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Botryosphaeriaceae from palms in Thailand II - two new species of *Neodeightonia, N. rattanica* and *N. rattanicola* from *Calamus* (rattan palm)

Sirinapa Konta[1], Sinang Hongsanan[1], Alan J.L. Phillips[3], E.B.G. Jones[4], Saranyaphat Boonmee[1] & Kevin D. Hyde[1,2,4]*

[1]*Center of Excellence in Fungal Research, Mae Fah Luang University, Chiang Rai 57100, Thailand*
[2]*Key Laboratory for Plant Biodiversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Science, Kunming 650201, Yunnan, China*
[3]*University of Lisbon, Faculty of Sciences, Biosystems and Integrative Sciences Institute (BioISI), Campo Grande, 1749-016 Lisbon, Portugal*
[4]*Department of Botany and Microbiology, College of Science, King Saud University, P.O. Box: 2455, Riyadh 1145, Saudi Arabia*

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Abstract

A large number of ascomycetes have been described from the palm *Calamus*. In this study, we report on *Neodeightonia* species (*Botryosphaeriaceae*) from the rachides of *Calamus* spp. collected in Phang-Nga Province, Thailand. Morphological characters were studied and with support from phylogenetic analyses of combined ITS, LSU, SSU and TEF1-α sequence data we introduce two new species *Neodeightonia rattanica*, and *N rattanicola* The new species are introduced with descriptions and illustrations and compared with other *Neodeightonia* species.

Key words – ascomycetes – Dothideomycetes – hyaline ascospores – palm fungi

Introduction

Rattan palms of the genus *Calamus* (Arecaceae) have been shown to be a rich source of unique fungal biodiversity, especially ascomycetes (Fröhlich & Hyde 2000, Hyde et al. 2000). This paper is the second in a series on *Botryosphaeriaceae* from palms in Thailand. In the first in this series we introduced the new species *Barriopsis archontophoenicis* from *Archontophoenix alexandrae* (Konta et al. 2016). *Botryosphaeriaceae* species are common plant pathogens (Hanlin 1990), as well as saprobes, and occur on a wide range of host plants (Phillips et al. 2008). Phillips et al. (2008) introduced *Neodeightonia phoenicum* on *Phoenix* sp. in Spain. Subsequently, Ligoxigakis et al. (2013) provided a first report of palm rot disease caused by *N. phoenicum* on *Phoenix* sp. in Greece. Several Botryosphaeriales species have been found on palms (Hyde et al. 2007, Liu et al. 2010).

Recent treatments of *Botryosphaeriaceae* are those of Liu et al. (2012) who recognized 29 genera and Phillips et al. (2013) who accepted 17 genera and 110 species based on species known from culture. *Botryosphaeriaceae* species are common on a wide range of gymnosperms and

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Corresponding Author: Kevin D. Hyde – e-mail – kdhyde3@gmail.com

angiosperms. *Neodeightonia* was established by Booth in Punithalingam (1969), with the type species *Neodeightonia subglobosa* (Punithalingam 1969). In their broad concept of *Botryosphaeria* von Arx and Muller (1975), in which they considered that ascospores can be brown, transferred the type species, *N. subglobosa*, to *Botryosphaeria*. However, Phillips et al. (2008, 2013) and Liu et al. (2012) accepted *Neodeightonia* as a distinct genus based on its dark, 1-septate ascospores and this was supported by phylogenetic analyses. Dai et al. (2016) introduced *N. microspora* D.Q. Dai & K.D. Hyde and recollected *N. subglobosa*.

In this paper, we introduce two new *Neodeightonia* species from the rachides of *Calamus*. They are morphologically unique and are supported by DNA sequence analyses. The two new species are compared with other *Neodeightonia* species.

Materials & Methods

Collection, isolation and identification

Rachises of *Calamus* were collected from Phang-Nga Province, Thailand. The specimens were examined following the methods described by Phukhamsakda et al. (2015), isolations were made from single ascospores following the method of Chomnunti et al. (2014) and sporulation in culture was achieved following the method of Phookamsak et al. (2015). Culture characteristics such as growth rate, colony shape, mycelium colour and morphology of the asexual morph were determined after incubation at 25°C in natural light/dark for up to 2 weeks.

The holotypes of the newly described *Neodeightonia* species were deposited in the herbarium of Mae Fah Luang University (MFLU), Chiang Rai, Thailand with isotypes in the Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (HAKS) and ex-type cultures are deposited in Mae Fah Luang Culture Collection (MFLUCC). *Facesoffungi* and *Index Fungorum* numbers were registered (Jayasiri et al. 2015, Index Fungorum 2016).

Fungal DNA extraction and PCR reaction

Genomic DNA was extracted from fresh mycelium grown on MEA for 2 weeks using the Biospin Fungus Genomic DNA Extraction Kit (BioFlux®) (Phukhamsakda et al. 2015). The ITS region was amplified with primers ITS1 and ITS4 (White et al. 1990), the LSU region with LROR and LR5 (Vilgalys & Hester 1990), the SSU with NS1 and NS4 (White et al. 1990), and the TEF1-α gene with EF1-728F and EF1-986R (Carbone & Kohn 1999). The PCR products were checked on 1% agarose electrophoresis gels stained with ethidium bromide. The purified PCR products were sequenced by Shangkai Majorbio Biopharm Technology Co., Ltd, China.

Sequence alignment and phylogenetic analyses

DNA sequences were checked with BioEdit (Hall 1999) and MEGA6 (Tamura et al. 2013). A BLAST search with the ITS sequences was used to reveal the closest matching taxa in *Botryosphaeriaceae* (Liu et al. 2014, Phookamsak et al. 2015). Multiple sequence alignments were done with MAFFT (Katoh et al. 2013) online alignment (http://www.ebi.ac.uk/Tools/msa/mafft/, Li et al. 2015). ITS, LSU, SSU, and TEF1-α sequences datasets were first analyzed separately and then the individual datasets were concatenated into a combined dataset and prepared in MEGA6 (Tamura et al. 2013). Data were converted from fasta to nexus format with Clustal X (Thompson et al. 1997). Maximum parsimony (MP) analysis was done with PAUP v. 4.0b10 (Swofford 2002) and robustness of the branches was determined with 1000 bootstrap replicates along with max-trees set at 1000. The models of evolution were determined with MrModeltest 2.2 (Nylander 2004) under the Akaike information criterion (AIC). The models selected were HKY+I, HKY+I+G, GTR+I, and HKY+G for SSU, ITS, LSU and TEF1-α respectively, and GTR-GAMMA for the combined dataset (Nylander 2004). Maximum likelihood analysis was performed by RAxML GUI v.0.9b2 with 1000 bootstrap replicates (Silvestro & Michalak 2010). The number of replications was inferred using the stopping criterion. Bootstrap values greater than 60% were accepted. Four chains

Table 1 GenBank Accession numbers of the sequences used in phylogenetic analyses. New sequences are in bold.

Species name	Strain	GenBank accession number			
		ITS	LSU	SSU	TEF
Diplodia mutila	CBS 112553	AY259093	AY928049	EU673213	AY573219
Diplodia mutila	CBS 230.30	DQ458886	EU673265	EU673214	DQ458869
Diplodia seriata	CBS 112555	AY259094	AY928050	KF766244	AY573220
Diplodia seriata	CBS 119049	DQ458889	EU673266	EU673216	DQ458874
Lasiodiplodia gonubiensis	CMW14077	AY639595	-	-	DQ103566
Lasiodiplodia gonubiensis	CMW14078	AY639594	-	-	DQ103567
Lasiodiplodia margaritacea	CBS122519	EU144050	-	-	EU144065
Lasiodiplodia margaritacea	CBS122065	EU144051	-	-	EU144066
Lasiodiplodia pseudotheobromae	CBS116459	EF622077	EU673256	KF766279	EF622057
Lasiodiplodia pseudotheobromae	CBS447.62	EF622081	EU673255	EU673198	EF622060
Lasiodiplodia theobromae	CBS 164.96	AY640255	EU673253	EU673196	AY640258
Lasiodiplodia theobromae	CBS124.13	DQ458890	AY928054	EU673195	DQ458875
Neodeightonia microspora	MFLUCC 11-0483	KU940110	KU863099	-	-
Neodeightonia microspora	MFLUCC 11-0504	KU940111	KU863100	-	-
Neodeightonia palmicola	MFLUCC 10-0822	HQ199221	HQ199222	HQ199223	-
Neodeightonia palmicola	MFLUCC10-0823	HQ199224	HQ199225	HQ199226	-
Neodeightonia phoenicum	CBS 122528	KF766198	EU673261	KF766285	EU673309
Neodeightonia phoenicum	CBS 123168	EU673339	EU673260	EU673204	EU673308
Neodeightonia phoenicum	CBS 169.34	EU673338	EU673259	EU673203	EU673307
Neodeightonia rattanica	**MFLUCC 15-0712**	**KX646357**	**KX646352**	**KX646355**	**KX646360**
Neodeightonia rattanica	**MFLUCC 15-0313**	**KX646358**	**KX646353**	**-**	**KX646361**
Neodeightonia rattanicola	**MFLUCC 15-0319**	**KX646359**	**KX646354**	**KX646358**	**KX646362**
Neodeightonia subglobosa	CBS 448.91	KF766199	DQ377866	KF766286	EU673306
Sphaeropsis visci	CBS 186.97	EU673325	EU754216	EU754117	EU673293
Sphaeropsis visci	CBS 100163	EU673324	EU754215	EU754116	EU673292

Abbreviation: CBS: Centraalbureau voor Schimmelcultures, The Netherlands; CPC: Collection of Pedro Crous housed at CBS; IRAN: Iranian Fungal Culture Collection, Iranian Research Institute of Plant Protection, Iran; MFLUCC: Mae Fah Luang University Culture Collection, Chiang Rai, Thailand; MUCC: Culture Collection, Laboratory of Plant Pathology, Mie University, Tsu, Mie prefecture, Japan; IMI: CABI Bioscience, Egham, UK; CMW: M.J. Wingfield, FABI, University of Pretoria, South Africa; ICMP: International Collection of Micro-organisms from Plants, Landcare Research, New Zealand; STE-U: Culture collection of the Department of Plant Pathology, University of Stellenbosch, South Africa.

were run for the individual and combined data sets. Posterior probabilities (PP) (Rannala & Yang 1996, Zhaxybayeva & Gogarten 2002) were determined by Markov Chain Monte Carlo sampling (MCMC) using MrBayes v3.1.2 (Huelsenbeck & Ronquist 2001). Five million generations was run with a sampling frequency of every 100 generations. The first 5,000 trees were excluded as burn-in phase. Bayesian posterior probabilities (BYPP) were calculated from the remaining 45,000 trees and values greater than 0.95 were accepted. The phylogenetic tree was visualized with Tree View32 (Page 1996). Trees and alignment files were deposited in TreeBase (submission ID: 19661).

Result

Phylogenetic analyses

The sequence alignment comprised 24 taxa of representative strains of *Botryosphaeriaceae*, including our new taxa. *Sphaeropsis visci* was used as outgroup. Phylogenetic trees were generated by maximum parsimony (MP), maximum likelihood (ML) and Bayesian analyses of combined ITS, LSU, SSU and TEF1-α sequence data. Topology of the trees produced by these three methods was similar and the best scoring ML tree is shown in Fig. 1. The new species *Neodeightonia rattanica*,

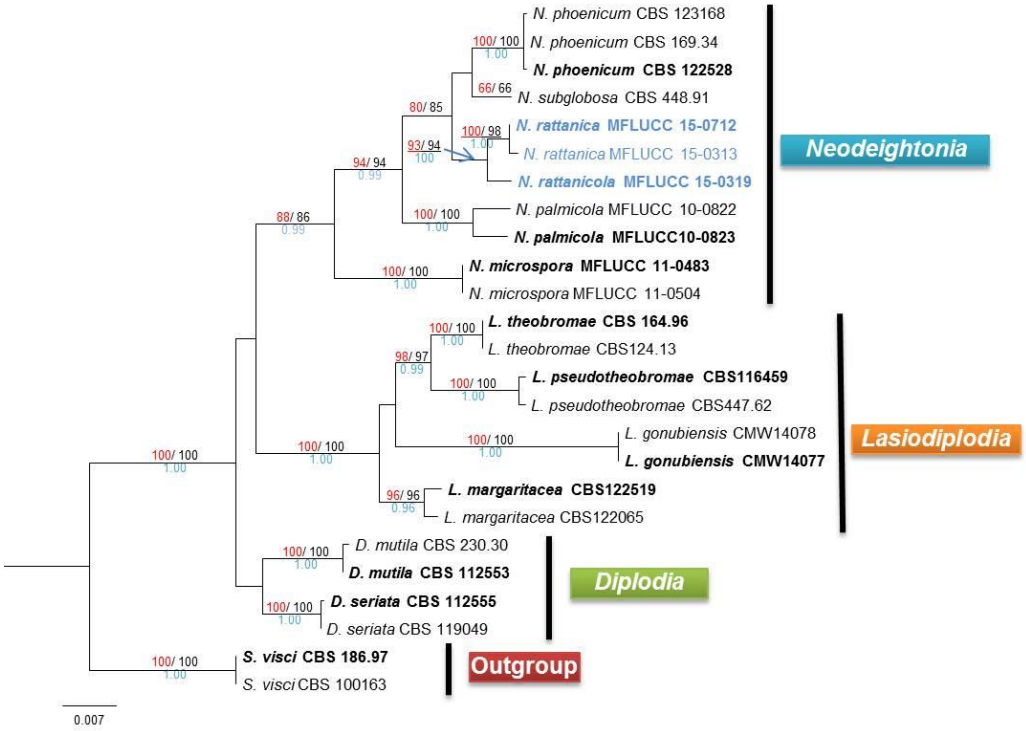

Fig. 1 – Maximum likelihood (ML) tree derived from analysis of a combined ITS, LSU, SSU, and TEF1-α sequence dataset. Bootstrap support values for maximum parsimony (MP, black) and maximum likelihood (ML, red) greater than 60% and Bayesian posterior probabilities (BYPP, blue) greater than 0.95 are given at the nodes. The tree is rooted to *Sphaeropsis visci*. Strain numbers are mentioned after the species names. The new species are highlighted in blue. Ex-type strains are in bold.

and *N. rattanicola* cluster with high bootstrap support (93% ML, 94% MP, 1.00 PP) within the *Neodeightonia* clade, which forms a sister clade to *Lasiodiplodia*. *Neodeightonia rattanica* and *N. rattanicola* are closely related but the two species are separated by 9 bp differences in ITS, and 5 bp differences in LSU.

Taxonomy

Neodeightonia rattanica Konta & K.D. Hyde, ***sp. nov.*** Figs 2–3

Index Fungorum number: IF552168; Facesoffungi number: FoF 02237

Etymology: The specific epithet refers to the common name for the host, rattan.

Holotype: MFLU: 15-1443

Saprobic on rachis of *Calamus* sp. ***Sexual morph***: *Ascomata* 222–241 high × 246–278 *μm* diam. ($\bar{x}$ = 262 × 235 *μm*, n = 10), immersed, solitary, scattered, uniloculate, subglobose, brown to reddish brown, with a long neck, rounded at the base. *Ostiole* central non-papillate. *Peridium* 49–76 *μm* diam. ($\bar{x}$ = 72 *μm*, n = 10), relatively thick, comprising several layers, outer layer thick, comprising reddish brown-walled cells of *textura angularis*, inner layer thin, comprising hyaline cells of *textura angularis*. *Hamathecium* comprising hypha-like, hyaline, septate, cellular pseudoparaphyses, up to 2.7 *μm* wide, often constricted at the septa. *Asci* 113–141 × 19–25 *μm* ($\bar{x}$ = 138 × 22 *μm*, n = 10), 8-spored, bitunicate, fissitunicate, cylindrical-clavate, with a thick endotunica, long pedicellate, apically thickened, with a distinct, ocular chamber. *Ascospores* 22–25 × 8–11 *μm* ($\bar{x}$ = 23 × 10 *μm*, n = 20), overlapping biseriate or obliquely biseriate, hyaline, ellipsoidal-fusiform, aseptate, often with a large guttule at the centre when immature, becoming granulate, with terminal apiculi, smooth-walled, surrounded by thick mucilaginous sheath. ***Asexual morph***: Coelomycetous. *Conidiomata stromatic* 245–349 high × 208–305 *μm* diam. ($\bar{x}$ = 297 × 255

μm, n = 5), pycnidial, superficial, purplish to black, covered with dense mycelium, on PDA uni-to multilocular, individual or aggregated. *Paraphyses* cylindrical, aseptate, hyaline. *Conidiogenous cells* 6−11 × 2−3 *μm* ($\overline{x}$ = 9.7 × 2.7 *μm*, n = 10), holoblastic, cylindrical to subcylindrical, hyaline. *Conidia* 19–22 × 7–9 *μm* ($\overline{x}$ = 20.7 × 8.4 *μm*, n = 20), initially hyaline, pale to dark brown when mature, unicellular, ellipsoid to obovoid, thick-walled, with granular content, rounded at the apex.

Culture characters – Ascospores germinating on MEA within 24 hours and germ tubes produced from both ends. Colonies on MEA fast growing, after 2 weeks reaching 7–8.5 cm diam. at 25°C, white at the edge, grey in the middle, outwardly strongly radiating. After 5 months of incubation, the colonies on MEA, becoming grey-olivaceous and spongy, hyphae, septate, branched and smooth, form asexual morph after 2 months.

Material examined – THAILAND, Phang-Nga, on dead rachis of *Calamus* sp. (*Arecaceae*), 6 December 2014, S. Konta, DNH05e (MFLU 15-1443, **holotype**; MFLU 15-0288, HKAS92531, HKAS92529, **isotype**); ex-type living culture, MFLUCC 15-0712, MFLUCC 15-0313.

Notes – *Neodeightonia rattanica* is characterized by large ascomata and ellipsoidal-fusiform, granulate ascospores, often with a single large guttule in immature ascospores, with polar apiculi and a thick mucilaginous sheath. Multi-locus analyses showed that *N. rattanica* (strain MFLUCC 15-0712) is closely related to *N. rattanicola* (strain MFLUCC 15-0319), but forms a distinct lineage (Fig. 1). Morphologically, *Neodeightonia rattanica* differs from *N. rattanicola* in having larger ascomata with a reddish brown peridium, while in *N. rattanicola* the peridium is dark brown to black (Figs. 2 *vs* Fig. 4, Table 2). The conidiomata of *N. rattanica* produced on media are purplish to black, while in *N. rattanicola* conidiomata on media are larger and dark brown to reddish brown (Figs. 3 *vs* Fig. 5, Table 3). *Neodeightonia rattanica* differs from *N. subglobosa* (the type species) in having hyaline, aseptate, granulate ascospores, often with a single large guttule in immature ascospores, while *N. subglobosa* has brown, 1-septate ascospores. *Neodeightonia rattanica* has ellipsoidal-fusiform ascospores with polar apiculi, while *N. microspora* has obovoid ascospores without polar apiculi (Figs 2 *viz* Fig 2 f–j Dai et al. (2016), Table 2). Although it is similar to *N. palmicola* in the sexual morph they differ in the asexual morph with aseptate conidia while conidia of *N. palmicola* have a single septum.

Neodeightonia rattanicola Konta & K.D. Hyde, ***sp. nov.*** Figs 4–5

Index Fungorum number: IF552169; Facesoffungi number: FoF 02238

Etymology: The specific epithet refers to the common name of host (rattan) and the Latin *cola* meaning loving.

Holotype: MFLU: 15-0294

Saprobic on rachis of *Calamus* sp., ***Sexual morph***: *Ascomata* 180–215 high × 146–168 *μm* diam. ($\overline{x}$ = 197 × 155 *μm*, n = 10), immersed to semi-immersed, solitary, scattered, uniloculate, subglobose to irregular, dark brown or black, with a long neck, irregular at the base. *Ostiole* central non-papillate. *Peridium* 35–51 *μm* diam. ($\overline{x}$ = 45 *μm*, n = 10), comprising several layers, outer layer thick, comprising dark brown to black-walled cells of *textura angularis*, inner layer thin, comprising hyaline cells of *textura angularis*. *Hamathecium* comprising hypha-like, hyaline, septate, cellular pseudoparaphyses, up to 3.27 *μm* wide, often constricted at the septa. *Asci* 91–108 × 19–25 *μm* ($\overline{x}$ = 101 × 22 *μm*, n = 10), 8-spored, bitunicate, fissitunicate, cylindrical-clavate, with thick endotunica, long pedicellate, apically thickened, with a distinct, ocular chamber. *Ascospores* 22–26 × 8–11 *μm* ($\overline{x}$ = 23× 10 *μm*, n = 20), overlapping biseriate or obliquely 2–3-seriate, hyaline, ellipsoidal-fusiform, aseptate, with polar apiculi, smooth-walled, surrounded by thin mucilaginous sheath. ***Asexual morph***: Coelomycetous. *Conidiomata stromatic* 420–510 high × 357–443 *μm* diam. ($\overline{x}$ = 446 × 381 *μm*, n = 5), pycnidial, superficial, dark brown to black, covered with dense mycelium, on PDA mostly uniloculate, individual or aggregated. *Paraphyses* cylindrical, aseptate hyaline. *Conidiogenous cell* 4.4−12.5 × 1.5−4.3 *μm* ($\overline{x}$ = 9.4 × 3.4 *μm*, n = 10), holoblastic, cylindrical to subcylindrical, hyaline. *Conidia* 13–20 × 7–8 *μm* ($\overline{x}$ = 17.3 × 8 *μm*, n = 20), initially hyaline, pale to dark brown when mature, unicellular, ellipsoid to obovoid, thick-walled, granulate, rounded at apex.

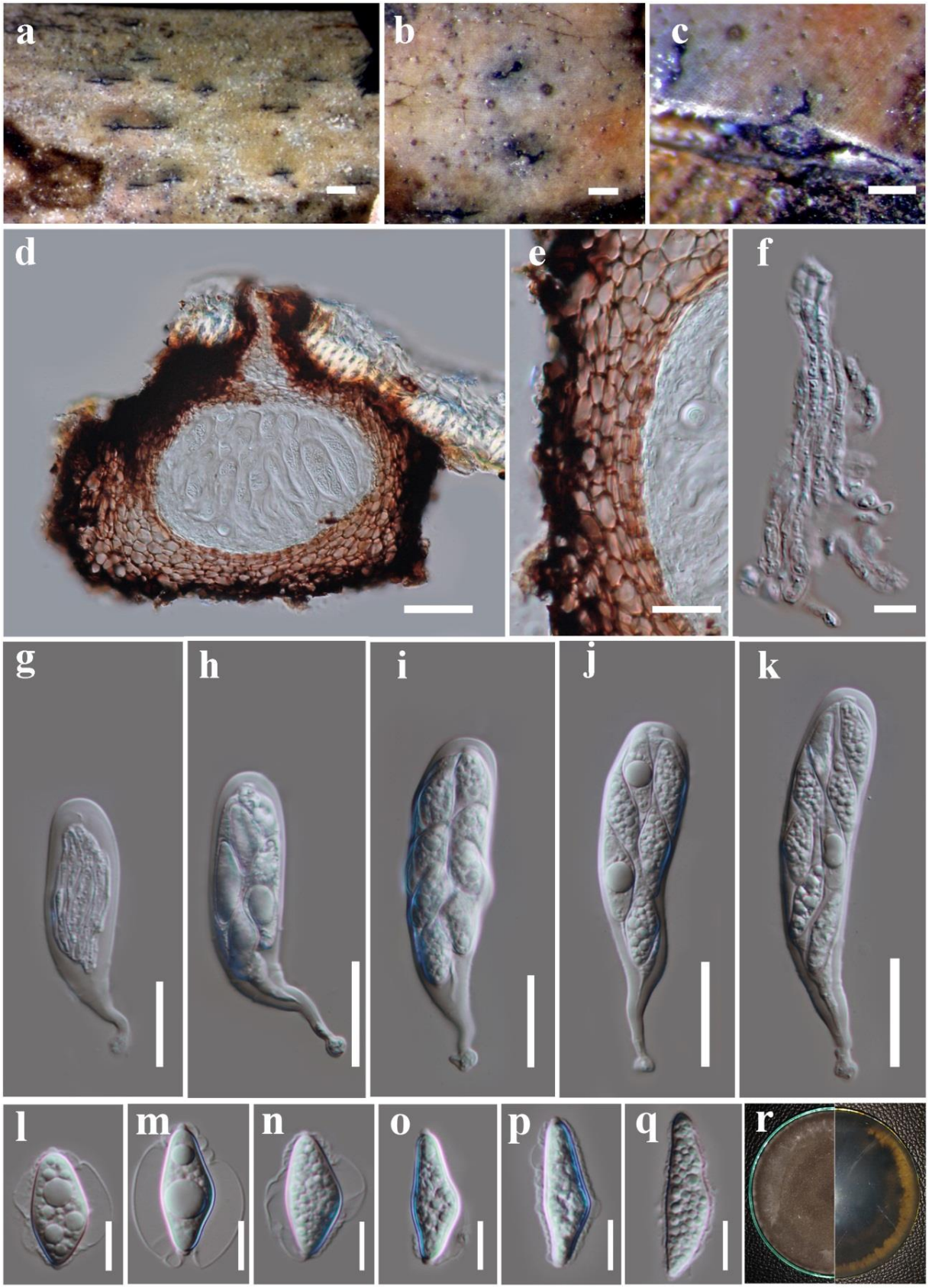

Fig. 2 – *Neodeightonia rattanica* (**holotype**) a. Appearance of ascomata on host substrate. b, c. Close-up of ascomata. d. Section of ascoma. e. Peridium. f. Pseudoparaphyses. g–k. Immature to mature asci. j, m. Ascospores with a single large guttule. l–q. Ascospores with polar apiculi and mucous sheath. r. Culture on MEA after 1. month, front and reverse. Scale bars: a = 500 *µm*, b–c = 200 *µm*, d = 50 *µm*, e = 20 *µm*, f = 10 *µm*, g–k = 20 *µm*, l–q = 10 *µm*.

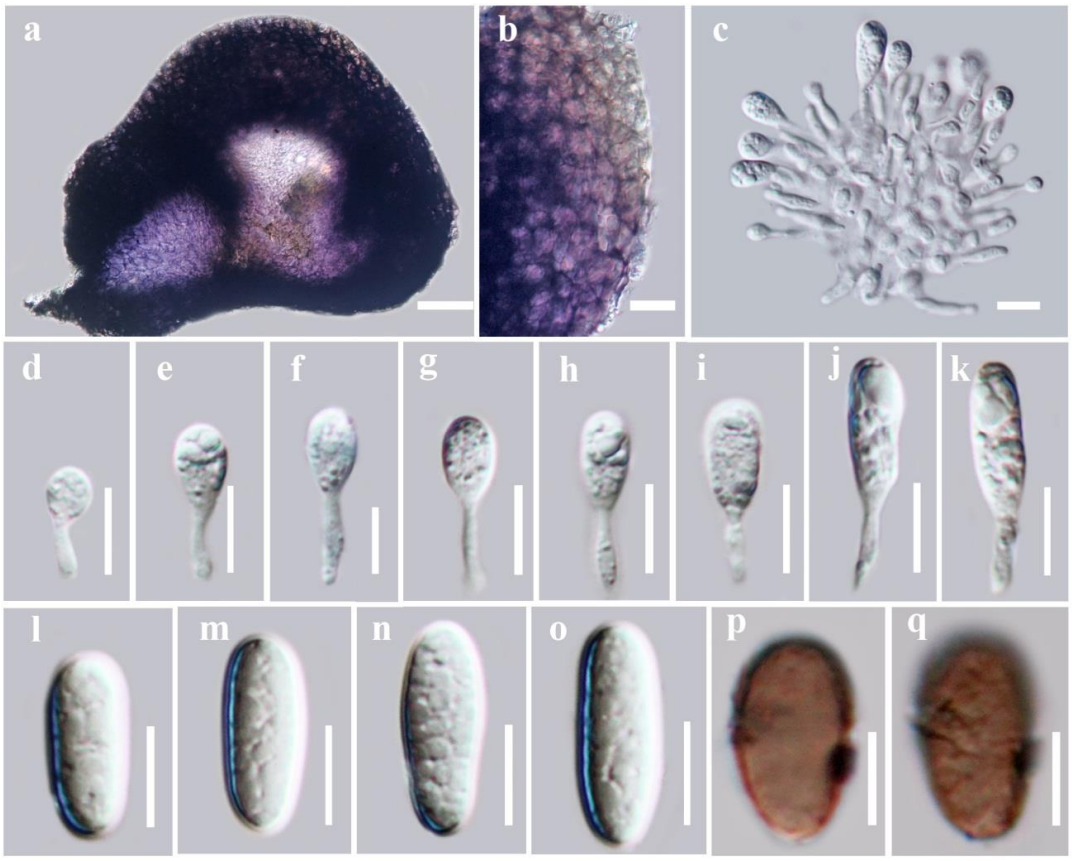

Fig. 3 – *Neodeightonia rattanica* (from ex-type culture) a. Section of conidioma. b. Peridium. c–k. Conidiogenous cells with conidia. l–o. Immature conidia. p–q. Mature conidia. Scale bars: a = 50 *μm*, b–q = 10 *μm*.

Culture characters – Ascospores germinating on MEA within 24 hours and germ tube produced from cell. Colonies on MEA fast growing, after 2 weeks reaching 8–9 cm diam. at 25°C, white at the edge, grey in the middle and outwardly strongly radiating. After 1 month of incubation, the colonies on MEA, grey-olivaceous and spongy, hyphae, septate, branched and smooth, form asexual morph after 6 weeks.

Material examined – THAILAND, Phang-Nga, on dead rachis of *Calamus* sp. (*Arecaceae*), 6 December 2014, S. Konta, DNH02p, (MFLU 15-0294, **holotype**; HKAS92530, **isotype**); ex-type living culture, MFLUCC 15-0319.

Notes – The phylogenetic analyses indicated that *Neodeightonia rattanicola* (strain MFLUCC 15-0319) is closely related to *N. rattanica* (strain MFLUCC 15-0712) but they are distinct species (Fig. 1). Morphological differences are discussed under the latter species. *Neodeightonia rattanicola* differs from *N. subglobosa* in having hyaline, aseptate ascospores, while *N. subglobosa* has brown, 1-septate ascospores. *Neodeightonia rattanicola* is distinct from *N. microspora* in having ellipsoidal-fusiform ascospores with polar apiculi, while *N. microspora* has obovoid ascospores lacking polar apiculi (Table 2) and it differs from *N. palmicola* and *N. phoenicum* in having aseptate conidia while *N. palmicola* and *N. phoenicum* have 1-septate conidia.

Discussion

In this study, we introduce two new species, *viz. Neodeightonia rattanica* and *N. rattanicola*. These two species were found on rattan palms and were differentiated from all other known species based on morphology and phylogenetic analyses. Phylogenetically *N. rattanica* and *N. rattanicola* cluster together with *N. subglobosa* and *N. phoenicum*, but form distinct lineages. *Neodeightonia rattanica* and *N. rattanicola* are morphologically similar to *N. phoenicum* but differ in having non-septate conidia, while *N. phoenicum* has 1-septate conidia.

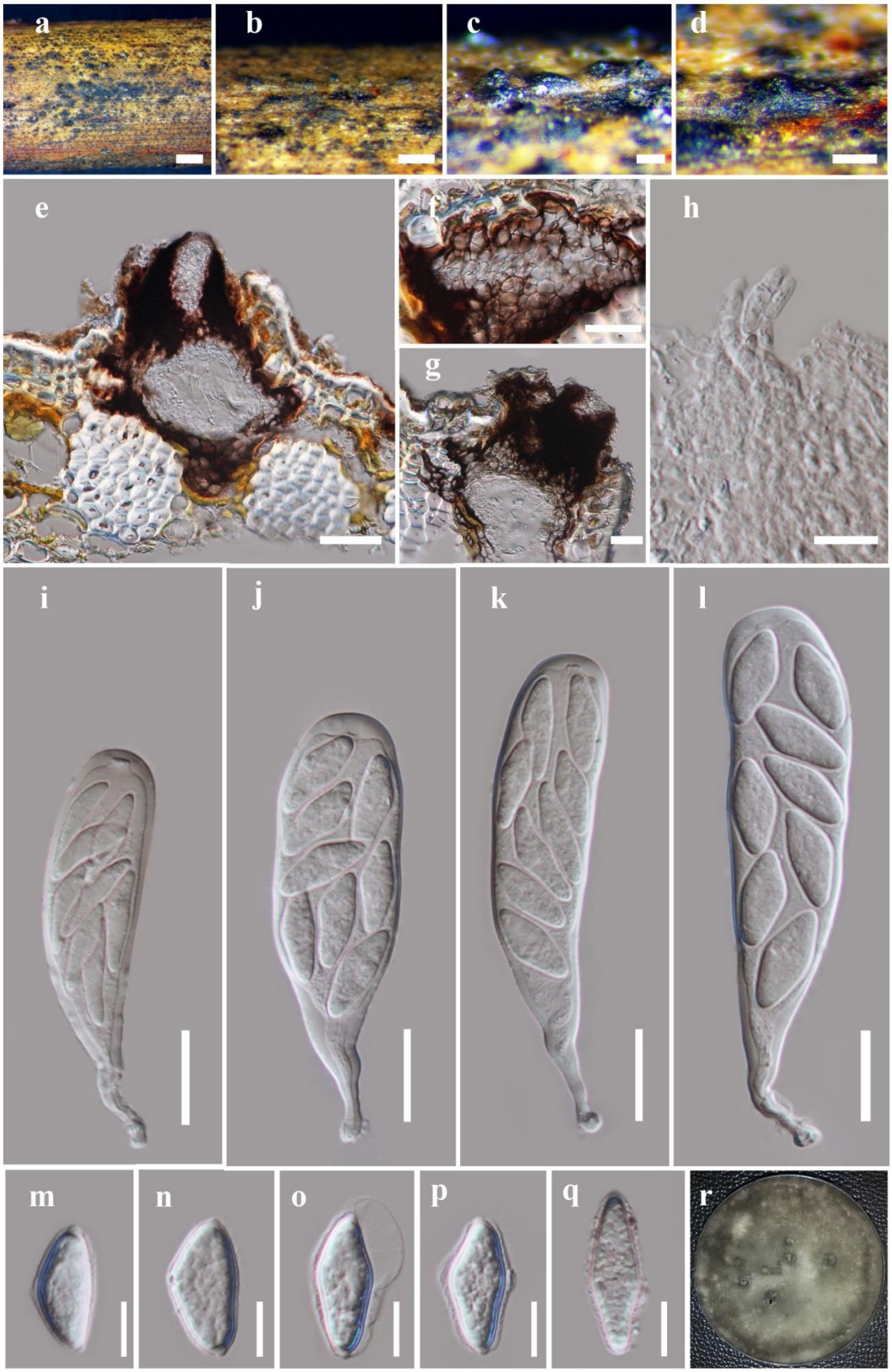

Fig. 4 – *Neodeightonia rattanicola* (MFLU 15-0294, **holotype**) a. Ascomata on host substrate. b–d. Close-up of ascomata. e. Section of ascoma. f. Peridium. g. Neck. h. Pseudoparaphyses. i–l. Asci. m–q. Ascospores. r Surface view of culture on MEA after 1 month. Scale bars: a = 1,000 *μm*, b = 500 *μm*, c–d = 200 *μm*, e = 50 *μm*, f, h = 10 *μm*, g = 20 *μm*, i–l = 20 *μm*, m–q = 10 *μm*.

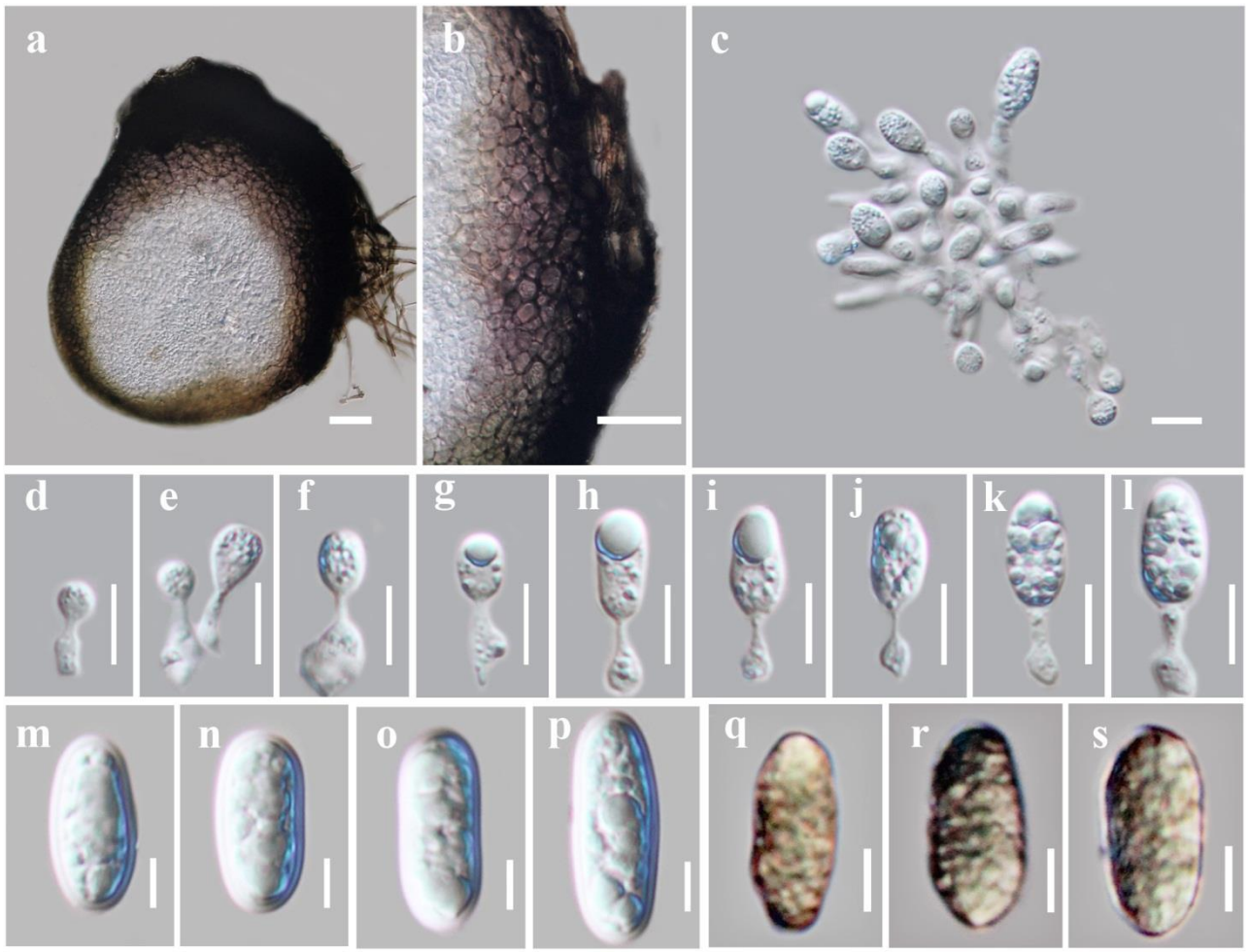

Fig. 5 – *Neodeightonia rattanicola* (MFLUCC 15-0319, **holotype**) a. Section of conidioma. b. Peridium. c–l. Conidiogenous cells with conidia. m−p. Immature conidia. q–s. Mature conidia. Scale bars: a–b = 50 *μm*, c–l = 10 *μm*, m–s = 5 *μm*.

Neodeightonia species belong in the family *Botryosphaeriaceae* (Botryosphaeriales, Lui et al. 2014) and *N. subglobosa* is the type species (Punithalingam 1969). There are presently six accepted species (Phillips et al. 2008, Liu et al. 2010, Dai et al. 2016). The sexual morph of *Neodeightonia* is characterized by hyaline, aseptate ascospores, with polar apiculi and surrounded by a mucilaginous sheath. The asexual morph is characterized by conidia that are initially hyaline that may become brown and 1-septate at maturity, with smooth to finely roughened walls or with fine striations (Phillips et al. 2008, 2013, Liu et al. 2012, Dai et al. 2016). This feature is unique to *Neodeightonia* differentiating it from all other genera in the *Botryosphaeriaceae.*

Neodeightonia rattanica and *N. rattanicola* form the asexual morph in cultures after up to 6 weeks of incubation. Although the sexual morph of *N. subglobosa* (type species) has been reported in cultures (Punithalingam 1969) we are unable to find the sexual morph in any culture even after long periods of incubation. The type species of *Neodeightonia* was found on *Bambusa* while the other species listed in Index Fungorum (2016) have been found on palms, such as *Arenga westerhoutii, Phoenix* sp. and *Caryota urens.* The two species introduced in this paper were isolated from the rattan palm. Thus, this genus is probably specific in host substrate or tissue. Tissue-specificity has been suggested for saprobic microfungi on palms by Fröhlich & Hyde (2000). Although *Neodeightonia* species have been reported associated with disease symptoms, pathogenicity has not been tested for any of them and thus it is not known if they are primary pathogens or secondary invaders of diseased hosts.

Table 2 Sexual morph

Species name	Ascomata	Peridium	Hamathecium	Ascospore	References
Neodeightonia rattanica MFLU 15-1443 (Figs 2)	222–241 *μm* high × 246–278 *μm* diam.	49–76 *μm* diam.	2.7 *μm* diam.	22–25 × 8–11 *μm* ($\bar{x}$ = 23 × 10 *μm*, n = 20)	This study
Neodeightonia rattanicola MFLU 15-0294 (Figs 4)	180–215 *μm* high × 146–168 *μm* diam.	35–51 *μm* diam.	3.2 *μm* diam.	22–26 × 8–11 *μm* ($\bar{x}$ = 23× 10 *μm*, n = 20),	This study
Neodeightonia phoenicum A.J.L. Phillips & Crous				Undetermined	Phillips et al. 2008
Neodeightonia palmicola J.K. Liu, Phook. & K.D. Hyde	180−230 *μm* high (excluding the neck), 270−420 *μm* diam.	26−55 *μm* diam.	3−5 *μm* diam.	23−31.5 × 8.5−12.5 *μm* ($\bar{x}$ = 24 × 10 *μm*, n = 20)	Liu et al. 2010
Neodeightonia microspora D.Q. Dai & K.D. Hyde	100–150 *μm* high × 95–150 *μm* diam.	15–20 *μm* diam.	absence	10–12 × 4.5–6 *μm*	Dai et al. 2016
Neodeightonia subglobosa C. Booth **(type species)**	160–220 *μm* high × 250–370 *μm* diam.	17–40 *μm* diam.	2–4 *μm* diam.	17–21 × 8–10.5 *μm*	Phillips et al. 2008, Lui et al. 2014, Dai et al. 2016

Table 3 Asexual morph

Species name	Conidiomata	Conidiogenous cell	Conidia	Growth rate	References
Neodeightonia rattanica MFLUCC 15-0396 (Figs 3)	245–349 high × 208–305 *μm* diam.	6.1−11.2 × 2.1−3.2 *μm*	19–22 × 7–9 *μm*	MEA fast growing, after 2 weeks, 7–8.5 cm diam. at 25°C.	This study
Neodeightonia rattanicola MFLUCC 15-0712 (Figs 5)	420–510 high × 357–443 *μm* diam.	4.4−12.5 × 1.5−4.3 *μm*	13–20 × 7–8 *μm*	MEA fast growing, after 2 weeks, 7–8.5 cm diam. at 25°C.	This study
Neodeightonia phoenicum			(14.5–)17–21(–24) ×(9–)10–12.5(–14) *μm* - 1-septate		Phillips et al. 2008, 2013,
Neodeightonia palmicola		9−20 × 3−6 *μm*.	17.5 −24.5 × 9.5−12.5 *μm* - 1-septate	PDA fast growing, after 4 days 50 mm.	Liu et al. 2010
Neodeightonia subglobosa (type species)	150–200 *μm* diam.	5–12.5 × 2–3 *μm*	11–13.5 × 8–10.5 *μm*	After 1 week, 5 cm diam. at 28 °C	Phillips et al. 2008, 2013, Lui et al. 2015, Dai et al. 2016

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