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Leptosporella (*Leptosporellaceae* fam. nov.) and *Linocarpon* and *Neolinocarpon* (*Linocarpaceae* fam. nov.) are accommodated in Chaetosphaeriales

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Abstract

In this paper we introduce the new species *Leptosporella arengae* and *L. cocois*, *Linocarpon arengae* and *L. cocois*, and *Neolinocarpon arengae* and *N. rachidis* from palms in Thailand, based on morphology and combined analyses of ITS and LSU sequence data. The phylogenetic positions all these new taxa are well-supported within the order Chaetosphaeriales (subclass Sordariomycetidae), but in distinct lineages. Therefore, a new family, *Leptosporellaceae* is introduced to accommodate species of *Leptosporella*, while *Linocarpaceae*, which constitutes a well-supported monophyletic clade is also introduced to accommodate *Linocarpon* and *Neolinocarpon* species. Both families are characterised by specific traits, such as the shape of ascomata and filiform, hyaline ascospores, which may be pale brown-yellowish in mass, that demarcate it from other families.

Key words – 2 new families – 6 new species – filiform ascospores – palm fungi – Phylogeny – Taxonomy – Sordariomycetes

Introduction

We have studied the genera of ascomycetes on palms since Hyde (1988). In most previous studies, taxa were introduced based solely on morphology (such as ascomata, asci and ascospores) and referred to different taxonomic ranks within the Ascomycota (Fröhlich & Hyde 2000, Taylor & Hyde 2003). This approach was, however, subjective and many taxa were assigned mostly to Ascomycota genera *incertae sedis*. Given that palms are important hosts with potential novel species, it is essential that these palm micro-fungi are recollected, epitypified where needed, isolated and sequence data obtained so that the palm microfungi can be placed in a natural taxonomic framework (Ariyawansa et al. 2014, Jayasiri et al. 2015).

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Penzig & Saccardo (1897) introduced *Leptosporella* Penz. & Sacc. with *L. gregaria* Penz. & Sacc. as the type species. *Leptosporella* was placed in Sordariomycetidae, genera *incertae sedis* by Lumbsch & Huhndorf (2010). The holotype was re-examined and fresh specimens collected and the genus was referred to the Chaetosphaeriales based on phylogenetic analysis of LSU sequence data (Huhndorf & Miller 2011, Dai et al. 2016). *Linocarpon* was introduced by Sydow & Sydow (1917), monographed by Hyde (1992a, 1997) with 23 accepted species. Many researchers have added novel species to this genus and accommodated them in *Xylariaceae* (Xylariales) (Dulymamode et al. 1998, Hyde & Alias 1999, Fröhlich & Hyde 2000, Thongkantha et al. 2003, Cai et al. 2004). Hyde (1992b) introduced *Neolinocarpon* K.D. Hyde as a novel genus which is typified by *N. globosicarpum* K.D. Hyde. The genus *Neolinocarpon* cannot be placed in any family within Xylariales with certainty and thus has been referred as Xylariales genera *incertae sedis* (Jones et al. 2009a, b, Maharachchikumbura et al. 2015).

Our fungal collections from palms have revealed six new species (*Leptosporella arengae*, *L. cocois*, *Linocarpon arengae*, *L. cocois*, *Neolinocarpon arengae*, *N. rachidis*) and these are described herein and their placement is supported with DNA sequence analyses. In this paper, we also accommodate *Linocarpon* and *Neolinocarpon* in *Linocarpaceae* fam. nov. and *Leptosporella* in *Leptosporellaceae* fam. nov. (Chaetosphaeriales). We list 12 species of *Leptosporella*, 41 species of *Linocarpon*, and 10 species of *Neolinocarpon*, however the known taxa need recollecting with molecular data, to establish their natural placements. Although some species have been transferred to other genera based on their morphological characteristics (Höhnel 1909, Arx & Olivier 1952, Petrak 1952, Walker 1980, Cribb & Cribb 1955, Vasilyeva 1993), most species have been introduced using only morphological characteristics, while less than 20 species have sequence data. All genera included in this study are poorly represented with sequence data in GenBank.

Materials & Methods

Collection, isolation and identification

Palm materials were collected from southern and western of Thailand. Specimens were examined with a Motic SMZ 168 series stereomicroscope and photographed with an Axio camera on a Zeiss Discover V8 stereomicroscope. Micromorphological structures were photographed with a Canon 600D camera on a Nikon ECLIPSE 80i microscope and measurement by Image Frame Work program (IFW) version 0.9.7. Photoplates were made with Adobe Photoshop CS5 Extended version 10. Isolations were made from single ascospores following the method of Chomnunti et al. (2014). Colony structures were recorded after seven days and/or until the colony growth nearly filled the Petri-dish when incubated at 25–28°C on MEA media. Holotype specimens are deposited in herbarium of Mae Fah Luang University (MFLU) and Herbarium of Kunming Institute of Botany, Chinese Academy of Sciences (HKAS). Living cultures are deposited in Mae Fah Luang University Culture Collection (MFLUCC) and BIOTEC Culture Collection Laboratory (BCC). Facesoffungi and Index Fungorum numbers are registered as outlined in Jayasiri et al. (2015) and Index Fungorum (2017). New species are established based on recommendations of Jeewon & Hyde (2016).

Fungal DNA extraction and PCR reaction

Genomic DNA was extracted from fresh mycelium grown on MEA for two weeks using the Biospin Fungus Genomic DNA Extraction Kit (BioFlux®). Specific rDNA regions were amplified with different gene primers, i.e. LROR and LR5 to amplify the large subunit rDNA (LSU) (Vilgalys & Hester 1990), NS1 and NS4 to amplify region of nuclear small subunit rDNA (SSU), ITS5 and ITS4 to amplify the internal transcribed spacers (ITS) (White et al. 1990), RPB2-5F and RPB2-7CR to amplify the RNA polymerase subunit II (RPB2) (Liu et al. 1999, Sung et al. 2007),

Table 1 Ascomata, hamathecium, asci and ascospore dimensions of species in *Leptosporella*, *Linocarpon* and *Neolinocarpon*.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
Leptosporella ambiens	300–400 µm diameter × 450 µm high	2 µm	150 × 12–15 µm	120 × 3 µm, parallel, filiform	On stalks of *Compositae vivae* (*Asteraceae*) Rio de Janeiro, Brazil	Rehm 1901
L. andina	-	-	-	-	On dead branchlets of a shrub Venezuela	Chardón & Toro 1934, Spegazzini 1912
[*]***L. arengae* MFLU 15–0305**	582–928 µm diameter × 293–354 µm high	1.5–3 µm diameter	137–190 × 10–14 µm	108–132 × 2–3.5 µm, C-shaped or sigmoid, ends rounded, with polar mucilaginous appendages	On dead rachis of *Arenga pinnata* (*Arecaceae*) Thailand	**In this study**
[*]*L. bambusae*	500–850 µm diameter × 200–250 µm high	2–3.5 µm diameter	100–195.5 × 9–13.5 µm	130–175 × 2–3 µm, 2–6-septate curved, narrow, acute at both ends	On dead culms of bamboo (*Poaceae*) Thailand	Dai et al. 2016
L. clelandii	-	-	-	-	On dead branches of *Acacia kempeana* (*Fabaceae*) Central Australia	Hansford 1957
L. clinopodii	-	-	-	-	*Clinopodium chinense* (*Lamiaceae*) Taiwan	Sawada 1943
[*]***L. cocois* MFLU 15–2349**	705–977 µm diameter × 209–298 µm high	3–6 µm diameter	145–242 × 8–13 µm	99–156 × 2.5–4 µm, straight or curved, rounded at the apex, pointed at the base	On dead rachis of *Cocos nucifera* (*Arecaceae*) Thailand	**In this study**
L. dicksoniae	-	-	-	-	*Dicksonia squarrosa* (*Dicksoniaceae*) Portugal	Sousa da Camara & da Luz 1939
[#,*]*L. gregaria* (type species)	800–1,000 µm diameter	filiform	100 × 9–10 µm	55–70 × 2.5–3 µm, 7-septate	Wood Tjibodas, Java, Indonesia	Penzig & Saccardo1897, Huhndorf et al. 2004, Huhndorf & Miller 2011

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
L. leucodontis	-	-	-	-	On dead leaves of *Leucodon sciuroides* (*Leucodontaceae*) France	Racovitza 1959
L. lignicola	-	-	-	-	Wood Venezuela	Chardón 1939
L. macrotheca	350–600 µm diameter	1–1.5 diameter µm	179–200 × 12–15 µm	82–110 × 4–5 µm	Wood New South Wales	Sydow 1938
L. rosae	-	-	-	-	On dead branches of *Rosa* (*Rosaceae*) Uttar Pradesh, India	Edward et al. 1972 (Not validly published)
L. sparsa	300 µm diameter	no observed	90–120 × 9–12 µm,	30–35 × 3 µm	Wood Java	Penzig & Saccardo 1897
Linocarpon alpiniae	400 µm diameter × 100 µm high	up to 4 µm at the base	81–108 × 8–11 µm	58–68 × 2.25–3 µm, lack refringent septum-like bands, ends of a rounded point with a minute mucilaginous drop	On basal stem of *Alpinia* (*Zingiberaceae*) Malaysia, Peninsular	Hyde 1997
*,$*L. angustatum*	800–944 µm diameter × 400–448 µm high	2–3 µm diameter	125–195 × 12.5–22 µm	57.5–87.5 × 3.5–6 µm, needle-shaped, narrow, point at the base, inconspicuous mucilage	On intertidal petiole of *Nypa fruticans* (*Arecaceae*) Malaysia, Peninsular	Hyde & Alias 1999, Bahl 2006
L. apiculatum	400–650 µm diameter × 80 µm high	up to 4 µm at the base	120–140 × 9–11 µm	56–64 × 3.5–4.5 µm	On decaying petiole of palm in freshwater swamp (*Arecaceae*) Papua New Guinea, Irian Jaya	Hyde 1997
**L. appendiculatum*	330–510 µm diameter × 120–180 µm high	wide at the base	110.5–169 × 7.8–9.8 µm	75–120 × 2.2–3.5 µm, with an appendage at a polar swelling with a flattened end (bell-shaped) containing mucilage	On rotten fronds of *Nypa fruticans* (*Arecaceae*) Brunei	Hyde 1988, 1992, Huhndorf et al. 2004, Miller & Huhndorf 2005, Bahl 2006

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
L. appendisporum	320 µm diameter × 150 µm high	up to 6.5 µm at the base	100–150 × 8–10 µm	60–76 × 2.75–4 µm, appendages at each ends containing mucilage	On dead leaves of *Pandanus* in freshwater swamp (*Pandanaceae*) Papua New Guinea, Irian Jaya	Hyde 1997
L. aquaticum	420–700 µm diameter × 300–450 µm high	up to 4 µm at the base	180–260 × 12–14 µm	110–160 × 2.4–2.8 µm, appendages at each ends, which grasps a mucilaginous	On rachis of palm (*Arecaceae*) Australia, Queensland	Hyde 1997
***L. arengae* MFLU 15–0306**	878–1,368 µm diameter × 125–355 µm high	2–3.5 µm diameter	132–177 × 9–15 µm	91–102 × 2–4 µm, ends rounded, with polar mucilaginous appendage at apex	On dead rachis of *Arenga pinnata* (*Arecaceae*) Thailand	**In this study**
L. australiense	520 µm diameter × 120 µm high	up to 3 µm diameter at the base	124–1 50 × 8–12 µm	92–108 × 2–2.5 µm, C-shaped or sigmoid, cream color in mass, ends round with an apiculate short appendage	On rachis of *Licuala ramseyi*, *Archontophoenix alexandrae* (*Arecaceae*) Australia, Queensland	Hyde 1997, Taylor & Hyde 2003
L. bambusicola	700–1300 µm diameter × 550–780 µm high	up to 4 µm wide at the base	155–(175)–190 × 7.5–(9.5)–11 µm	107–132.5–170 × 1.5–1.8–2 µm, rounded at the apex, the basal end provided with 1–3 minute mucilaginous drops	On stems of bamboo submerged in river (*Poaceae*) Philippines	Cai et al. 2004
L. bipolare	520–1040 µm diameter × 195–325 µm high	9 µm at the base and 1 µm distally	150–215 × 7.5–12 µm	90–139 × 2–3 µm	On intertidal fronds of *Nypa fruticans* (*Arecaceae*) Brunei	Hyde 1992a
L. breve	600 µm diameter × 130 µm high	up to 3 µm wide at the base	104–138 × 4.5–6 µm	34–45 × 2.2–2.6 µm, 2–3-seriate, with a collar-like appendage containing mucilage at each ends	On dead leaves of *Pandanus* (*Pandanaceae*) Papua New Guinea, Irian Jaya	Hyde 1997

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
L. bruneiense	1,060 µm diameter × 340 µm high	2.5 µm diameter	224.4–265.2 µm × 10.2–15.3 µm	(117.3–)126.2–159.4 × (2.6–)3.1–3.8(–4.6) µm, a small mucilage appendage at both tips, rounded end, a crescent-shape pad while the narrower end has a flame-shaped appendage	On dead petiole of *Calamus pogonacanthus* (*Arecaceae*) Brunei	Fröhlich & Hyde 2000
L. cajani	325–390 µm diameter × 130–260 µm high	5 µm at the base, 2 µm at the apex	82–100 × 7–10 µm	50–80 × 1.5–2.5 µm diameter, both ends rounded with a small mucilaginous pad at each end	On dry stalks of *Cajanus cajan* (*Fabaceae*), *Elaeis guineensis* (*Arecaceae*) Papua New Guinea, Tanzania	Petrak & Deighton 1952, Pirozynski 1972, Hyde 1992a
L. calamicola	542–587 µm diameter × 310–368 µm high	3.8–4.4 µm diameter at the base	178–240 × 8–11.2(–14.35) µm	97.9–117.45 × 2–2.6 µm, a mucilaginous pad at the base, with bipolar pads at maturity	On dead rattan of *Calamus australis*, *C.conirostris*, *Archontophoenix alexandrae* (*Arecaceae*) Australia, Queensland	Fröhlich & Hyde 2000, Taylor & Hyde 2003
*,$*L. carinisporum*	560 µm diameter × 160 µm high	up to 6 µm at the base	110–160 × 8–1 1 µm	84–98 × 2.4–3.2 µm, with or without refringent septum-like bands, rounded and swollen at the apex, basally narrow (cone-shaped) with a keel-like mucilaginous appendage	On dead rachis of *Licuala ramsayi*, *Cocos nucifera*, *Calamus conirostris*, *Calamus pogonacanthus* (*Arecaceae*) Peninsular Malaysia, Australia, Brunei Darussalam	Hyde 1997, Froehlich & Hyde 2000, Taylor & Hyde 2003, Bahl 2006
*,$*L. clavatum*	360 µm diameter × 160 µm high	up to 4 µm at the base	74–92 × 12–17 µm, clavate	41–51 × 4–5.5 µm, clavate, widest at the center, lack appendage, basal truncate and narrow, with a mucilaginous appendage	On rachis of *Pinanga* (*Arecaceae*) Peninsular Malaysia	Hyde 1997, Bahl 2006

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
***L. cocois* MFLU 15–2345**	400–980 µm diameter × 73–184 µm high	0.5–1 µm diameter	100–153 × 8–15 µm	69–90 × 3–5 µm, without refringent septum-like bands, ends rounded, the base wider than apex	On dead rachis of *Cocos nucifera* (*Arecaceae*) Thailand	**In this study**
L. copelandi	-	-	-	-	*Daemonorops* sp. (*Arecaceae*) Brunei	Bahl 2006
L. eccentricollum	233–360 µm diameter × 86–160 µm high	2.75–5 µm diameter at the base	103.75–137.5 × 8.75–11(–13.5) µm	68.75–100 × 2.5–3.25 µm, obvious mucilage appendage at the base of the ascospore only	On dead petiole of *Mauritia flexuosa* (*Arecaceae*) Ecuador	Fröhlich & Hyde 2000, Bahl 2006
L. elaeidis	(350–)450–(480–)520 µm diameter × (150–)195(–220) µm high	3–3.5 µm wide	(94–)116–(134–)148 × (8–)9–(10–)13 µm, clavate-cylindric, cylindrical	72–(90–)97 × (2–)3–4 µm, mucilage at the base	Dead rachis of *Elaeis guineensis*, *Calamus conirostris*, *C.radicalis*, *Calamus* sp., *Licuala longicalycata*, *Mauritia* sp., *Phoenix hanceana*, *Phoenix* sp., *Raphia vinifera*, *Trachycarpus fortunei*, *Trachycarpus* sp. (*Arecaceae*) Brazil, Brunei Darussalam, Australia, Malaysia, Sierra Leone, Tanzania, Thailand, Hong Kong	Petrak & Deighton 1952, Pirozynski 1972, Turner 1971, Liu 1977, Hyde 1992, Fröhlich & Hyde 2000, Lu et al. 2000, Zhuang 2001, Taylor & Hyde 2003, Bahl 2006, Pinruan et al. 2007
L. falciformisporum	500 µm diameter × 120 µm high	up to 5 µm wide at the base	112–140 × 8–10 µm	33–42 × 2.5–4.5 µm, 2–3-seriate, appendage mucilaginous becoming sickle-shaped or veil-like in water	On decaying leaves of *Pandanus* in freshwater swamp (*Pandanaceae*) Papua New Guinea, Irian Jaya	Hyde 1997

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
L. fasciatum	550–650 µm diameter × 140–170 µm high	2–6 µm diameter	110–178 × 8–14 µm	84–110 × 2.5–3.5 µm, appendage absent	On fallen leaves of *Pandanus eydouxia* (*Pandanaceae*) Mauritius	Dulymamode et al. 1998
L. freycinetiae	280–420 µm diameter × 100 µm high	poorly preserved	54–82 × 7–10 µm, cylindric-clavate	28–32 × 2.5–3 µm, no appendages observed	In freshwater swamp on decaying *Pandanus* leaves (*Pandanaceae*) Indonesia	Hyde 1997
L. hamaspora	170–220 µm diameter × 120–150 µm high	deliquescent	44–66 × 8–11 µm	38.5–50 × 1–2 µm, with an obtuse apex and tapering to the base	On leaves of *Quercus tinctoria* (*Fagaceae*) Great Smoky Mountains National Park (U.S. National Park Service)	Barr 1993, Hyde 1997
L. lammiae	420–485 µm diameter × 190–202 µm high	3–7 µm diameter	97–133 × 13.5–26 µm	53–76 × 4.5–7 µm, without visible gelatinous appendages	On decaying leaves of *Pandanus tectorius* (*Pandanaceae*) Queensland, Australia	Thongkantha et al. 2003
[*,$]*L. livistonae*	up to 700 µm diameter × 195 µm high	embedded in a gel, wide	100–140 × 6–12 µm, whitish in mass, short-pediculate	70–104 × 1.6–2.3 µm, apex rounded, the base narrow with mucilage	*Pandanus* (*Pandanaceae*), *Livistona chinensis*, *Livistona* sp., *Arenga engleri*, *Archontophoenix alexandrae*, *Licuala longicalycata*, *Ptychosperma* sp., (*Arecaceae*) Philippines, Mindanao Island, Taiwan, Australia, Thailand, Indonesia	Hyde 1989, 1992a, Bahl 2006, Taylor & Hyde 2003, Pinruan et al. 2007
L. longisporum	585–780 µm diameter × 130–210 µm high	6 µm at the base, 2 µm at the apex	170–216 × 8–12 µm, long-pediculate	124–140 × 2.5–3.0 µm, one end rounded, one end tapering with mucilage, curved, C-shaped or sigmoid, very rarely 1-septate in the center	On intertidal fronds of *Nypa fruticans* (*Arecaceae*) Brunei	Hyde 1992a

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
L. luteocollum	260–425 µm diameter × 70–130 µm high	2–5 µm	156–186 × 7.6–10 µm	88–107 × 2–2.8 µm, parallel in asci, rounded apex, attenuated base with small mucilaginous pad, lacking or present refringent septum-like bands	On dead rachis of *Archontophoenix alexandrae* (*Arecaceae*) Australia, Queensland	Taylor & Hyde 2003
L. manihotis	150–300 µm diameter	-	50–90 µm × 5–10 µm	45–70 × 1–1.5 µm	*Manihot utilissima* (*Manihotis utilissimae*) (*Euphorbiaceae*) India, Travancore, Pulliyanur	Petrak 1956
L. mauritiae	360–472 µm diameter × 152–232 µm high	1.5–2.5 µm diameter at the base	125–170 × 10–12 µm	82.5–107.5 × 2–2.8 µm, neither ascospore end has a mucilaginous appendage	On dead petiole of *Mauritia flexuosa* (*Arecaceae*) Ecuador	Fröhlich & Hyde 2000
L. nipae	465–620 µm diameter × 150–290 µm high	wide at the base	147–221 × 11.7–18.2 µm, long-cylindrical, strongly curved, long-pediculate	91–123.5 × 2.6–4.3 µm, yellowish in mass, mucilage at basal	*Nypa fruticans* (*Arecaceae*) Philippines, Luzon, Pampanga, Brunei Darussalam	Hyde 1989, 1992a
L. palmetto	325–429 µm diameter	wide at the base	70–100 × 8–10 µm	50–56 × 2.5–3.5 µm, hyaline in mass, one end wider with mucilage at the base	On dead places in living leaves of *Sabal palmetto* (*Arecaceae*) United States, Langlois, Oregon, Louisiana	Barr 1978, Hyde 1992
[#,*,$]*L. pandani* (type species)	up to 600–650 µm diameter × 200–300 µm high	3–4 µm wide at base	100–140 × 8–10 µm, long cylindrical	62–80 × 2–4 µm, centrally wide, ends rounded, parallel or spiral, without gelatinous appendages or mucilage	*Pandanus* leaves (*Pandanaceae*), *Arenga engleri*, *Licuala longicalycata*, *Ptychosperma* sp. (*Arecaceae*) Hong Kong, Thailand, Taiwan	Sydow & Sydow 1917, Sivanesan & Hsieh 1989, Hyde 1992a, Bahl 2006, Pinruan et al. 2007

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
**L. pandanicola*	700–800 µm diameter × 185–260 µm high	up to 6 µm wide at the base	160–190 × 8–10 µm	72–100 × 2.6–3.2 µm, with a small mucilaginous pad	*Pandanus* decaying leaves, in freshwater swamp (*Pandanaceae*), *Archontophoenix alexandrae*, *Mauritia flexuosa*, *Phoenix hanceana*, *Phoenix* sp. (*Arecaceae*) Papua New Guinea (Iryan Jaya), Australia, Ecuador	Hyde 1997, Froehlich & Hyde 2000, Lu et al. 2000, Zhuang 2001, Taylor & Hyde 2003
L. siamense	575–825 µm diameter × 650–875 µm high	3.1–12.3 µm	100–156 × 7.7–9.3 µm,	59–71 × 3.1–3.3 µm, with appendage	On decaying leaves of *Pandanus penetrans* (*Pandanaceae*) Thailand	Thongkantha et al. 2003
L. smilacis	300–350 µm diameter × 300–400 µm high	2–5 µm wide	150–160 × 7–10 µm	120–130 × 2–2.5 µm, ends rounded	On dead stems of *Smilax* (*Smilacaceae*) Taiwan	Hsieh et al. 1998
L. spathulatum	240–320 µm diameter × 70–100 µm high	3.5–4.5 µm wide	110–170 × 12–16 µm	66–89 × 4–5.5(–6) µm, the appendage tip rounded	On dead leaf of *Pandanus palustris* (*Pandanaceae*) Mauritius	Dulymamode et al. 1998
L. stipae	-	-	-	-	On dead culms of *Stipa* sp. (*Poaceae*) South Australia	Hansford 1954
L. sulcatum	260–340 µm diameter × 70–130 µm high	2–4 µm wide, rarely branched	92–170 × 12–20 µm	76–107 × 3–4 µm, with a basal appendage	On dead leaves of *Pandanus barklyi* (*Pandanaceae*) Mauritius	Dulymamode et al. 1998
L. suthepense	300–485 µm diameter	4.6–7.7 µm	77–92.5 × 61–7.7 µm	18.5–30.8 × 2.3–3.1 µm, with appendage	On dead leaves of *Pandanus penetrans* (*Pandanaceae*) Thailand	Thongkantha et al. 2003
L. verminosum	Up to 600 µm diameter	-	70–102 × 9–12 µm	60–88 × 1.9–3.2 µm, spiral in asci, hyaline in mass, lacking mucilage	In petioles of palms and *Sabal palmetto*, Guiana, Cayenne, Florida	Schrantz 1960, Hyde 1989, 1992a

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
L. versisporum	250–333 µm diameter	embedded in a gel, wide	70–80 × 8–9 µm,	60–70 × 2–2.5 µm, pale yellow, without septate	On dead petioles of *Sabal serrulata* (*Arecaceae*) Florida	Petrak 1952
L. williamsii	-	-	-	-	On dead culms of Gramineae (*Poaceae*) South Australia	Hansford 1954
L. zingiberacicola	600 µm diameter × 320 µm high	up to 4 µm at the base	140–180 × 9–1 2 µm	102–120 × 2.4–3 µm, mostly curved, the ends rounded with mucilage	On basal stem of *Zingiberaceae* Malaysia, Peninsular	Hyde 1997
Neolinocarpon arengae* **MFLU 15–0298	230–490 µm diameter × 336–566 µm high	2–4 µm diameter	168–214 × 15–21 µm	114–134 × 3–4 µm, ends rounded, with polar mucilaginous appendage at apex	On dead leaflet of *Arenga pinnata* (*Arecaceae*) Thailand	**In this study**
N. attaleae	350–880 × 220–650 µm	up to 5 µm	137.5–227.5 × 7.5–14(–15) µm	(52.5–)57.5–93(–105) × 3–4(–5) µm, filiform-fusoid to clavate, lack appendages	On dead rachis of *Attalea funifera* (*Arecaceae*) Brazil, Bahia	Vitoria et al. 2013
N. australiense	560–616(–760) µm diameter × (204–)296–380 µm high	deliquescing during maturation	125–164 × 11–15 µm	81–107(–126) × 2.5–3.5 µm, base narrower than apex with an inconspicuous, keel-like mucilaginous appendage, lacking appendage	On dead rattan of *Calamus moti*, *Calamus australis*, *Arenga engleri*, *Arenga* sp., *Livistona chinensis* (*Arecaceae*) Australia, North Queensland, Hong Kong	Hyde et al. 1998, Lu et al. 2000, Zhuang 2001
**,$N. calami*	448–500 µm diameter × 292–336 µm high	-	115–138 × 10.5–13 µm	68–85 × 2.5–3.5 µm, swollen blunt base, rounded apex, crescent-shaped mucilage pad at end, lacking at the rounded end	On dead petiole of *Calamus conirostris* (*Arecaceae*) Brunei	Hyde et al. 1998, Bahl 2006
**,$N. enshiense*	225–335 µm diameter × 200–260 µm high	2–3.6 µm at the base	74–108 × 8–13 µm	42–64 × 2–3.5 µm, apex rounded, truncate with a small mucilaginous pad	On dead petiole of *Trachycarpus fortunei* (*Arecaceae*) China, south west Hubei, Enshi	Hyde et al. 1998, Bahl 2006

Table 1 Continued.

Species name	Ascomata	Hamathecium	Asci	Ascospores	Host/Substrates/Location	References
N. eutypoides	204–312 µm diameter × 544–576 µm high	up to 5.2 µm wide at the base, tapering to 1–2.9 µm at the tip	108–138 × 6–8.5 µm	73–95(–106) × 1.5–2.2(–2.5) µm, rounded apex towards the flexuose or pointed base, mucilaginous appendage	*Acrocomia sclerocarpa*, *Archontophoenix alexandrae*, *Calamus conirostris*, *Cocos nucifera*, *Daemonorops margaritae*, *Licuala* spp., *Livistona chinensis*, *Plectocomia elongata* (*Arecaceae*) Australia, Brunei Darussalam, Hong Kong, Indonesia, Malaysia	Hyde et al. 1998, Lu et al. 2000
[#,*,$]*N. globosicarpum* (type species)	155–400 µm diameter × 310–520 µm high	5.6 µm diameter at the base	136–170 × 11–12 µm	70–1 19.3 × 2.0–2.8 µm, one end rounded, the other end irregular with a mucilaginous appendage	On decaying intertidal fronds of *Nypa fruticans* (*Arecaceae*) Brunei, South China Sea	Hyde 1992b, Bahl 2006, Jasrotia et al. 2014
N. inconspicuum	200–255 µm diameter × 365–410 µm high	2.6–6 µm diameter at the base	106–156 × 7.5–12 µm	76–98 × 2–3 µm	On dead rachis of *Archontophoenix alexandrae* (*Arecaceae*) Australia, Queensland	Hyde et al. 1998
[*,$]*N. nonappendiculatum*	635–710 µm diameter × 375–520 µm high	2.8–4 µm diameter at the base	134–190 × 8.5–12 µm	114–138 × 2–2.5 µm	On dead petiole of *Archontophoenix alexandrae* (*Arecaceae*) Australia, Queensland, Singapore	Hyde et al. 1998, Bahl 2006
N. nypicola	600–1,000 µm diameter	5–8.8 µm diameter at the base	100–164 × 8–10 µm,	92–117 × 2–3.8 µm, cream color in mass	On dead aerial rachids of *Nypa fruticans* (*Arecaceae*) Malaysia, Kuala Selangor	Hyde & Alias 1999
N. penniseti	-	-	-	-	On dead stem of *Pennisetum purpureum* (*Poaceae*) Hong Kong	Bhilabutra et al. 2006
[*]***N. rachidis* MFLU 15–0307**	320–390 µm diameter × 508–590 µm high	2.5–4 µm diameter	157–205 × 9–19 µm	123–140 × 2–4, apex rounded, pointed at the base, appendage	On dead rachis of *Arenga pinnata* (*Arecaceae*) Thailand	**In this study**

Note: [#]the type species; *have sequence data; [$]have sequence data but not used in this study.

and EF1-983F and EF1-2218R to amplify the fragment of translation elongation factor 1-α (TEF1-α) (Rehner & Buckley 2005).

Polymerase chain reaction (PCR) amplification was carried out as follows: the final volume of the PCR reaction was 25 µl, which contained 1 µl of DNA template, 1 µl of each forward and reverse primers, 12.5 µl of 2 × Power Taq PCR Master Mix and 9.5 µl distilled deionized water. The PCR thermal cycle program of ITS, LSU, and SSU genes amplifications were provided as: initially 94 °C for 3 min, followed by 35 cycles of denaturation at 94 °C for 30 s, annealing at 55 °C for 50 s, elongation at 72 °C for 1 min, and final extension at 72 °C for 10 min. The PCR thermal cycle program for the RPB2 gene was provided as initially 95 °C for 5 min, followed by 35 cycles of denaturation at 95 °C for 1 min, annealing at 52 °C for 2 min, elongation at 72 °C for 90 s, and final extension at 72 °C for 10 min. The PCR thermal cycle program for TEF1-α was set for denaturation at 96°C for 2 minutes, followed by 40 cycles of denaturation at 96°C for 45 seconds, annealing at 52°C for 30 seconds and extension at 72°C for 1.30 minutes, with a final extension step at 72°C for 5 minutes. Amplified PCR fragments were sequenced at the company. Generated new sequences of ITS, SSU, LSU, RPB2, and TEF1-α regions were deposited in GenBank.

Sequence alignment and phylogenetic analyses

DNA sequences were aligned in BioEdit (Hall 2004). Based on blast searches in GenBank, using LSU or ITS sequence data, separate phylogenetic analyses were carried out to determine the phylogeny of each fungal group within Sordariomycetes. Supplementary sequences were downloaded from GenBank, based on blast search and recent publications.

Multigene sequence alignments were generated with MAFFT v. 7.215 (Katoh & Standley 2013, http://mafft.cbrc.jp/alignment/server/index.html) and edited manually when necessary in MEGA7 version 7.0 (Kumar et al. 2016) or BioEdit v. 7.0 (Hall 2004). ITS and LSU sequence datasets were selected to construct the phylogenetic tree, were first analyzed separately and then the individual datasets were concatenated into a combined dataset and prepared in MEGA7 (Kumar et al. 2016). Data were converted from fasta to nexus format with Alignment Transformation Environment online, ALTER (Glez-Peña et al. 2010, https://sing.ei.uvigo.es/ALTER/).

Maximum likelihood analysis was performed by RAxMl GUI v.1.0. (Stamatakis 2006, Silvestro & Michalak 2011). Alignments in PHYLIP format were exchanged and loaded from the website (http://sing.ei.uvigo.es/ALTER/) (Glez-Peña et al. 2010). The search strategy was set to rapid bootstrapping at 1,000 and the analysis carried out using the GTR-GAMMA model of nucleotide substitution. The model of evolution was determined with MrModeltest 2.2 (Nylander 2004) under the Akaike information criterion (AIC). The model selected was GTR+I+G for each of gene and the combined dataset (Nylander 2004). The number of replicates was inferred using the stopping criterion. Bootstrap values greater than 50% were accepted. The posterior probabilities (PP) were determined by Markov Chain Monte Carlo sampling (BMCMC) using MrBayes v3.1.2 (Huelsenbeck & Ronquist 2001). Six simultaneous Markov chains were run for ten million generations and trees sampling frequency of every 1,000 generations. The first 10,000 trees were excluded as burn-in phase based on suggestion from Tracer. Bayesian posterior probabilities (BYPP) were calculated from the remaining 5,000 trees and values greater than 0.95 were accepted. The phylogenetic tree was visualized by FigTree v1.4.0 (Rambaut 2006).

Results

Phylogenetic analyses

The combined ITS and LSU sequence dataset alignment including our new taxa comprise taxa from related Sordariomycetes species. Members from Boliniales are a basal clade in this tree. Phylogenetic trees were generated by maximum likelihood (ML) under different optimality criteria, but tree topologies were similar and the best scoring ML with BYPP is shown in Fig. 1. Species of *Linocarpon* and *Neolinocarpon* cluster together in a moderately supported clade which we

established herein as *Linocarpaceae* fam. nov. Species of *Leptosporella* form another well-supported monophyletic clade which we introduce as *Leptosporellaceae* fam. nov. within Chaetosphaeriales. Our phylogenetic analysis depicts a close relationship of *Linocarpon arengae* with *L. cocois* with good support (95 % ML, 1.00 BYPP), while related to the sister branches which comprise other species of *Linocarpon*. *Neolinocarpon arengae* groups with *N. rachidis* (96 % ML, 1.00 BYPP). *Leptosporella arengae* and *L. cocois* cluster with good bootstrap support (93 % ML). Our six new species show a relationship in Chaetosphaeriales in the phylogenetic tree (Fig. 1).

Taxonomy

Leptosporellaceae Konta & K.D. Hyde, fam. nov.

Index Fungorum number: IF553956; Facesoffungi number: FoF03840

Saprobic or *endophytic* on various plants. Sexual morph: *Ascomata* solitary, superficial, comprising black, carbonaceous, dome-shaped, raised, blistering areas, within the plant tissues, flattened at the base, ostiole central. *Peridium* outer cells merging with the host epidermal cells, composed of dark brown to black cells of textura angularis. *Hamathecium* comprising numerous paraphyses. *Asci* 8-spored, unitunicate, cylindrical, long-pedicellate, with a J^-, wedge-shaped, subapical ring. *Ascospores* fasciculate, filiform, hyaline or pale-yellowish in mass, aseptate, ends rounded, with or without polar mucilaginous appendages. Asexual morph: Undetermined.

Notes – Species of *Leptosporellaceae* are mostly saprobic on wood, and have been recorded on stalks of *Compositae vivae* (*Asteraceae*), on dead branchlets of a shrub, *Rosa*, *Acacia kempeana* (*Fabaceae*), dead culms of bamboo, dead rachides or petioles of palms, on *Clinopodium chinense* and *Dicksonia squarrosa*, and dead leaves of *Leucodon sciuroides*, an endophytic species have been recovered from eupolypod fern (Polypodiales) (Penzig & Saccardo 1897, Rehmit 1901, Spegazzini 1912, Chardón & Toro 1934, Sydow 1938, Chardón 1939, Sousa da Camara & da Luz 1939, Sawada 1943, Hansford 1957, Racovitza 1959, Edward et al. 1972, Huhndorf et al. 2004, Huhndorf & Miller 2011, Dai et al. 2016, Del & Arnold 2017). Our phylogenetic analysis show that *Leptosporellaceae* species cluster together in a distinct clade, sister to *Helminthosphaeriaceae* in Chaetosphaeriales (Fig. 1). The new family differs from others families within Chaetosphaeriales as a morphologically and phylogenetically a well-resolved group.

Type genus – *Leptosporella* Penz. & Sacc., Malpighia 11(9-10): 406 (1897)

***Leptosporella* Penz. & Sacc., 1987**

Saprobic or *endophytic* on undetermined wood, bamboo (*Poaceae*), *Acacia kempeana* (*Fabaceae*), *Clinopodium chinense* (*Lamiaceae*), *Dicksonia squarrosa* (*Dicksoniaceae*), *Leucodon sciuroides* (*Leucodontaceae*), *Rosa* (Rosaceae), palms (*Arecaceae*) and eupolypod ferns (Polypodiales). Sexual morph: *Ascomata* solitary, superficial, comprising black, carbonaceous, dome-shaped, raised, blistering areas, within the plant tissues, subglobose, flattened at the base, ostiole central. *Peridium* outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising numerous, hyaline, hypha-like, septate, paraphyses, longer than asci. *Asci* 8-spored, unitunicate, cylindrical, long-pedicellate, with a J^-, wedge-shaped, subapical ring. *Ascospores* fasciculate, spiral, filiform, straight or curved, hyaline or pale-yellowish in mass, aseptate, ends rounded, with or without polar mucilaginous appendages, smooth-walled. Asexual morph: Undetermined.

Notes – *Leptosporella* was introduced by Penzig & Saccardo (1897) with *L. gregaria* Penz. & Sacc. as the type species. This genus was placed in the subclass Sordariomycetidae, genera *incertae sedis* by Lumbsch & Huhndorf (2010) and the holotype and fresh specimens were examined by Huhndorf & Miller (2011). Based on the phylogenetic analyses of LSU sequence data, *Leptosporella* was transferred to the Chaetosphaeriales (Huhndorf & Miller 2011). Maharachchikumbura et al. (2015) did not assign *Leptosporella* to any families in Sordariomycetes. Dai et al. (2016) introduced a new species, *L. bambusae*, from bamboo and based on LSU and ITS

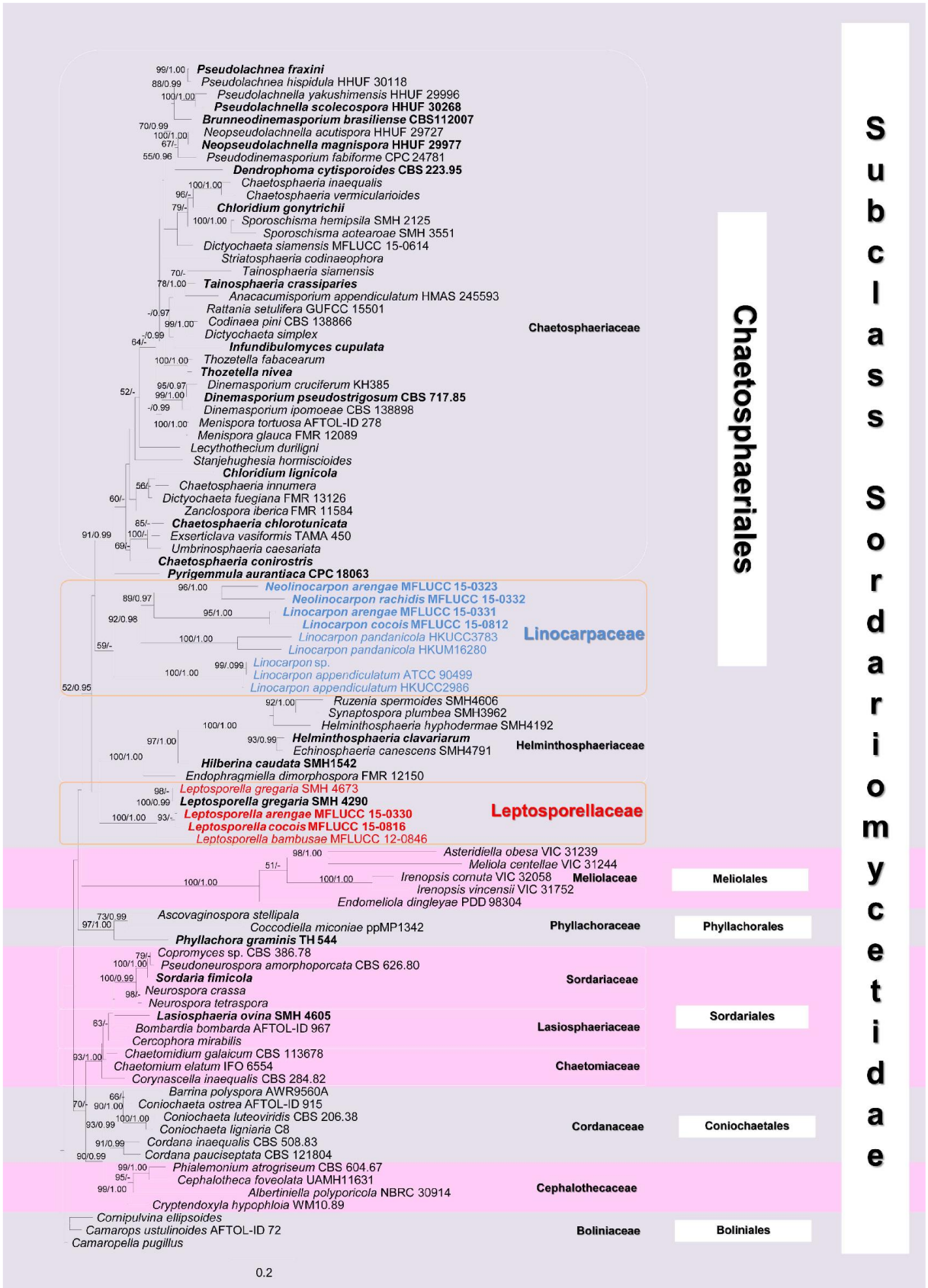

Figure 1 The parsimonious trees resulting from maximum likelihood (ML) analysis of a combined ITS and LSU dataset of species in the subclass Sordariomycetidae. Maximum likelihood (ML) bootstrap values ≥50%. Bayesian posterior probabilities (BYPP) greater than 0.95 is given at the nodes. The ex-type strains are in bold. The new family *Linocarpaceae* and new strains are in blue. The new family *Leptosporellaceae* and new strains are in red.

Table 2 GenBank accession numbers of the sequences used in phylogenetic analysis.

Species name	Strains	GenBank accession numbers	
		LSU	ITS
Albertiniella polyporicola	NBRC 30914	AB178271	AB278196
Anacacumisporium appendiculatum	HMAS 245593	KT001553	KT001555
Ascovaginospora stellipala	-	U85088	-
Asteridiella obesa	VIC31239	JX096809	KC252608
Barrina polyspora	AWR9560A	AY346261	-
Bombardia bombarda	AFTOL-ID 967	DQ470970	-
Brunneodinemasporium brasiliense	CBS 112007	JQ889288	JQ889272
Camaropella pugillus	-	EU481406	-
Camarops ustulinoides	AFTOL-ID 72	DQ470941	-
Cephalotheca foveolata	UAMH11631	KC408398	KC408422
Cercophora mirabilis	SMH 4002	-	KX171945
Chaetomidium galaicum	CBS113678	FJ666361	JN573175
Chaetomium elatum	IFO 6554	DQ368628	-
Chaetosphaeria chlorotunicata	SMH 1565	AF466064	-
Chaetosphaeria conirostris	SMH 2183	AF466066	-
Chaetosphaeria inaequalis	-	-	AF178564
Chaetosphaeria vermicularioides	MR 1148	-	AF178550
Chloridium gonytrichii *="Melanopsammella gonytrichii"*	SMH 3785	AF466085	-
Chloridium lignicola	CBS 143.54	AF178544	AF178544
Coccodiella miconiae	ppMP1342	KX430506	-
Codinaea pini	CBS 138866	KP004493	KP004465
Coniochaeta ligniaria	C8	AY198388	AY198390
Coniochaeta luteoviridis	CBS 206.38	AF353603	-
Coniochaeta ostrea	AFTOL-ID 915	DQ470959	-
Copromyces sp.	CBS 386.78	AY346277	-
Cordana inaequalis	CBS 508.83	HE672157	HE672146
Cordana pauciseptata	CBS:121804	HE672160	HE672149
Corynascella inaequalis	CBS 284.82	-	HQ871763
Dendrophoma cytisporoides	CBS 223.95	JQ889289	JQ889273
Dictyochaeta fuegiana	FMR_13126	KY853500	KY853440
Dictyochaeta siamensis	MFLUCC 15-0614	KX609952	KX609955
Dictyochaeta simplex	ICMP 14613	-	EF029193
Dinemasporium cruciferum	KH385	-	AB900896
Dinemasporium ipomoeae	CBS 138898	KP004474	KP004446
Dinemasporium pseudostrigosum	CBS 717.85	JQ889294	JQ889278
Echinosphaeria canescens	SMH4791	AY436403	-
Endomeliola dingleyae	PDD98304	GU138866	GU138865
Endophragmiella dimorphospora	FMR_12150	KY853502	KY853442
Exserticlava vasiformis	TAMA 450	AB753846	-
Helminthosphaeria clavariarum	-	AY346283	-
Helminthosphaeria hyphodermae	SMH4192	KF765608	-
Hilberina caudata	**SMH1542**	**KF765615**	-
Irenopsis cornuta	VIC32058	KC618642	-
Irenopsis vincensii	VIC31752	JX096807	KC252607
Infundibulomyces cupulata	-	EF113979	EF113976
Lasiosphaeria ovina	SMH4605	AY436413	AY587923
Lecythothecium duriligni	-	AF261071	-
Leptosporella arengae	**MFLUCC 15-0330**	**MG272246**	**MG272255**
Leptosporella bambusae	MFLUCC 12-0846	KU863122	KU940134
Leptosporella cocois	**MFLUCC 15-0816**	-	**MG272256**
Leptosporella gregaria	**SMH 4290**	**AY346290**	-
Leptosporella gregaria	SMH 4673	HM171287	-
Linocarpon appendiculatum	ATCC 90499	AY346291	-
Linocarpon appendiculatum	HKUCC2986	DQ810199	-
Linocarpon arengae	**MFLUCC 15-0331**	**MG272247**	-
Linocarpon cocois	**MFLUCC 15-0812**	**MG272248**	**MG272257**
Linocarpon pandanicola	HKUCC3783	DQ810210	-

Table 2 Continued.

Species name	Strains	GenBank accession numbers	
		LSU	ITS
Linocarpon pandanicola	HKUM16280	DQ810211	-
Neolinocarpon arengae	**MFLUCC 15-0323**	**MG272249**	**MG272258**
Neolinocarpon rachidis	**MFLUCC 15-0332**	**MG272250**	**-**
Meliola centellae	VIC31244	JQ734545	-
Menispora glauca	FMR 12089	HF678538	HF678528
Menispora tortuosa	AFTOL-ID 278 = DAOM231154	AY544682	KT225527
Neopseudolachnella acutispora	HHUF:29727	AB934041	AB934065
Neopseudolachnella magnispora	HHUF:29977	AB934042	AB934066
Neurospora tetraspora =Gelasinospora tetrasperma	CBS 178.33 = AFTOL-ID1287	DQ470980	AY681178
Phyllachora graminis	TH544	KX430508	-
Pseudodinemasporium fabiforme	CPC 24781	KR611906	KR611889
Pseudolachnea fraxini	CBS 113701	JQ889301	JQ889287
Pseudolachnea hispidula	HHUF 30118	AB934048	AB934072
Pseudolachnella scolecospora	HHUF:30268	AB934062	AB934086
Pseudolachnella yakushimensis	HHUF:29996	AB934064	AB934088
Pseudoneurospora amorphoporcata	CBS 626.80	AJ579682	-
Pyrigemmula aurantiaca	CBS 126743	-	HM241692
Rattania setulifera	GUFCC15501	HM171322	GU191794
Ruzenia spermoides	SMH4606	AY436422	
Sordaria fimicola	CBS 508.50	AY681160	AY681188
Sporoschisma aotearoae ="Melanochaeta aotearoae"	SMH 3551	AF466082	-
Sporoschisma hemipsila = "Melanochaeta hemipsila"	SMH2125	AY346292	-
Stanjehughesia hormiscioides	-	DQ408570	-
Striatosphaeria codinaeophora	CBS 101323	-	AF178546
Synaptospora plumbea	SMH3962	KF765621	-
Tainosphaeria crassiparies	SMH 1934	AF466089	-
Tainosphaeria siamensis	MFLUCC 15-0607	KY212758	KY212750
Thozetella fabacearum	MFLUCC 15-1020	KY212762	KY212754
Thozetella nivea	-	EU825200	EU825201
Umbrinosphaeria caesariata	-	AF261069	-
Zanclospora iberica	FMR_11584	KY853544	KY853480

sequence data and placed *Leptosporella* as Chaetosphaeriales *incertae sedis*. In this study we formally establish *Leptosporella* in *Leptosporellaceae* fam. nov. (Chaetosphaeriales). Presently 12 species epithets are included *Leptosporella* in Index Fungorum (2017). The ascospores in species of *Leptosporella* are narrowly, long filiform, with gradually tapering ends and if mucilage is present it is indistinct. In *Linocapon* and *Neolinocarpon* species ascospores have a distinct appendage at the apex and are generally wider and differ in appearance at the ends.

Leptosporella arengae Konta & K.D. Hyde, sp. nov. Fig. 2

Index Fungorum number: IF553957; Facesoffungi number: FoF03841

Etymology – The specific epithet refers to the host genus *Arenga*

Holotype – MFLU 15–0305

Saprobic on rachis of *Arenga pinnata* (Wurmb) Merr. Sexual morph: *Ascomata* 582–928 μm diameter × 293–354 μm high ($\bar{x}$ = 777 × 333 μm, n = 10), solitary, superficial, comprising black, carbonaceous, dome-shaped, raised blister-like areas, subglobose, flattened at the base, ostiole central. *Peridium* 78–150 μm diameter ($\bar{x}$ = 104 μm, n = 10), outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising numerous, 1.5–3 μm diameter ($\bar{x}$ = 2 μm, n = 10), hyaline, hypha-like, septate paraphyses, longer than asci. *Asci* 137–190 × 10–14 μm ($\bar{x}$ = 160 × 12 μm, n = 20), 8-spored, unitunicate, cylindrical, long-pedicellate, with a J^-, wedge-shaped, subapical ring. *Ascospores* 108–

132 × 2–3.5 µm ($\bar{x}$ = 122 × 3 µm, n = 20), fasciculate, spiral, filiform, straight or curved, C-shaped or sigmoid, hyaline or pale-yellowish in mass, aseptate, ends rounded, with polar mucilaginous appendages, smooth-walled. Asexual morph: Undetermined.

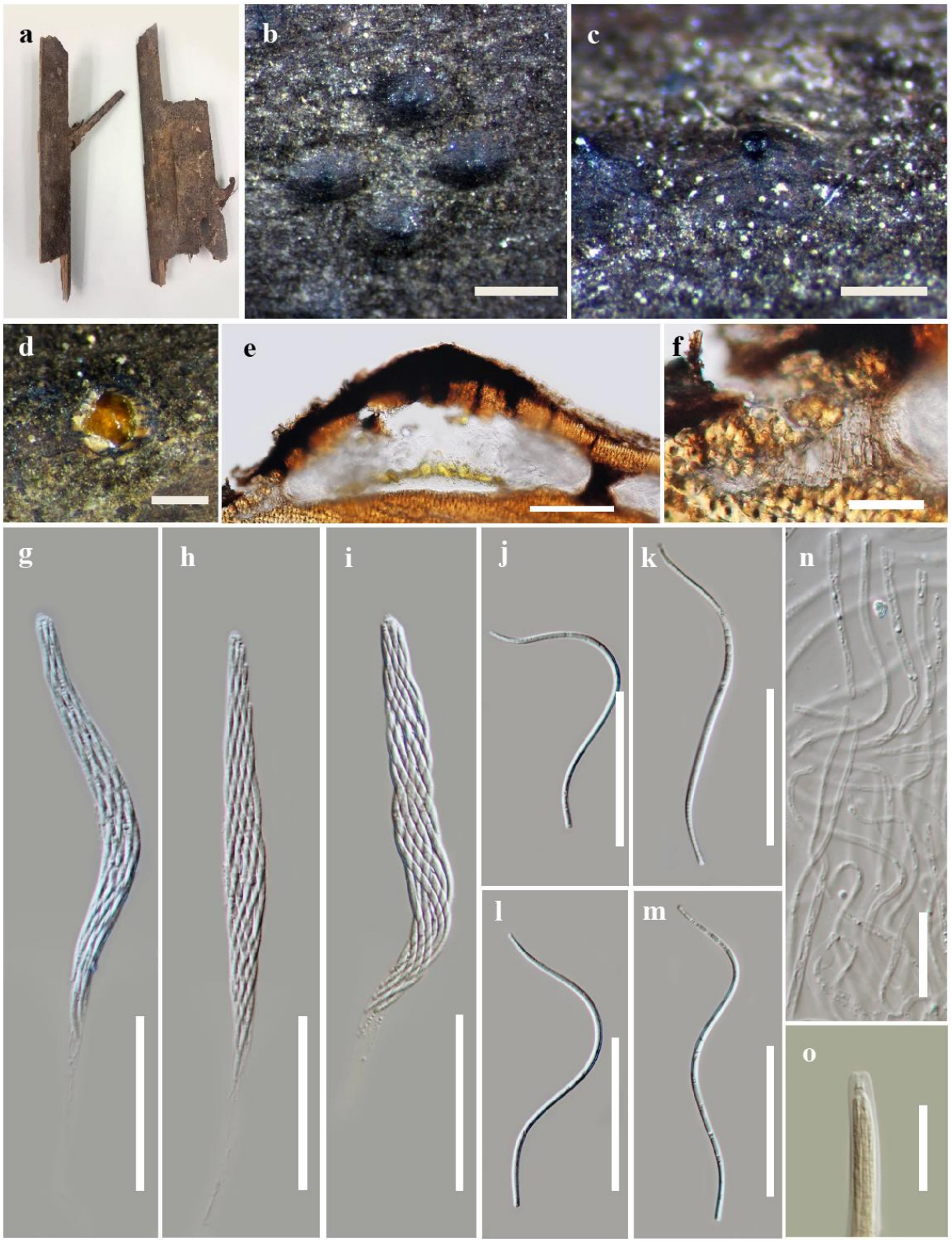

Figure 2 – ***Leptosporella arengae*** (MFLU 15–0305, holotype). a Appearance of ascomata on host substrate. b, c Close up of ascomata. d Yellowish ascospore mass. e Section of ascoma. f Peridium. g–i Asci. j–m Ascospores. n Paraphyses. o J- reaction of apical ring. Scale bars: b = 1,000 µm, c–d = 500 µm, e = 200 µm, f–m = 50 µm, n–o = 20 µm.

Culture characters – Ascospores germinating on MEA within 3 days. Colonies on MEA reaching 6–7.5 cm diameter after two months at 25°C, white at the edge, brown in the center with strong radiations outwards, after 30 days of incubation, colonies smooth-walled, flat, margin lobate, white at the center and become brown at the margin, hyphae, septate, branched and smooth-walled.

Material examined – THAILAND, Phang-Nga Province, on dead rachis of *Arenga pinnata* (Wurmb) Merr. (*Arecaceae*), 5 December 2014, Sirinapa Konta PHR07a (MFLU 15–0305, holotype); HKAS100704, isotype; ex-type living culture, MFLUCC 15–0330.

GenBank numbers – SSU: MG366594; TEF: MG272259; RPB2: MG272260

Notes – *Leptosporella arengae* is introduced as a new species based on its unique morphology and phylogeny. It differs from other species in *Leptosporella* in having cylindrical, long pedicellate, thin-walled asci and spiral, filiform, straight or curved, C-shaped or sigmoid ascospores with polar mucilaginous appendage at the apex (Table 1). However, it shares similarity with other species, it has solitary, superficial, carbonaceous, dome-shaped ascomata, asci with J-, subapical ring, and hyaline ascospores. Phylogenetic analysis indicates that *Leptosporella arengae* clusters with *L. cocois* (93% BS), but differs in having smaller ascomata, asci, ascospores, aseptate with a mucilaginous appendage ascospores, while *L. cocois* has larger ascomata, paraphyses, asci, ascospores without mucilaginous appendage, and 2–4-septate when ascospore geminated. Sequence data are available only for *L. gregaria* and *L. bambusae*, and with two unidentified strains.

Leptosporella cocois Konta & K.D. Hyde, sp. nov. Fig. 3

Index Fungorum number: IF553958; Facesoffungi number: FoF 03842

Etymology – The specific epithet refers to the host genus *cocos*

Holotype – MFLU 15–2349

Saprobic on rachis of *Cocos nucifera* L. Sexual morph: *Ascomata* 705–977 μm diameter × 209–298 μm high ($\bar{x}$ = 800 × 250 μm, n = 10), solitary or aggregated, superficial, comprising black, dome shaped, raised blistering areas, subglobose, flattened at the base, ostiole central. *Peridium* 76–125 μm diameter ($\bar{x}$ = 98 μm, n = 10), outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising numerous, 3–6 μm diameter ($\bar{x}$ = 4.5 μm, n = 10), hypha-like, septate paraphyses, longer than asci. *Asci* 145–242 × 8–13 μm ($\bar{x}$ = 187 × 10 μm, n = 20), 8-spored, unitunicate, cylindrical, long-pedicellate, with a J-, wedge-shaped, subapical ring. *Ascospores* 99–156 × 2.5–4 μm ($\bar{x}$ = 126 × 3 μm, n = 20), fasciculate, becoming spiral when mature, filiform, straight or curved, hyaline, aseptate, rounded at the apex, pointed at the base, smooth-walled, 1–4-septate when geminated. Asexual morph: Undetermined.

Culture characters – Ascospores germinating on MEA within 2 days. Colonies on MEA growing, reaching 7–8.5 cm diameter after 2 months at 25°C, white at the edge, brown in the center, outwardly with strong light brown radiations. After 30 days of incubation, colonies smooth, flat, margin entire, hypha septate, branched and smooth-walled.

Material examined – THAILAND, Prachaupkhirikan Province, Sai Khu Water Fall, on dead rachis of *Cocos nucifera* L. (*Arecaceae*), 30 July 2015, Sirinapa Konta PJK04k (MFLU 15–2349, holotype, HKAS 100705, isotype; ex-type living culture, MFLUCC 15–0816).

Notes – The phylogenetic analyses indicate that *Leptosporella cocois* is closely related to *L. arengae*, but they differ in the features of ascomata, asci, ascospores and paraphyses (Figs. 1, 2 and 3). Morphological differences are discussed under the latter species. *Leptosporella cocois* differs from *L. gregaria* (type species) in having larger asci with long pedicels, and filiform aseptate ascospores, while *L. gregaria* has smaller asci and ascospores than *L. cocois*, short pedicellate asci, and 7-septate ascospores. *Leptosporella cocois* is distinct from *L. arengae* in having larger ascomata, asci and ascospores without mucilaginous appendages, while *L. arengae* has smaller ascomata, asci and aseptate ascospores, lacking mucilaginous appendages and it differs from *L. macrothecea*, *L. sparsa*, and *L. bambusae* in having filiform ascospores, while *L. macrothecea* and *L. sparsa* have fusoid ascospores and *L. bambusae* has long fusiform ascospores (Table 1).

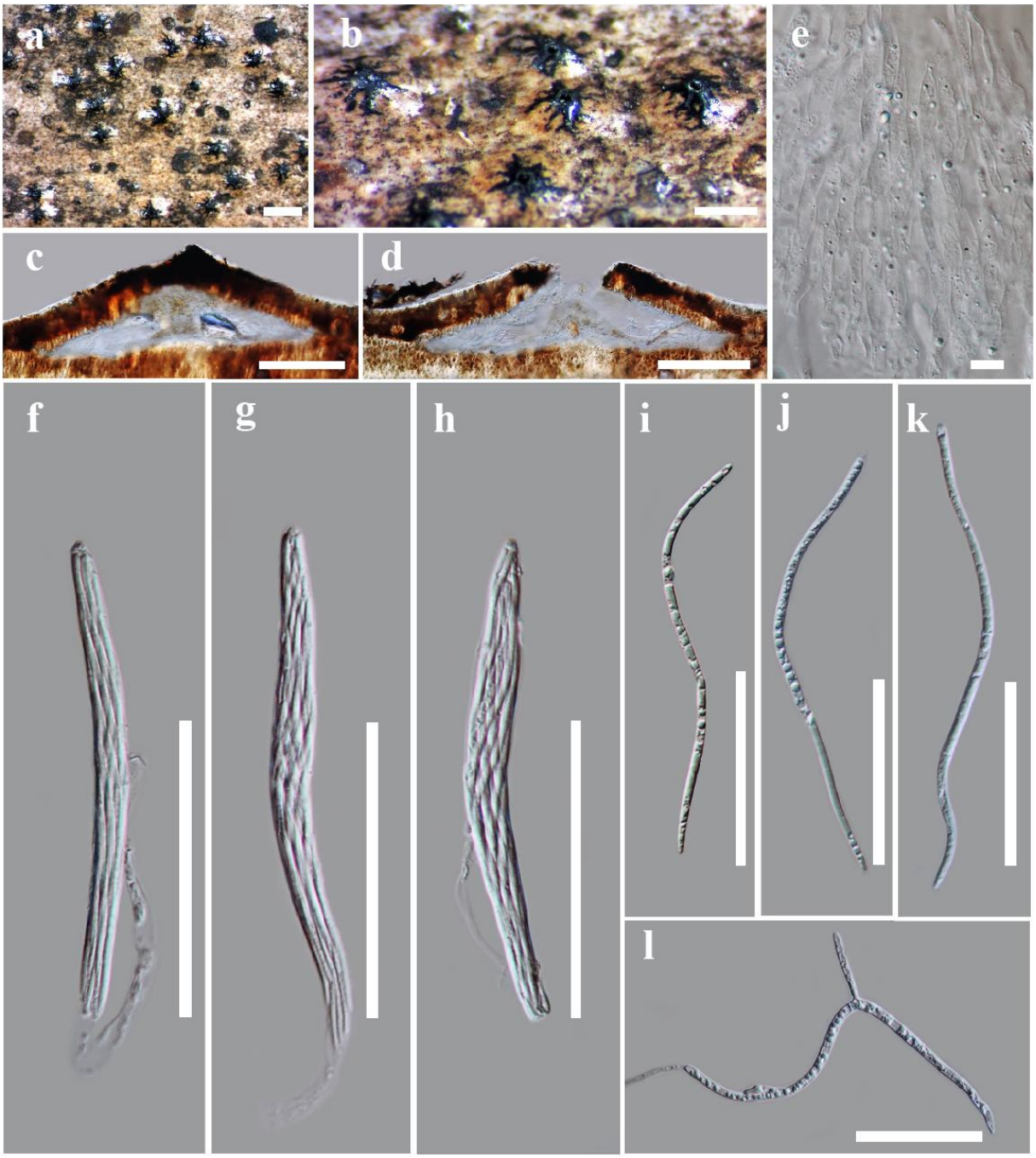

Figure 3 – ***Leptosporella cocois*** (MFLU 15–2349, holotype). a Appearance of ascomata on host substrate. b Close up of ascomata. c–d Sections of ascomata. e Paraphyses. f–h Asci. i–k Ascospores. l Germinated ascospore. Scale bars: a = 1,000 μm, b = 500 μm, c–d = 200 μm, e = 10 μm, f–k = 50 μm, l = 20 μm.

Linocarpaceae Konta & K.D. Hyde, fam. nov.

Index Fungorum number: IF553959; Facesoffungi number: FoF03843

Saprobic on monocotyledon and dicotyledons. Sexual morph: *Ascomata* solitary, superficial comprising black, dome-shaped (*Linocarpon*), slightly raised or flattened circular areas, or immersed (*Neolinocarpon*) with a black shiny papilla. *Peridium* composed of dark brown to black cells of *textura angularis*. *Hamathecium* of septate paraphyses, longer than asci, wider at the base, tapering towards the apex. *Asci* 8-spored, unitunicate, cylindrical, with a J^- an apical ring, developing from the base and periphery of the ascomata. *Ascospores* parallel or spiral in asci, filiform, straight or curved, hyaline or pale-yellowish in mass, unicellular with refringent bands,

with or without polar appendages. Asexual morph: A phialophora-like spp. was found in *Linocarpon appendiculatum* and *L. elaeidis* cultures (Hyde 1992a), but has not been recovered in other species.

Notes – The species belongs in *Linocarpaceae* are saprobes on monocotyledons and dicotyledons plants. Characteristic of species of *Linocarpaceae* was mentioned above and phylogenetic analysis indicates that *Linocarpaceae* forms a distinct clade sister to Chaetosphaeriaceae (Fig. 1). Thus, *Linocarpaceae* is introduced as a new family in Chaetosphaeriales (Sordariomycetidae) based on morphology and phylogeny.

Type genus – *Linocarpon* Syd. & P. Syd., Annls mycol. 15(3/4): 210 (1917)

Linocarpon Syd. & P. Syd., Annls mycol. 15(3/4): 210 (1917)

Saprobic on monocotyledon and dicotyledon plants. Sexual morph: *Ascomata* solitary, superficial, comprising black, dome-shaped, raised blistering areas, subglobose, flattened at the base, with a central ostiole. *Peridium* outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising hyaline, septate paraphyses, longer than asci, wider at the base, tapering towards the apex. *Asci* 8-spored, cylindrical, unitunicate, apically rounded, with a small non amyloid apical ring, developing from the base and periphery of the ascomata. *Ascospores* filiform, hyaline or pale-yellowish in mass, parallel or spiral in the ascus, ends rounded, inflated, appendage or acute, containing numerous refringent septum-like bands (Syd & Syd 1917, Hyde 1992a). Asexual morph: Phialophora-like spp. was found in *Linocarpon appendiculatum* and *L. elaeidis* cultures but never reported in other species.

Notes – *Linocarpon* was introduced by Sydow & Sydow (1917), monographed by Hyde (1992a), and updated by Hyde (1997), Dulymamode et al. (1998), Hyde & Alias (1999), Fröhlich & Hyde (2000), Thongkantha et al. (2003) and Cai et al. (2004). *Linocarpon* species have ascomata on the host surface that form black, dome-shaped, raised blistering areas, with a central ostiole. Asci are unitunicate, cylindrical with a small non-amyloid apical ring. Ascospores are filiform and aseptate (Fröhlich & Hyde 2000, Poonyth et al. 2000). The distinct ascospore appendage at the apex is important to differentiate *Linocarpon* and *Neolinocarpon* from *Leptosporella* as well as distinguish between species (Poonyth et al. 2000, Yanna & Hyde 2003, Cai et al. 2004). The *Phialophora* asexual morph of *Linocarpon* is rarely observed (Hyde 1992a). Fourty-one records of *Linocarpon* are listed in Index Fungorum 2017 and DNA sequence data are available for 33 sequences in GenBank (16 November 2017).

Linocarpon arengae Konta & K.D. Hyde, sp. nov. Fig. 4

Index Fungorum number: IF553960; Facesoffungi number: FoF03844

Etymology – The specific epithet refers to the host genus *Arenga*.

Holotype: MFLU: 15–0306.

Saprobic on rachis of *Arenga pinnata* (Wurmb) Merr. Sexual morph: *Ascomata* 125–355 μm high × 878–1,368 μm diameter ($\bar{x}$ = 205 × 1,094 μm, n = 10), solitary or aggregated, superficial, comprising black, dome-shaped, raised, blistering areas, subglobose, flattened at the base, with a central ostiole. *Peridium* 64–90 μm diameter ($\bar{x}$ = 76 μm, n = 10), outer cells merging with the host epidermal cells, composed of dark brown to black cells of textura angularis. *Hamathecium* comprising numerous, 2–3.5 μm diameter ($\bar{x}$ = 3 μm, n = 10), hyaline, hypha-like, septate paraphyses, longer than asci. *Asci* 132–177 × 9–15 μm ($\bar{x}$ = 153 × 11 μm, n = 20), 8-spored, unitunicate, cylindrical, long-pedicellate, with a J^-, wedge-shaped, subapical ring. *Ascospores* 91–102 × 2–4 μm ($\bar{x}$ = 102 × 3 μm, n = 20), parallel when immature, becoming spiral when mature, filiform, straight or curved, hyaline, aseptate, containing numerous refringent septum-like bands, ends rounded, with polar mucilaginous appendage at the apex, smooth-walled. Asexual morph: Undetermined.

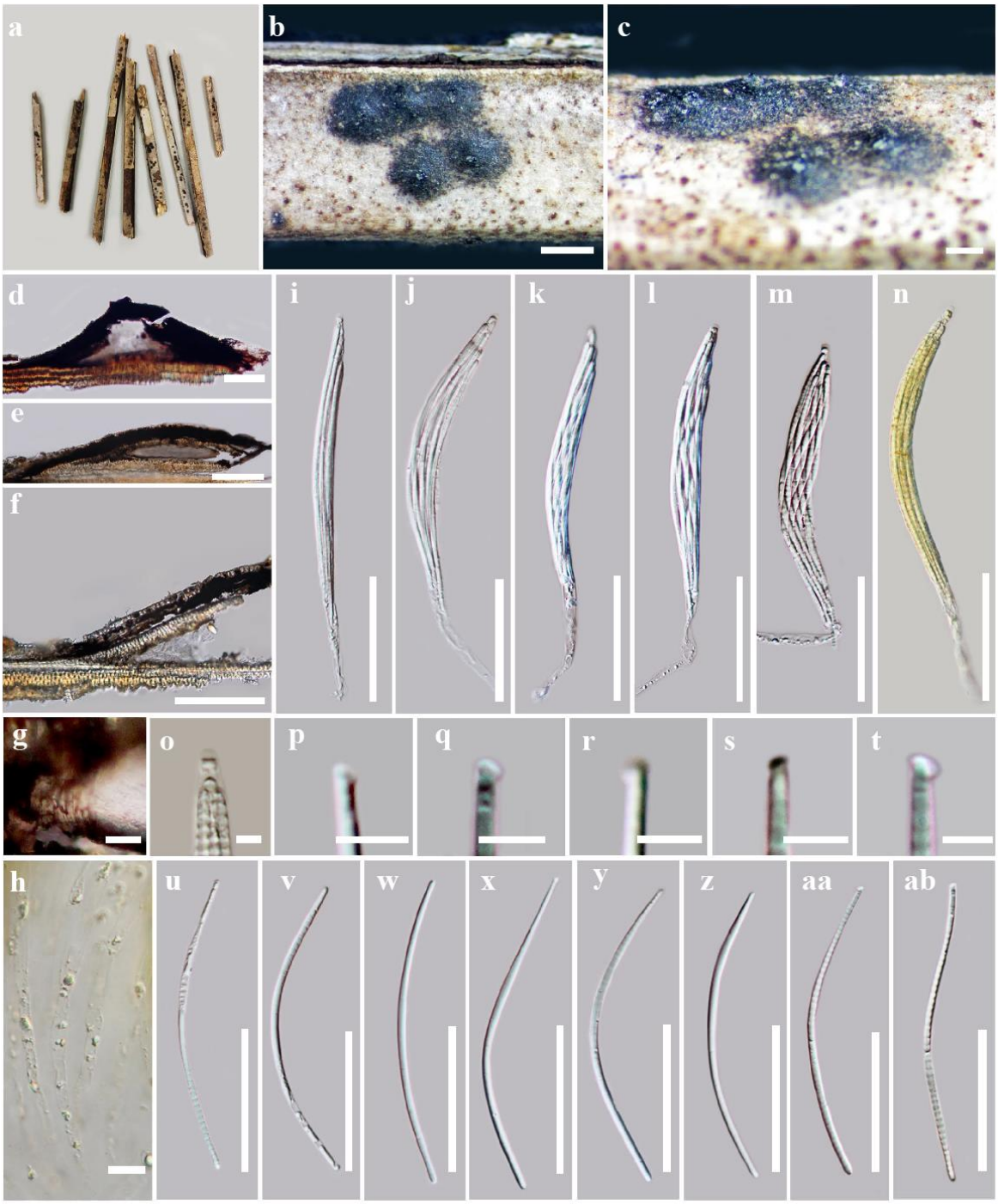

Figure 4 – *Linocarpon arengae* (MFLU 15–0306, holotype). a Appearance of ascomata on host substrate. b, c Close up of ascoma. d Yellowish ascospore mass. e Section of ascomata. f, g Peridium. h Paraphyses. i–n asci. o J- reaction of apical ring. p–t Appendage. u–ab Ascospores. Scale bars: b = 500 μm, c–f = 200 μm, g = 20 μm, h = 10 μm, i–n, u–ab = 50 μm, and o–t = 5 μm.

Culture characters – Ascospores germinating on MEA within 3 days. Colonies on MEA reaching 6.5–7 cm diameter after 2 months at 25°C, white at the edge, brown in the middle with strong radiations outwards. After 30 days of incubation, colonies smooth, hyphae septate, branched, smooth.

Material examined – THAILAND, Phang-Nga Province, on dead rachis of *Arenga pinnata* (Wurmb) Merr. (*Arecaceae*), 5 December 2014, Sirinapa Konta PHR07h (MFLU 15–0306, holotype); HKAS100700, isotype; ex-type living culture, MFLUCC 15–0331.

GenBank number – SSU: MG366596

Notes – *Linocarpon arengae* is introduced as a new species based on the morphology and DNA sequence data. However, the species that was included in this genus is known form a polyphyletic clade based on LSU sequence data (Bahl 2006). Furthermore, in this study the phylogenetic analyses indicated that *L. arengae* is most closely related to *L. cocois* with good bootstrap support and was placed in the same clade with *L. pandanicola* and shown as a monophyletic clade within *Linocarpaceae* fam. nov., but it forms a distinct lineage (Table 1).

Linocarpon cocois Konta & K.D. Hyde, sp. nov. Fig. 5

Index Fungorum number: IF553961; Facesoffungi number: FoF 03845

Etymology – The specific epithet refers to the host genus *Cocos*

Holotype: MFLU 15–2345

Saprobic on rachis *of Cocos nucifera* L. Sexual morph: *Ascomata* 73–184 μm high × 400–980 μm diameter ($\bar{x}$ = 124 × 655 μm, n = 10, up to 1,000 μm), solitary or aggregated, superficial, comprising shiny, black, dome shaped, raised blistering areas, subglobose, flattened at the base, central ostiole. *Peridium* 60–92 μm diameter ($\bar{x}$ = 71 μm, n = 10), outer cells merging with the host epidermal cells, composed of dark brown to black, cells of textura angularis. *Hamathecium* comprising numerous, 0.5–1 μm diameter ($\bar{x}$ = 0.7 μm, n = 10), hyaline, septate, hypha-like paraphyses, longer than asci. *Asci* 100–153 μm × 8–15 μm ($\bar{x}$=120 × 10 μm, n = 20), 8-spored, unitunicate, cylindrical, long-pedicellate, with a J-, wedge-shaped, subapical ring. *Ascospores* 69–90 × 3–5 μm ($\bar{x}$ = 76 × 4 μm, n = 20), parallel when immature, becoming spiral at maturity, filiform-fusiform, straight or curved, hyaline, aseptate when mature, becoming multi-septate when germinating, without refringent septum-like bands, ends rounded, the base wider than apex, smooth-walled, with a mucilaginous appendage at the apex, producing germ tube from each cell. Asexual morph: Undetermined.

Culture characters – Ascospores germinating on MEA within 24 hours. Colonies on MEA reaching 7–8.5 cm diameter after 2 months at 25°C, white at the edge with strong radiations outwards. After 30 days of incubation, colonies smooth, flat, entire edge margin, brown, hyphae septate, branched, smooth.

Material examined – THAILAND, Prachaupkhirikan Province, Sai Khu Water Fall, on dead rachis of *Cocos nucifera* L. (*Arecaceae*), 30 July 2015, Sirinapa Konta PJK04f (MFLU 15–2345, holotype); HKAS100701, isotype; ex-type living culture, MFLUCC 15–0812.

Notes – *Linocarpon cocois* is morphologically similar to *Linocarpon* genus in its black, dome-shaped, raised blistering areas, flattened at the base, with a central ostiole. Phylogenetically *L. cocois* groups together with *L. arengae* (Fig. 1). In addition our *L. cocois* isolate has been collected from the same family host (*Arecaceae*) with *L. arengae* but has been collected from *Cocos nucifera* and *Arenga pinnata*. *Linocarpon pandanicola*, on the other hand, has been isolated from *Pandanaceae*. Although *L. cocois* is closely related to *L. arengae*, it differs in having ascospore shape, size, lack the refringent septum-like bands and differ in the shape and the type of appendages.

Neolinocarpon K.D. Hyde 1992

Saprobic on mostly monocotyledons. Sexual morph: *Ascomata* solitary, deeply immersed, oval to globose, with central raised, dark, shiny papilla, ostiole with periphyses, ascospores pale-yellowish in mass. *Peridium* outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising tapering, septate paraphyses, longer than asci. *Asci* 8-spored, unitunicate, long cylindrical, pedicelate, apex rounded, containing an oblong to wedge-shaped, refractive, apical ring, and some with a refractive circular body below. *Ascospores* filiform, straight or curved, hyaline, 1-celled, with refringent bands, with apical appendages (Hyde 1992b). Asexual morph: Undetermined.

Notes – *Neolinocarpon* was introduced by Hyde (1992b) and typified by *N. globosicarpum* K.D. Hyde. This genus was placed in *Xylariaceae* based on morphology (Hyde 1992b). Hyde (1997) included *Neolinocarpon* in *Hyponectriaceae*. Wang & Hyde (1999) excluded

Neolinocarpon from *Hyponectriaceae*. Then Kirk et al. (2001) and Eriksson (2006) assigned *Neolinocarpon* into Sordariomycetes *incertae sedis*. Bahl (2006) re-examined the utilized fresh samples and dried herbarium material. Based on the phylogenetic analysis of LSU and RPB2 DNA sequence data, *Neolinocarpon* was not monophyletic clade and transferred into Xylariales and Chaetosphaeriales (Bahl 2006). Maharachchikumbura et al. (2015) did not determine the family placement of *Neolinocarpon* in their studies.Vitoria et al. (2013) introduced new species of *Neolinocarpon attaleae* from *Attalea funifera* (*Arecaceae*) based on the morphological characters. In this study *Neolinocarpon* is placed in *Linocarpaceae* (Chaetosphaeriales) based on phylogenetic analysis (Fig. 1). Ten species epithets of *Neolinocarpon* are listed in Index Fungorum (2017).

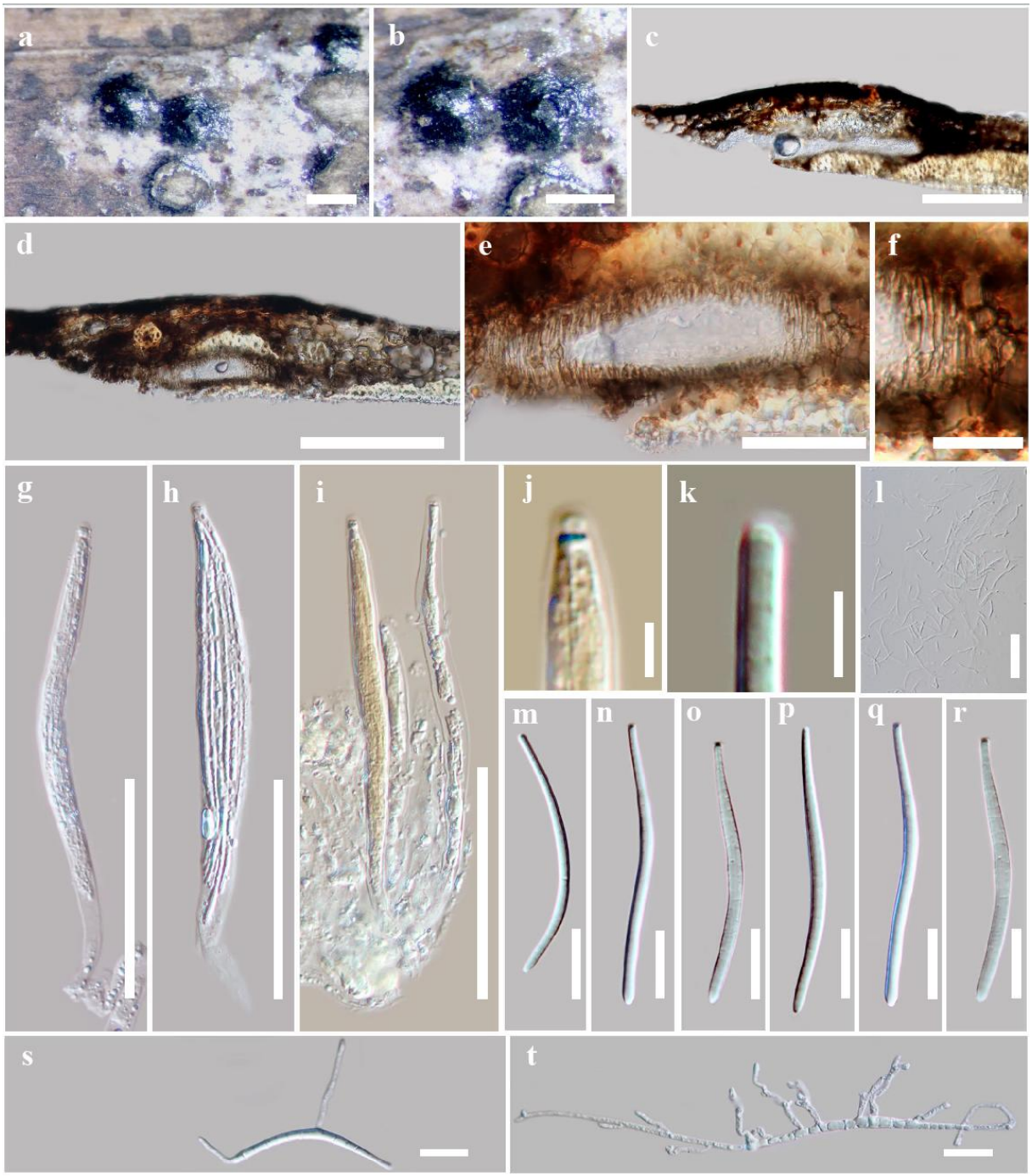

Figure 5 – *Linocarpon cocois* (MFLU 15–2345, holotype). a Ascomata on host substrate. b Close up of ascomata. c–e Sections of ascomata. f Peridium. g–i Asci. j J^- reaction of apical ring. k Appendage. l Paraphysoids. m–r Ascospores. s–t Germinated ascospores. Scale bars: a, b = 500 µm, c, d = 200 µm, e, g–i = 50 µm, j, k = 5 µm, f, l–t = 20 µm

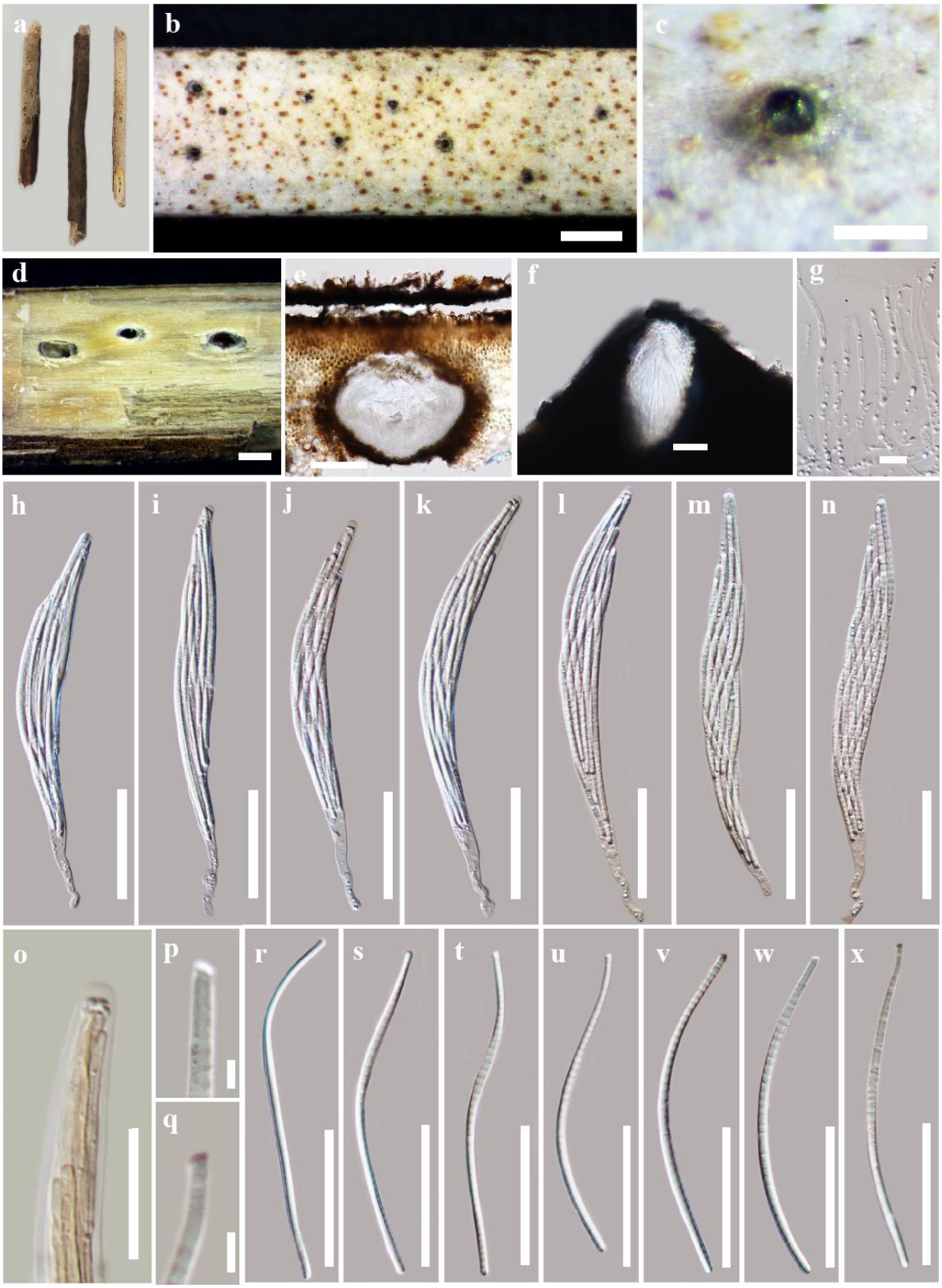

Figure 6 – *Neolinocarpon arengae* (MFLU 15–0298, holotype). a Appearance of ascomata on host substrate. b, c Close up of ascomata. d Yellowish ascospore mass. e Section of ascoma. f Papilla. g Paraphyses. h–n Asci. o J- reaction of apical ring. p–q Appendages. r–x Ascospores. Scale bars: b = 500 µm, c = 200 µm, d = 50 µm, e = 200 µm, g = 10 µm, h–n, r–x = 50 µm, o = 20 µm, and p–q = 5 µm.

Neolinocarpon arengae Konta & K.D. Hyde, sp. nov. Fig. 6

Index Fungorum number: IF553963; Facesoffungi number: FoF03847

Etymology – The specific epithet refers to the host genus *Arenga*

Holotype: MFLU 15–0298

Saprobic on dead leaflet of *Arenga pinnata* (Wurmb) Merr. Sexual morph: *Ascomata* 336–566 µm high × 230–490 µm diameter ($\bar{x}$ = 430 × 368 µm, n = 10), solitary, deeply immersed, with a central raised black, papilla, with a central ostiole. *Papilla* 129–218 µm high × 174–296 µm diameter at the base ($\bar{x}$ = 154 × 203 µm, n = 5), black, shiny, with hyaline periphyses. *Peridium* 33–80 µm diameter ($\bar{x}$ = 50 µm, n = 10), outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising numerous, 2–4 µm diameter ($\bar{x}$ = 3 µm, n = 10), hypha-like, septate, unbranched paraphyses, longer than asci,. *Asci* 168–214 × 15–21 µm ($\bar{x}$ = 186 × 18 µm, n = 20), 8-spored, unitunicate, cylindrical, long-pedicellate, with a J-, wedge-shaped, subapical ring. *Ascospores* 114–134 × 3–4 µm ($\bar{x}$ = 121 × 4 µm, n = 20), parallel when immature, becoming spiral at maturity, filiform, straight or curved, hyaline, aseptate, containing numerous refringent septum-like bands, ends rounded, with polar mucilaginous appendage at apex, smooth-walled. Asexual morph: Undetermined.

Culture characters – Ascospores germinating on MEA within 2 days. Colonies on MEA reaching 6–8 cm diameter after 2 months at 25°C, white to gray at the edge, gray to brown in the middle forward until nearly margin, light brown at margin, dark brown when mycelium growing into media 30 days of incubation, colonies smooth, flat, lobate margin, hyphae septate, branched, smooth.

Material examined – THAILAND, Phang-Nga Province, on dead leaflet of *Arenga pinnata* (Wurmb) Merr. (*Arecaceae*), 5 December 2014, Sirinapa Konta PHR07d (MFLU 15–0298, holotype); HKAS100703, isotype; ex-type living culture, MFLUCC 15–0323.

GenBank numbers –SSU: MG366597; RPB2: MG272261

Notes – *Neolinocarpon arengae* is similar to species of *Neolinocarpon* with respect to the ascomata and filiform ascospores. It however differs from some species in terms of ascomata size, ascospores shape at both ends and presence of mucilaginous appendage, and based on host differences (Table 1). Phylogenetic analysis incicated that *Neolinocarpon arengae* is related to *N. rachidis* (96% ML, 1.00 PP) (Fig.1).

Neolinocarpon rachidis Konta & K.D. Hyde, sp. nov. Fig. 7

Index Fungorum number: IF553962; Facesoffungi number: FoF 03846

Etymology – The specific epithet refers to the host habitat (rachids).

Holotype: MFLU: 15–0307.

Saprobic on rachis of *Arenga pinnata* (Wurmb) Merr. Sexual morph: *Ascomata* 508–590 µm high × 320–390 µm diameter ($\bar{x}$ = 557 × 346 µm, n = 10), solitary, deeply immersed, with a central raised, black, globose-subglobose papilla, with a central ostiole. *Papilla* 157–223 µm high × 127–198 µm diameter at the base ($\bar{x}$ = 188 × 157 µm, n = 5), black, shiny, with hyaline periphyses. *Peridium* 34–80 µm wide ($\bar{x}$ = 55 µm, n = 10), outer cells merging with the host epidermal cells, composed of dark brown to black cells of *textura angularis*. *Hamathecium* comprising numerous, 2.5–4 µm diameter ($\bar{x}$ = 3 µm, n = 10), hypha-like, septate, unbranched, paraphyses, longer than asci. *Asci* 157–205 × 9–19 µm ($\bar{x}$ = 180 × 14 µm, n = 20), 8-spored, unitunicate, cylindrical, long-pedicellate, with a wedge-shaped, J-, subapical ring. *Ascospores* 123–140 × 2–4 µm ($\bar{x}$ = 133 × 3 µm, n = 20), parallel in ascus, becoming spiral when mature, filiform, straight or curved, hyaline, aseptate, containing numerous refringent septum-like bands, rounded at the apex with appendage, pointed at the base, smooth-walled. Asexual morph: Undetermined.

Culture characters – Ascospores germinating on MEA within 7 days. Colonies on MEA reaching 3–4 cm diameter after two months at 25°C, white at the edge, brown in the middle with strong radiations outwards. After 30 days of incubation, colonies smooth, flat, margin undulate, white to gray in the center, gray-brown at the margin, mycelium becoming dark brown when growing into media, hyphae septate, branched, smooth-walled.

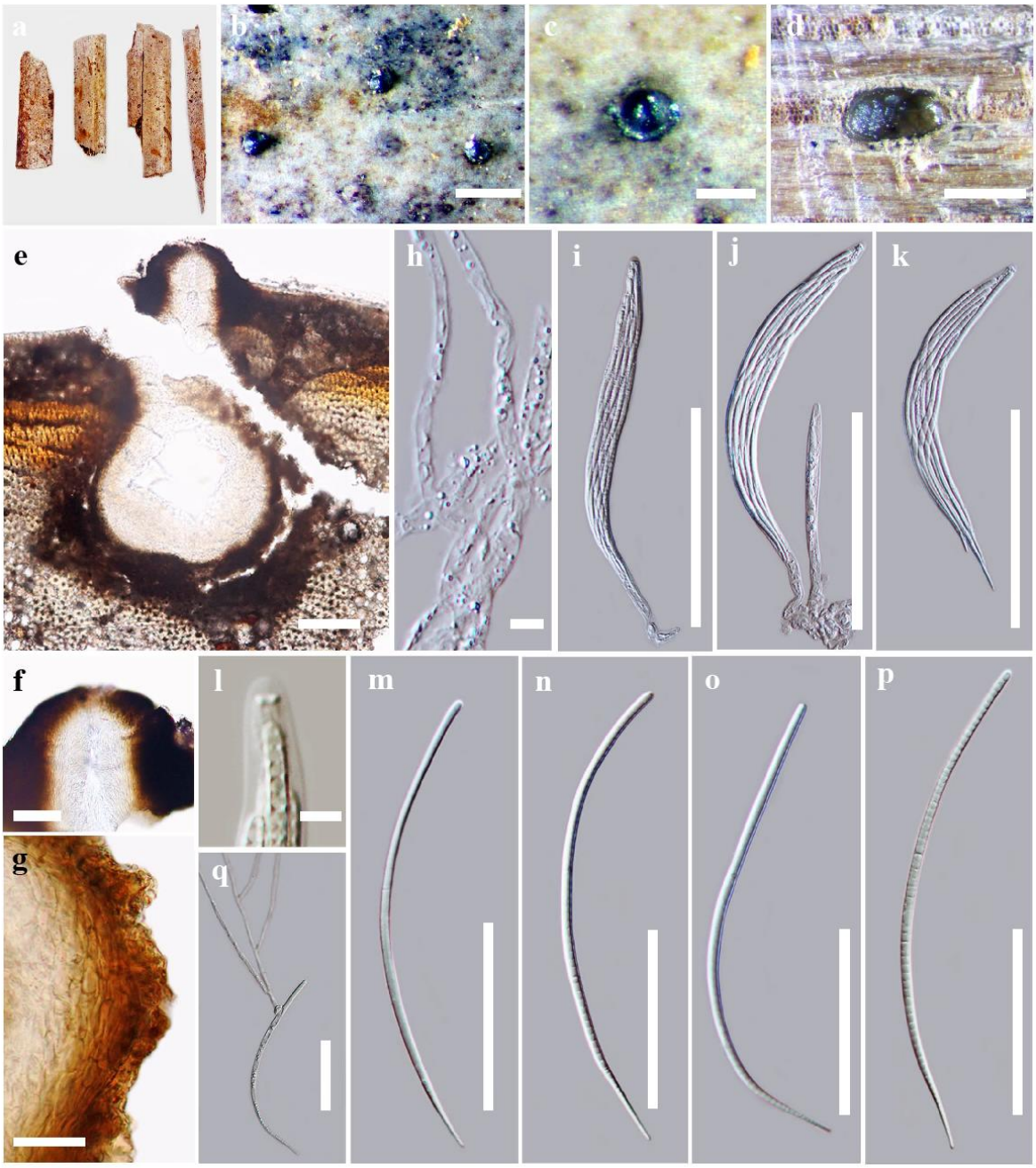

Figure 7 – *Neolinocarpon rachidis* (MFLU 15–0307, holotype). a Appearance of ascomata on host substrate. b, c Close up of ascomata. d Yellowish ascospore mass. e Section of ascoma. f Papilla. g Peridium. h Paraphyses. i–k Asci. l J- reaction of apical ring. m–p Ascospores. q Germinated ascospore. Scale bars: b, d = 500 µm, c = 200 µm, e, i–k = 100 µm, f–g = 20 µm, h = 10 µm, l = 5 µm, m–q = 50 µm.

Material examined – THAILAND, Phang-Nga Province, on dead rachis of *Arenga pinnata* (Wurmb) Merr. (*Arecaceae*), 5 December 2014, Sirinapa Konta PHR06e (MFLU 15–0307, holotype); HKAS 100702, isotype; ex-type living culture, MFLUCC 15–0332).

GenBank number –SSU: MG366598

Notes – *Neolinocarpon rachidis* is typical of *Neolinocarpon* species in having deeply immersed ascomata with a shiny visible papilla and filiform, hyaline ascospores. However, it is distinct as ascospores are rounded at the apex and pointed at the base, and differing type of mucilaginous appendages (Table 1). In the phylogenetic analysis *N. rachidis* clusters with *N. arengae* (96% ML, 1.00 PP) (Fig. 1), but the species have very different ascospores (Table 1).

Discussion

Hyde (1992b) suggested that *Linocarpon* and *Neolinocarpon* species are similar to Lasiosphaeriaceous taxa in the apical structure of the ascus and in ascospore morphology. Hyde (1997) assigned *Linocarpon* and *Neolinocarpon* to *Hyponectriaceae*, Jeewon et al. (2003) also indicated *Linocarpon* to have relationships with *Hyponectriaceae* (Xylariales), while Bahl (2006) suggested *Linocarpon* and *Neolinocarpon* to have a closer relationship with *Chaetosphaeriaceae* and *Helminthosphaeriaceae* (Duong et. al 2004, Huhndorf et al. 2004). Our study confirms that these *Linocarpon* and *Neolinocarpon* should be placed in Chaetosphaeriales in a distinct family (Fig. 1).

Linocarpon (*Linocarpaceae*) and *Leptosporella* (*Leptosporellaceae*) species have very similar ascomata and asci and are therefore hard to distinguish. The easiest way to distinguish these genera/ families is by the ascospores. In *Linocarpon* the ascospores are slightly wider and have distinct, blunt, appendages at the apex, while in *Leptosporella* the ascospores are narrower and taper gradually towards the ends and if an appendages are present they are relatively indistinct. *Neolinocarpon* can be distinguished from both *Linocarpon* and *Leptosporella* as ascomata are deeply immersed and oval-globose, with a superficial, black, shiny papilla, while the ascus is sometimes provided with a refractive globose body as well as a ring. The ring with continuous structures will appear when staining with erythosin, lactofuschin and lactophenol cotton blue (Hyde 1992b). Bahl (2006) found that *Linocarpon* species are frequently isolated from *Pandanus* hosts and rarely occur on bamboo (Thongkantha et al. 2003). Fresh collections with molecular data are needed from taxa from various hosts to establish whether they have been correctly named based on modern concepts.

In this study, we introduce two new families, *Leptosporellaceae* and *Linocarpaceae*, based on phylogenetic analysis (Table 2). Both ML and BYPP analyses gave the same topologies and placed the families in Chaetosphaeriales in separate clades (Fig. 1), with Boliniales as basal. In these families, ascomata form blackened/darkened domes (*Leptosporella*, *Linocarpon*) on the host surface or are immersed with only shiny erumpent papilla showing (*Neolinocarpon*). Asci are unitunicate, cylindrical with J- subapical ring. Ascospores are 8-spored, filiform, hyaline, and septate or aseptate, with or without mucilaginous appendages (Fröhlich & Hyde 2000). The nature of the ascospore appendages is important in differentiating between species (Poonyth et al. 2000). The asexual morph has rarely been observed and is Phialophora-like (Hyde 1992a). Four orders were recognized in the subclass Sordariomycetidae by Maharachchikumbura et al. (2015, 2016) and six well-resolved orders were reported by Hongsanan et al. (2017). The MCC tree supported the status of the families in Sordariomycetidae with stem ages between 145–216 MYA (Hongsanan et al. 2017).

Leptosporellaceae clusters as a monophyletic clade (Fig. 1) with a stable position within Chaetosphaeriales and is introduced as a novel family with a single genus *Leptosporella*. All species that are included in this genus have similar morphology in possessing superficial ascomata, and filiform ascospores. *Linocarpaceae* is introduced as a new family in Chaetosphaeriales comprising *Linocarpon* and *Neolinocarpon*. Several strains of *Linocarpon* and *Neolinocarpon* in GenBank have low quality sequence data, such as the LSU sequence data for *Linocarpon pandani* (type species), which are less than 800 base pairs. Thus, we used sequence data from our taxonomic novelties, plus some quality sequences in GenBank, to clarify the placement of the taxa that were previously placed in Xylariomycetidae genera *incertae sedis*.

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