $\mu$ m.

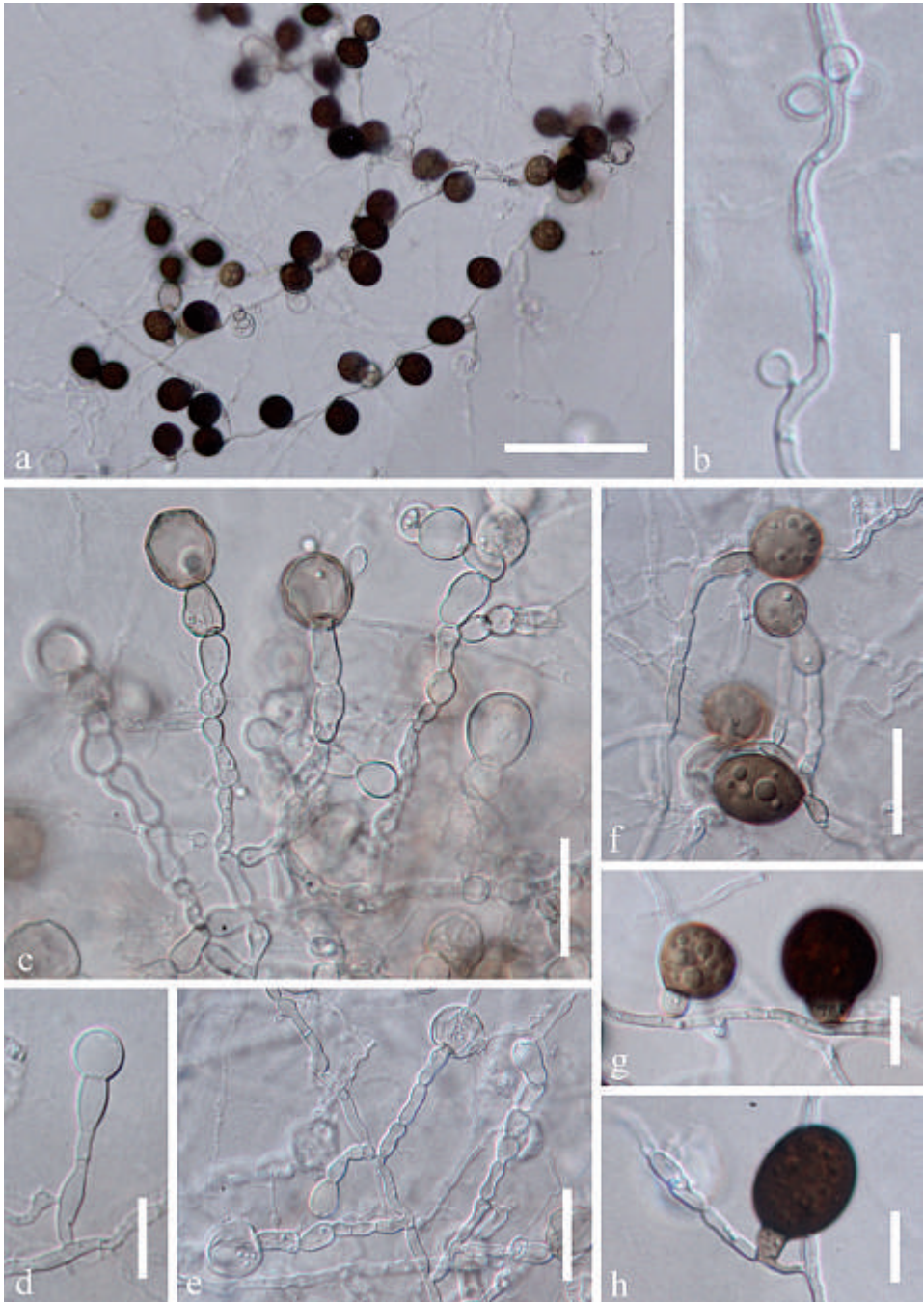


Fig. 5. Sporulation of *Parafuscosporella moniliformis* on PDA. **a.** Conidia on PDA. **b-f.** Conidia and conidiogenous cells on PDA. **g, h.** Conidia. Scale bars: a = 30  $\mu\text{m}$ , b, d, g, h = 5  $\mu\text{m}$ , c, e, f = 10  $\mu\text{m}$ .

mononematous, compact, flexuous, simple or branched, mostly moniliform, with globose to subglobose, ellipsoidal or clavate cells, hyaline, smooth-walled,  $13\text{--}60 \times 3.5\text{--}6 \mu\text{m}$ , with each cell  $13.5\text{--}23 \times 3.5\text{--}6 \mu\text{m}$ . *Conidiogenous cells* monoblastic, integrated, sometimes discrete, terminal, globose, subglobose, ellipsoidal or clavate, hyaline, smooth-walled,  $5.5\text{--}36 \times 5\text{--}21 \mu\text{m}$ . *Conidia* acrogenous, ellipsoidal to broadly obpyriform, with a septum near the base, sometimes with a small ( $6\text{--}7 \times 3.5\text{--}4 \mu\text{m}$ ) protuberance, smooth, dark brown to black, pale brown at basal cell,  $28\text{--}37 \times 14\text{--}21 \mu\text{m}$  ( $\bar{x} = 32 \times 17 \mu\text{m}$ ,  $n = 40$ ). **Sexual morph** Undetermined.

*Culture characteristics*: Conidia germinating on PDA within 24 h. Germ tubes produced from the basal cell. Colonies on MEA reaching 1–2 cm diam. after one month at 25°C, in natural light, irregularly layered, dark brown, with sparse mycelium on the surface, dark brown to black in reverse, with undulate margin. Conidial formation from single spore germination on PDA. Sporulation appears first in the centre of the colony, later over the whole colony. Conidiophores macronematous, branched, sometimes reduced to a single conidiogenous cell, rising from the aerial and submerged hyphae, 12–110  $\mu\text{m}$  long, 2.5–8  $\mu\text{m}$  wide, hyaline to pale brown. Conidiogenous cells monoblastic, holoblastic, integrated, cylindrical, subglobose or dumbbell-shaped, hyaline to pale brown,  $5\text{--}15 \times 2\text{--}10 \mu\text{m}$ . Conidia globose to subglobose, medium brown to dark brown when mature, aseptate to uniseptate, sometimes with paler, triangular basal cell or with a small ( $9\text{--}15 \times 3\text{--}4.5 \mu\text{m}$ ) protuberance,  $15.5\text{--}24.5 \times 13\text{--}18.5 \mu\text{m}$  ( $\bar{x} = 19.5 \times 16 \mu\text{m}$ ,  $n = 20$ ).

*Habitat and distribution*: On submerged wood in freshwater, Thailand.

*Material examined*: THAILAND, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream, 25 December 2014, Jaap van Strien, Site4-48-1 (MFLU 15-1161, **holotype**), ex-type living culture, MFLUCC 15-0626; *ibid.* (HKAS 95049, **isotype**).

*Notes*: Morphologically, there are very few characters to distinguish *Parafuscosporella* and *Fuscosporella*. However, the two genera are clearly distinct based on molecular data. *Parafuscosporella moniliformis* is similar to *Fuscosporella pyriformis* in characters of conidiophores, conidiogenous cells and conidia on wood. However the genera differ as *Fuscosporella* forms filamentous to helicoid conidia in culture, whereas *Parafuscosporella* produces aseptate or uniseptate, trichocladium-like or humicola-like conidia. Phylogenetic analysis (Fig. 1) indicates that *Parafuscosporella moniliformis* is a sister taxon to *Bactrodesmiastrum* species and *Pseudoascotaiwania personii*, but with weak support. *Parafuscosporella moniliformis* differs from *Bactrodesmiastrum monilioides* (Hernandez-Restrepo *et al.*, 2015) by its larger uniseptate conidia and hyaline conidiogenous cells.

***Parafuscosporella mucosa* J. Yang J. Bhat & K.D. Hyde, sp. nov.**

**Figs 6–7**

*Index Fungorum number*: IF552305

*Facesoffungi number*: FoF 02426

*Etymology*: Referring to the slimy conidiomata

*Holotype*: MFLU 16-1980

*Saprobic* on twigs from freshwater habitats. **Asexual morph** Colonies on natural substrate black, sporodochial, scattered, with jelly-like cover, velvety. *Mycelium* partly immersed, partly superficial, composed of septate, hyaline hyphae. *Conidiophores* macronematous, mononematous, cylindrical, erect, hyaline, smooth-walled, 12.5–37  $\mu\text{m}$  long, 4–9  $\mu\text{m}$  wide. *Conidiogenous cells* monoblastic, integrated, terminal, globose, subglobose, ellipsoidal or clavate, hyaline, smooth-walled, 7–17  $\mu\text{m}$  long, 4–12  $\mu\text{m}$  wide. *Conidia* acrogenous, obovoid to obpyriform, with a septum near the

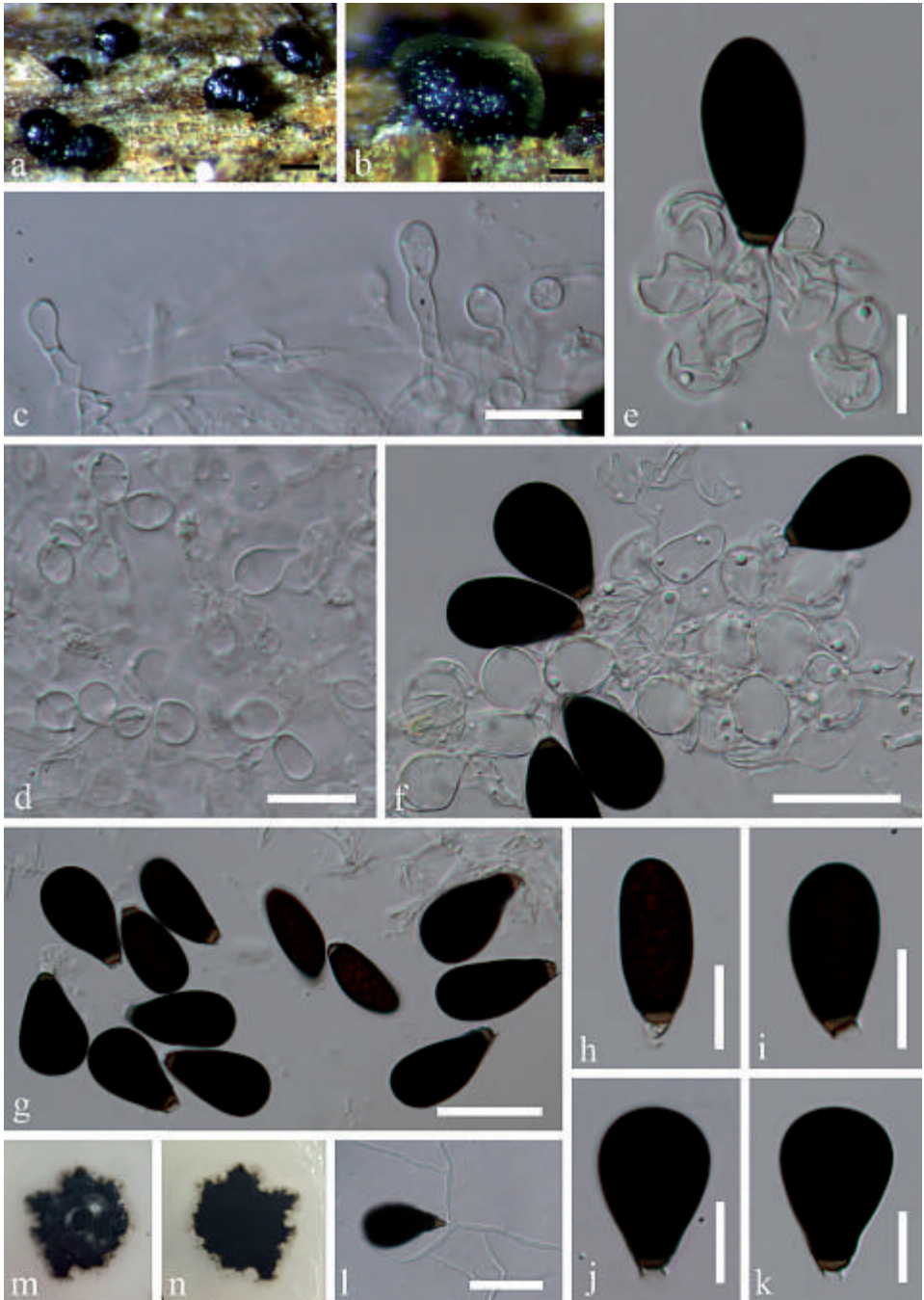


Fig. 6. *Parafuscosporella mucosa* (MFLU 16-1980, holotype) a, b. Sporodochia on wood. c, d. Conidiogenous cells and conidiophores. e, f. Conidia with conidiogenous cells. g-k. Conidia. l. Germinated conidium on PDA. m, n. Culture, m from above, n from below. Scale bars: a = 100 µm, b = 30 µm, c, j = 20 µm, d-i = 10 µm.



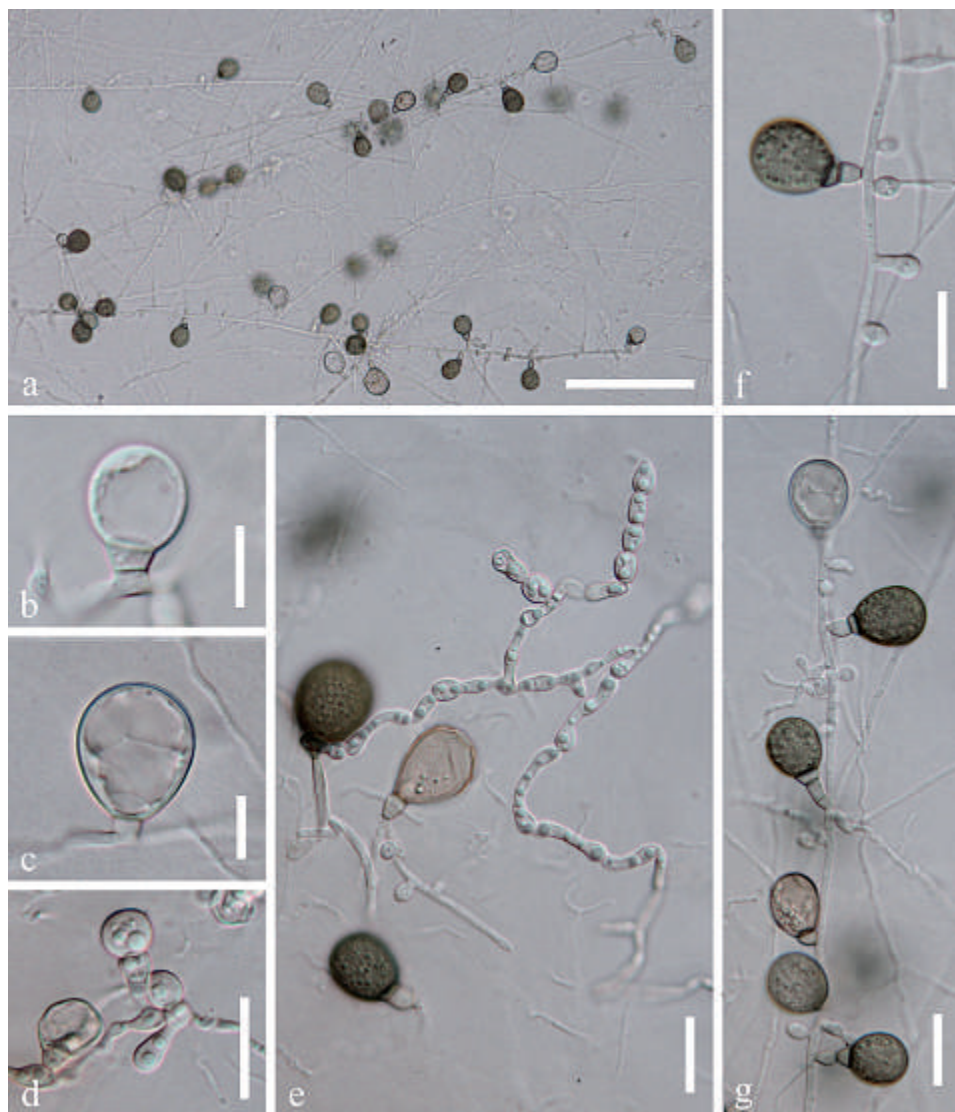


Fig. 7. Sporulation of *Parafuscosporella mucosa* on PDA. **a.** Conidia. **b, c.** Young conidia. **d.** Conidiogenous cells. **e.** Chlamydoconidia. **f, g.** Conidia and hyphae. Scale bars: a = 100  $\mu\text{m}$ , b, c = 10  $\mu\text{m}$ , d-g = 20  $\mu\text{m}$ .

base and truncate base, smooth, brown to dark brown, basal cell paler,  $26.5\text{--}36 \times 12\text{--}26 \mu\text{m}$  ( $\bar{x} = 31.5 \times 18 \mu\text{m}$ ,  $n = 40$ ), with a distinct basal frill  $1\text{--}2 \mu\text{m}$  long derived from the distal end of the conidiogenous cell. **Sexual morph** Undetermined.

**Culture characteristics:** Conidia germinating on PDA within 24 h. Germ tubes produced from both ends. Colonies on PDA slow growing, reaching 1 cm diam. after one month at  $25^\circ\text{C}$ , irregular, greyish green at first, later dark brown,

with sparse aerial hyphae on the surface, dark brown to black in reverse, with undulate margin. Hyphae in the middle producing chlamydospores. Conidial formation from single spore germination on PDA. Sporulation appears first in the centre of the colony, later in the whole colony. Conidiophores reduced to a single conidiogenous cell. Conidogenous cells monoblastic, integrated, doliform or obovoid, hyaline to subhyaline, 4-9.5  $\mu\text{m}$  long, 2-5  $\mu\text{m}$  wide. Conidia globose to subglobose, olivaceous to pale brown, uniseptate, with a paler, triangular basal cell, 16.5-29  $\times$  13-19  $\mu\text{m}$  ( $\bar{x}$  = 20.5  $\times$  15  $\mu\text{m}$ , n = 20).

*Habitat and distribution:* On submerged wood in freshwater, Thailand.

*Material examined:* THAILAND, Prachuap Khiri Khan Province, Hua Hin, stream flowing outside Kaeng Krachan National Park, on decaying submerged wood, 25 December 2014, Jaap van Strien, Site5-29-1 (MFLU 16-1980, **holotype**), ex-type living culture, MFLUCC 16-0571, GZCC 15-0082; *ibid.* (HKAS 95051, **isotype**).

*Notes:* We identified this fungus only by the shape and formation of conidia in culture. *Parafuscosporella mucosa* is assigned to *Parafuscosporella* in having uniseptate, globose to subglobose conidia and doliform or obovoid, hyaline conidiogenous cells. This species could not be sequenced successfully, therefore molecular data is required in the future to confirm the classification.

***Mucispora*** J. Yang, J. Bhat & K.D. Hyde, **gen. nov.**

*Index Fungorum number:* IF552293

*Facesoffungi number:* FoF 02427

*Etymology:* “Mucus” meaning mucilage, slime, referring to the conidia sheath

*Saprobic* on decaying plant substrates submerged in freshwater. **Asexual morph** Colonies effuse, dark brown, hairy. *Mycelium* partly superficial, partly immersed, consisting of branched, septate, pale brown to dark brown hyphae. *Conidiophores* macronematous, mononematous, erect, solitary or in small groups on compactly aggregated cells, simple, cylindrical, smooth, brown, straight or slightly flexuous, some with percurrent proliferation, septate. *Conidiogenous cells* monoblastic, holoblastic, integrated, terminal, cylindrical, smooth, pale brown. *Conidia* acrogenous, solitary, simple, smooth, ellipsoidal to obovoid, hyaline to subhyaline when young, dark brown when mature, with obvious septa in young conidia, paler at basal cell, truncate at base, sometimes covered by a hyaline mucilaginous sheath. **Sexual morph** Undetermined.

*Type species:* *Mucispora obscuriseptata*

***Mucispora obscuriseptata*** J. Yang, J. Bhat & K.D. Hyde, **sp. nov.**

**Figs 8-9**

*Index Fungorum number:* IF552291

*Facesoffungi number:* FoF 02428,

*Etymology:* Referring to the unobservable septa of mature conidia

*Holotype:* MFLU 15-1153

*Saprobic* on twigs submerged in freshwater stream. **Asexual morph** Colonies effuse, dark brown, hairy. *Mycelium* partly superficial, partly immersed, consisting of branched, septate, pale brown to dark brown hyphae. *Conidiophores* macronematous, mononematous, erect, solitary or in small groups on compactly aggregated cells, simple, cylindrical, smooth, dark brown, straight or slightly flexuous, percurrently proliferating 2-3 times, 2-5-septate, 80-170  $\times$  5-7.5  $\mu\text{m}$  ( $\bar{x}$  = 120  $\times$  6.5  $\mu\text{m}$ , n = 30). *Conidiogenous cells* monoblastic, holoblastic, integrated, terminal, cylindrical, smooth, pale brown. *Conidia* acrogenous, solitary, simple,



Site4 19-1

Fig. 8. *Mucispora obscuriseptata* (MFLU15-1153, holotype) **a**. Colonies on substrate. **b**, **d**, **e**. Conidiophores and developing conidia. **c**, **f**. Conidiophores and conidia. **g**. Conidiophores. **h**. conidiogenous cell. **i-n**. Conidia with mucilage sheath. **o**. Germinated conidium on PDA. **p-q**. Culture, **p** from above, **q** from below. Scale bars: **a** = 200  $\mu$ m, **b-g** = 40  $\mu$ m, **h-o** = 20  $\mu$ m.



Fig. 9. Sporulation of *Mucispora obscuriseptata* on PDA (from ex-type culture). **a**. Conidiophores. **b**, **f**. Conidiogenous cells. **c**. Branched conidiophore. **d**, **e**. Pale brown and middle brown conidiophores. **g**, **i**, **j**. Conidiophores with conidia. **h**. Formation of conidiophore. **k**, **l**. Conidia. Scale bars: **a** = 50  $\mu$ m, **b**, **c**, **e**, **g**, **h**, **j**–**l** = 20  $\mu$ m, **d**, **i** = 30  $\mu$ m, **f** = 10  $\mu$ m.

smooth, ellipsoidal to obovoid, hyaline to subhyaline when young, dark brown when mature, 3-septate, with paler basal cell, truncate at base,  $29\text{--}41 \times 16\text{--}22 \mu\text{m}$  ( $\bar{x} = 35 \times 19 \mu\text{m}$ ,  $n = 35$ ),  $4\text{--}7 \mu\text{m}$  at the base, mostly covered by a hyaline mucilaginous sheath. **Sexual morph** Undetermined.

*Culture characteristics:* Conidia germinating on PDA within 24 h. Germ tubes produced from the base. Colonies on MEA reaching 5–8 mm diam. after 2 weeks at 25°C, in natural light, greyish-brown with dense, fluffy mycelium on the middle surface, paler to white with loose mycelium to the entire margin; reverse of the colony brown in the middle, white at margin. Conidial formation from single spore germination on PDA. Sporulation appears first in the centre, later over the whole colony. Conidiophores macronematous, mononematous, septate, branched, dark brown, cylindrical, up to  $367 \mu\text{m}$  long,  $4.5\text{--}9 \mu\text{m}$  wide, in mature conidiophores pale brown cells alternate with mid to dark brown cells. Conidiogenous cells monoblastic, holoblastic, integrated, terminal becoming intercalary, cylindrical. Conidia ellipsoidal to obovoid, pale brown to dark brown, clearly 2–3-septate, rarely uniseptate, slightly contracted at the septa, truncate at the base,  $18\text{--}30 \times 10\text{--}18.5 \mu\text{m}$  ( $\bar{x} = 25 \times 15.5 \mu\text{m}$ ,  $n = 30$ ).

*Habitat and distribution:* On submerged wood in freshwater, Thailand.

*Material examined:* THAILAND, Prachuap Khiri Khan Province, Hua Hin, stream flowing outside Kaeng Krachan National Park, on decaying submerged wood, 25 December 2014, Jaap van Strien, Site4-19-1 (MFLU 15-1153, **holotype**), ex-type culture, MFLUCC 15-0618; *ibid.* HKAS 95047, **isotype**).

*Notes:* The morphology of *Mucispora obscuriseptata* on natural wood is different to that in culture media. The dark brown conidia, unbranched conidiophores and terminal conidiogenous cells on wood with obscure septa contrast with the mid brown, distinctly septate conidia, branched conidiophores and intercalary conidiogenous cells in culture. Moreover, the sheath on the conidia and percurrent proliferation of conidiogenous cells are absent when they are produced on media. Morphologically, *Mucispora obscuriseptata* resembles *Monotosporella setosa* (Berk. & M.A. Curtis) S. Hughes. The characters they share include mononematous, unbranched conidiophores; monoblastic, terminal, percurrently proliferating, conidiogenous cells and dark brown, obovoid to obpyriform, 1–3-septate conidia. However, conidiogenous cells in *Mucispora obscuriseptata* are cylindrical, while slightly swollen in the distal part in *Monotosporella setosa*. Although the conidia size of both fungi are similar, the conidiophores of *Monotosporella setosa* are much longer (Sadowski *et al.*, 2012) than those of *Mucispora obscuriseptata*.

*Ascotaiwania fusiformis* J. Yang, Maharachch. & K.D. Hyde, **sp. nov.** **Fig. 10**

*Index Fungorum number:* IF552294

*Facesoffungi number:* FoF 02429

*Etymology:* Fusiformis meaning fusiform, referring to the conidia shape.

*Holotype:* MFLU 15-1156

*Saprobic* on twigs submerged in freshwater stream. **Asexual morph**  
*Colonies* scattered, glistening, black. *Mycelium* mostly immersed, consisting of hyaline hyphae. *Conidiophores* semi-micronematous, mononematous, solitary, erect, smooth, pale brown, 1–4-septate, basal cell normally rounded,  $15\text{--}65 \times 4.5\text{--}7 \mu\text{m}$  ( $\bar{x} = 29 \times 6 \mu\text{m}$ ,  $n = 35$ ). *Conidiogenous cells* monoblastic, integrated, terminal, cylindrical, pale brown. *Conidia* acrogenous, fusiform, subhyaline when young, becoming olive to dark brown, paler at the basal cell, smooth, 2-septate, seen as uniseptate when mature, lacerate at the base,  $29.5\text{--}38.5 \times 18.5\text{--}25 \mu\text{m}$  ( $\bar{x} = 33.5 \times 21 \mu\text{m}$ ,  $n = 40$ ). **Sexual morph** Undetermined.



Fig. 10. *Ascotaiwania fusiformis* (MFLU 15-1156, holotype) **a**. Colonies on substrate. **b-g**. Conidiophores, developing and mature conidia. **h-k**. Conidiophores and conidiogenous cell. **l-q**. Conidia. **r**. Germinated conidium on PDA. **s, t**. Culture, s from above, t from below. Scale bars: a = 50  $\mu$ m, b = 15  $\mu$ m, c-k = 20  $\mu$ m, l-q = 15  $\mu$ m, r = 40  $\mu$ m.

*Culture characteristics:* Conidia germinating on PDA within 24 h. Germ tubes produced from the basal cell. Colonies on MEA reaching 5-10 mm diam. after 2 weeks at 25°C, dry, dark brown, with dense, tight mycelium on the surface, extending to 1-2 mm, inconspicuous, hyaline margin, dark brown in reverse, with smooth, entire margin, producing asexual spores.

*Habitat and distribution:* On submerged wood in freshwater, Thailand.

*Material examined:* THAILAND, Prachuap Khiri Khan Province, on decaying submerged wood in a stream, 25 December 2014, Jaap van Strien, Site4-27-1 (MFLU 15-1156, **holotype**), ex-type living culture, MFLUCC 15-0621; *ibid.* (HKAS 95048, **isotype**).

*Notes:* Phylogenetic analyses revealed *Ascotaiwania fusiformis* groups here as a sister taxon to *A. limnetica* (H.S. Chang & S.Y. Hsieh) Réblová & J. Fourn. *Ascotaiwania fusiformis* is morphologically similar to *Monotosporella* species as well as the *Brachysporiella*-like asexual morphs of *Ascotaiwania* (Réblová *et al.*, 2016; Sadowski, 2012). Considering the *Monotosporella* species with short conidiophores, *A. fusiformis* is easily distinguishable from *Monotosporella rhizoidea* Rao & de Hoog in the absence of lobe-like swollen conidiogenous cells (Rao & de Hoog, 1986). *Ascotaiwania fusiformis* can be separated from *Monotosporella clavata* Yanna & K.D. Hyde which has clavate, 4-6-septate conidia, by its fusiform and less septate conidia (Hyde & Hyde, 2002). *Ascotaiwania fusiformis* differs from *Monotosporella doerfeltii* Sadowski, Beimforde, Gube & A.R. Schmidt in having larger conidia with dark basal cells (Sadowski, 2012). *Brachysporiella*-like asexual morphs of *A. limnetica* have (3-)5-6 septate conidia, while *A. fusiformis* usually have 2-septate conidia (Réblová *et al.*, 2016).

***Pseudoascotaiwania*** J. Yang, J. Bhat & K.D. Hyde, **gen. nov.**

*Index Fungorum number:* IF552322

*Facesoffungi number:* FoF02482

*Etymology:* Referring to the distinction from *Ascotaiwania*.

*Saprobic* on twigs from freshwater habitats. **Sexual morph** *Ascomata* scattered, immersed, urniform, rostrate, membranous, black, paraphysate, with beaked ostiole. *Periphyses* simple, septate. *Peridium* several layers thick, brown, of *textura angularis*. *Paraphyses* simple or branched. *Asci* in a broad hymenium, unitunicate, cylindrical, eight-spored, persistent, with a long stalk and an apical ring, staining blue in aqueous cotton blue. *Ascospores* uniseriate, cylindrical to fusoid, septate, pale to light brown, acute or rounded at ends. **Asexual morph** Undetermined.

*Type species:* *Pseudoascotaiwania persoonii*

***Pseudoascotaiwania persoonii*** (Fallah, J.L. Crane & Shearer) J. Yang, J. Bhat & K.D. Hyde, **comb. nov.**

*Index Fungorum number:* IF552323

*Facesoffungi number:* FoF02483

≡ *Ascotaiwania persoonii* Fallah, J.L. Crane & Shearer. *Can. J. Bot.* 77: 87 (1999)

*Holotype:* CANADA; Manitoba: Grass River (Brostrum Lake) at jct. with Rt. 391, UTM Zone 14, 535280 m E, 6110780 m N, 55°8'39"N, 98°26'47"W, on decorticated submerged wood, 20 Oct. 1996, leg. JLC & CAS, A-57-5, (ILLS 52298).

*Notes:* In the absence of asexual morph, Reblova *et al.* (2016) did not introduce a new genus for *Ascotaiwania persoonii*. Though the asexual morph of

*Ascotaiwania persoonii* is unknown and DNA sequences of some *Ascotaiwania* species are unavailable, *Pseudoascotaiwania* is introduced because *A. persoonii* clusters in Fuscosporellales. We have not examined the type of *Pseudoascotaiwania*. The details provided by Fallah *et al.* (1999) are quite illustrative and descriptive.

## DISCUSSION

The combined LSU, SSU and RPB2 phylogenetic analyses of the clade containing the new genera, *Fuscosporella*, *Parafuscosporella*, *Mucispora*, *Bactrodesmisatrum* species, *Plagiascoma* and *Pseudoascotaiwania persoonii* represent a monophyletic group, sister to the orders Conioscyphales, Pleurotheciales and Savoryellales in Sordariomycetes. The clade is introduced as Fuscosporellales, as it represents a distinct taxonomic group at the ordinal level within the Hypocreomycetidae. Fuscosporellaceae is introduced which is monotypic. *Fuscosporella* and *Parafuscosporella* resemble *Bactrodesmisatrum* and *Bactrodesmium* species. The characters shared by these four genera are sporodochial conidiomata, monoblastic conidiogenous cells and brown septate conidia (Hernández-Restrepo *et al.*, 2013, 2015). However, *Fuscosporella* and *Parafuscosporella* have hyphoid, hyaline, conidiogenous cells, while *Bactrodesmiastrum* is characterized by solitary or aggregated conidiophores reduced to brown, single or moniliform, monoblastic conidiogenous cells (Hernández-Restrepo *et al.*, 2015; Holubová-Jechová, 1984). *Bactrodesmium* is differentiated by hyaline or brown, simple or branched conidiophores supporting mono- or polyblastic conidiogenous cells (Ellis, 1971; Holubová-Jechová, 1972) and recent phylogenetic studies have revealed its placement within the Dothideomycetes (Hernández-Restrepo *et al.*, 2015). The uniseptate conidia in *Fuscosporella* and *Parafuscosporella* are distinguished from the multi-septate conidia, sometimes with a dark band at one or more septa of *Bactrodesmiastrum* and *Bactrodesmium*. *Vanakripa* also resembles *Fuscosporella* and *Parafuscosporella* in having large, dark coloured conidia and sporodochial conidiomata. However, specific separating cells are present in *Vanakripa* while these are globose to ovoid, hyaline conidiogenous cells in *Fuscosporella* and *Parafuscosporella*.

It is challenging to distinguish *Fuscosporella* and *Parafuscosporella* based on the almost similar morphology. However, the two genera are phylogenetically distinct with weak support. Thus, we distinguish these genera considering the sporulating morphology on culture media. *Fuscosporella* is distinct from *Parafuscosporella* by multi-celled, filamentous to helicoid conidia, while *Parafuscosporella* produces globose to obpyriform, uniseptate conidia in culture. The moniliform conidiogenous cells in *Parafuscosporella* are absent in *Fuscosporella* on natural substrate. *Parafuscosporella mucosa* is classified in *Parafuscosporella* because of the similar sporulation on culture as subglobose conidia and monoblastic conidial formation, although molecular evidence is required to confirm the natural placement of *Parafuscosporella mucosa*.

The genus *Ascotaiwania* is found to be polyphyletic in our study, agreeing with the previous study carried out by Réblová *et al.* (2016). The type species *A. lignicola* (Sivanesan & Chang, 1992) and three other *Ascotaiwania* species clustered in the Savoryellales. *Helicoön farinosum* (as *A. hughesii*, Fallah *et al.*, 1999) nests in Pleurotheciales, while *Ascotaiwania persoonii* (Fallah *et al.*, 1999)



nests in Fuscosporellales. In the absence of asexual morph, Reblova *et al.* (2016) were hesitant to introduce a new genus for *A. persoonii*. Although the asexual morph of *A. persoonii* is unknown, and because *A. persoonii* clusters in Fuscosporellales, far away from Savoryellales, we introduced a new genus to accommodate it. *Ascotaiwania fusiformis* is placed in *Ascotaiwania* sister to *A. limnetica* with weak support. However, its characters fit well with the genus *Monotosporella*, which is considered as the asexual morph of *Ascotaiwania* (Ranghoo & Hyde, 1998; Sadowski *et al.*, 2012; Sivichai *et al.*, 1998). *Ascotaiwania fusiformis* differs from previously described *Monotosporella* species in having shorter conidiophores and fusiform conidia. Considering that the sexual morph of *A. fusiforme* is unknown and DNA sequences of some *Ascotaiwania* species are unavailable, it is difficult to confirm the relationship between *A. fusiformis* and the *Ascotaiwania* species.

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