

Dictyosporium matherense sp. nov.: A new-fangled cheirosporous fungal species described from the Western Ghats of India

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Abstract. Dubey R. 2022. *Dictyosporium matherense* sp. nov.: A new-fangled cheirosporous fungal species described from the Western Ghats of India. *Asian J For* 6: 1-8. A new species of *Dictyosporium* from forest areas of Matheran, Western Ghats of India, is described and illustrated. This new-fangled cheirosporous species is characterized by large conidia being cheiroid, digitate, variable shape, having 600-3000 individual cells arranged in 15-80 rows consisting of widening apical ends with tightly appressed prolongations/arms which produce hyaline, rounded appendages which latter on produces 8-20 hyaline, long, and hypha-like septate appendages. The isolate was identified based on asexual morphs and, to some extent, stands close to *D. palmae*, *D. digitatum*, and *D. stellatum* but remarkably differs from all in size of conidia. To our understanding, the present taxon has turned out to be a hitherto unreported species. The morphological character of all accepted species of *Dictyosporium* is also presented.

Keywords: Ascomycetes, asexual-morphs, cheirosporous, Matheran, taxonomy

INTRODUCTION

Matheran means forest on the forehead of the mountains and is located in the Western Ghats of India at an elevation of around 800 m above sea level. It is an eco-sensitive region declared by the Ministry of Environment, Forest and Climate Change, Government of India, and is the only automobile-free hill station in Asia. During the mycological exploration of Matheran and other fungi, an interesting conidial fungus was collected from the stem of an unknown plant, which was undoubtedly similar to the genus *Dictyosporium* established by Corda (1836).

The genus *Dictyosporium* is characterized by colonies that are usually in the form of compact sporodochia or rarely effuse, with mostly immersed mycelium. Conidiophores are micronematous or absent, but conidiogenous cells, which arise directly from hyphae and cells constituting the conidiomata, are discrete and doliiform or subspherical. Conidia are dematiaceous, holoblastic, solitary, multiseptate, cheiroid with multiple columns of cells, closely branched from the base, without the arms separating, in most species flattened in one plane, and they secede rhexolytically (Damon 1952; Ellis 1971; Sutton 1985). A few *Dictyosporium* species have conidia with appendages generally thin-walled, hyaline, and may be clavate, cylindrical, and filiform or globose in shape (van Emden 1975; Bhat and Sutton 1985; Tzean and Chen 1989; Chen et al. 1991). The teleomorph is characterized by dark brown, subglobose superficial ascomata, bitunicate cylindrical asci and hyaline, and fusiform uniseptate ascospores with or without a sheath. *Dictyosporium* species have been grown in vitro and can sporulate in culture (von Arx 1981; Matsushima 1975, 1980, 1981, 1993; Tzean and Chen 1989; Chen et al. 1991).

The cheirosporous *Dictyosporium* has been reported worldwide from dead wood and plant litter in terrestrial and aquatic habitats (Hyde and Goh 1998; Ho et al. 2002; Pinnoi et al. 2006; Pinruan et al. 2007). Based on molecular phylogenetic analysis, *Dictyosporium* is placed under Pleosporales (Tsui et al. 2006; Crous et al. 2009; Liu et al. 2015; Tanaka et al. 2015). Tsui et al. (2006) considered that the genus is closely related to the family of Massarinaceae (Pleosporales) based on phylogenetic analysis using small ribosomal subunit and large ribosomal subunit sequence data. Tanaka et al. (2015) and Boonmee et al. (2016) have long-established the phylogenetic placement of *Dictyosporium* in Dictyosporiaceae (Massarinaceae, Pleosporales) along with other genera, such as *Aquaticheirospora*, *Gregarithecium*, *Diplococcium*, *Pseudocoleophoma*, *Paraconiothyrium*, *Dendryphiella*, *Digitodesmium*, and *Pseudodictyosporium*. Later on, *Cheirosporum*, *Vikalpa*, *Dictyocheirospora*, *Jalapriya*, *Aquadictospora*, and *Neodendryphiella* were placed under Dictyosporiaceae (Yang et al. 2018; Hyde et al. 2020). Goh et al. (1999) reviewed the genus *Dictyosporium* and accepted 22 species, and dichotomous keys were provided for *Dictyosporium* species (Cai et al. 2003b; Crous et al. 2009; Whitton et al. 2012; Silva et al. 2015). However, until 2015, only 48 species were accepted under the genus (Whitton et al. 2012; Prasher and Verma 2015, and Silva et al. 2015).

During 2015-2017, nine more new species were established under the genus, namely *D. araucariae* S.S. Silva, R.F. Castaneda & Gusmao; *D. hydei* I.B. Prasher & R.K. Verma; *D. indicum* I.B. Prasher & R.K. Verma; *D. olivaceosporum* Kaz. Tanaka, K. Hiray., Boonmee & K.D. Hyde; *D. palmae* Abdel-Aziz; *D. pseudomusae* Kaz. Tanaka, G. Sato & K. Hiray; *D. sexualis* Boonmee & K.D.

Hyde; *D. splendidum* Alves-Barb., Malosso & R.F. Castañeda, and *D. wuyiense* Y. Zhang & G.Z. Zhao were newly introduced to the genus (Prasher and Verma 2015; Tanaka et al. 2015; Abdel-Aziz 2016; Boonmee et al. 2016; da Silva et al. 2016; Alves-Barbosa et al. 2017; Zhang et al. 2017). Furthermore, additional nine new species were established after 2017 under the genus, namely *D. appendiculatum* Tibpromma & K.D. Hyde; *D. guttulatum* Tibpromma & K.D. Hyde; *D. krabiense* Tibpromma & K.D. Hyde; *D. hongkongensis* Tibpromma & K.D. Hyde; *Dictyosporium pandanicola* Tibpromma & K.D. Hyde; *Dictyosporium tratense* J. Yang & K.D. Hyde; *D. tubulatum* J. Yang, K.D. Hyde & Z.Y. Liu; *D. marinum* Dayarathne & E.B.G. Jones; *D. muriformis* N.G. Liu, K.D. Hyde & J.K. Liu. Currently, 13 species of *Dictyosporium* have been re-assigned to other genera (Boonmee et al. 2016; Yang et al. 2018), and 53 species are accepted under the genus (Table 2 & 3). In addition, Wijayawardene et al. (2017) provided information on the availability of cultures and references to accessible sequence data of the genus.

MATERIALS AND METHODS

Samples of fallen stems infested with fungi were collected from the ground, placed in a paper bag, taken to the laboratory, and treated as per the protocol provided by Castaneda-Ruiz (2005). Colonies were taken from the surface of the wood with a needle and transferred to a drop of lactophenol [lactic acid 20 %, glycerol 40 %, phenol 20 %, distilled water 20 % (v/v)] on a slide. Finally, the slides were sealed with Dibutylphthalate Polystyrene Xylene (DPX). All Micrographs were captured using (OLYMPUS CX41 aided with Digi-CAM) microscope. All microscopic characters were determined based on measurements of 25 mature conidia mounted in lactophenol, and measurements of the fungal structures were taken from the microscope. According to the manufacturer's protocol, scanning electron microscopic images were captured using a Zeiss scanning electron microscope EVO 18-12 -97 (Zeiss, Germany). The holotype and Isotypes are deposited in the Fungal Herbarium of Botanical Survey of India, WRC, Pune, India.

RESULTS AND DISCUSSION

Dictyosporium matherense sp.nov. Rashmi Dubey (Figures 2 & 3) Mycobank: MB840295.

Saprobic on the unknown fallen stem. Sexual morph: undetermined. Asexual morph: mycelium light brown, verrucose, 2.5–4 µm thick, septate. Conidiomata on the natural substrate sporodochial, loose, scattered, shining black, 1-10 mm in length. Conidiophores are inconspicuous or absent. Conidiogenous cells are monoblastic, determinate, brown in color, sub-globose to ovate, thin-walled, 8-10 × 6–7.5 µm. Conidia are solitary, holoblastic, light reddish to dark brown, smooth, complanate, cheiroporous, mostly digitate or very variable in shape, viz. V/Yshaped or multifigured or feathery, widened apical

end with tightly appressed prolongations/arms, round to tapered base, 172-271 × 68-244 µm (\bar{x} = 207 × 160, n = 25), consisting cylindrical, elongated, 5–7 µm tall, 2.5–4 µm wide, 600-3000 individual cells arranged in 15-80 rows, each row with 40-50 cells, tips of some rows are armed with jelly-like, hyaline, rounded appendages which latter on produces 8-20 hyaline, long, hypha-like septate appendages which are up to 50 µm long and 3-4 µm thick.

Material Examined: — India, Maharashtra, Matheran, 18°59'08.2"N 73°15'41.2"E, on dry stem litter, 4.11.2017, Rashmi Dubey, BSI (W.C.) 205598 (Holotype), 205599 (isotype) deposited in Botanical Survey of India, Western Regional Centre, Pune, Maharashtra, India.

Etymology: species named after the place of collection 'Matheran' in Maharashtra, India.

Additional material/cultures examined: — Culture has grown on Potato Dextrose Agar (PDA) medium and Malt Extract Agar medium (MEA) under different light and dark conditions. Vegetative hyphae grew on medium for 7 days but did not sporulate, and the culture died.

Distribution - Only known from the type locality in forest areas of Matheran in the Western Ghats, Maharashtra, India, at an altitude of 800 m asl. Along with type, the species of *Monodictys* spp. and *Pithomyces* spp. were found to be associated.

Taxonomic notes

As per Index fungorum (2021), a total of 82 species were recognized under the *Dictyosporium*, of which 16 species were found doubtful or excluded by Goh et al. 1999 (Table 1), 13 species were re-assigned to other genera, namely *Dictyocheiropora*, *Jalapriya*, and *Vikalpa* (Table 2) and presently 53 species are accepted under the genus (Table 3). Therefore, the present collection undoubtedly falls in the category of *Dictyosporium* based on morphological features.



Figure1. Map of Maharashtra State (yellow) showing the GPS location of the collection site (dot)

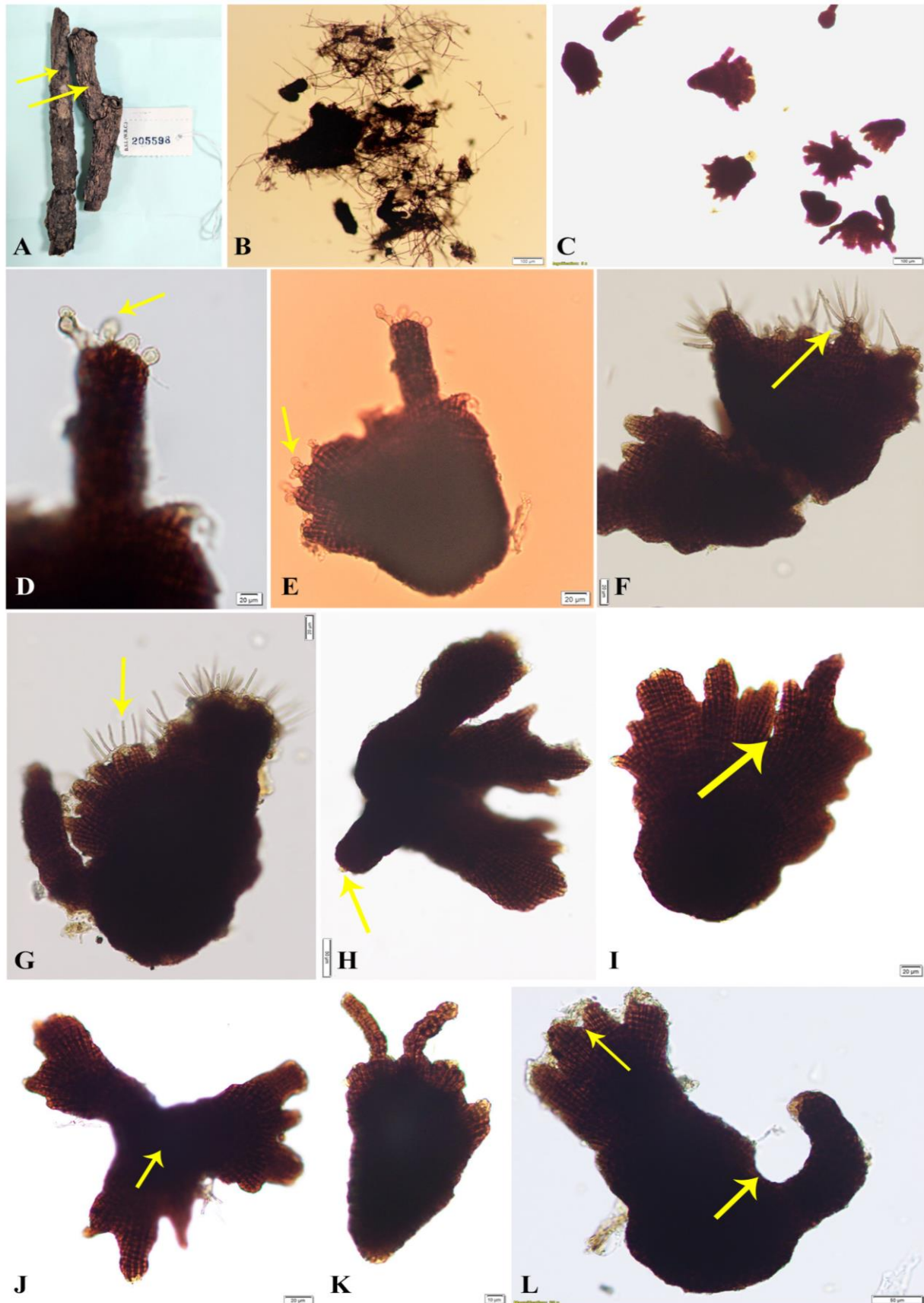


Figure 2. *Dictyosporium matherense* sp. nov. (A) black colonies on the host surface (arrow), (B) colonies with mycelium and sporodochia, (C) conidia, (D-E) tip of conidia armed with hyaline rounded appendages colonies (arrow), (F-G) tip of conidia armed with hyaline hyphae like appendages (arrow), (H) conidia with conidiogenous cell (arrow), (I) digitate conidia with deep constrictions (arrow), (J) feather-like conidia, (K) V-shaped, (L) palm-like conidia

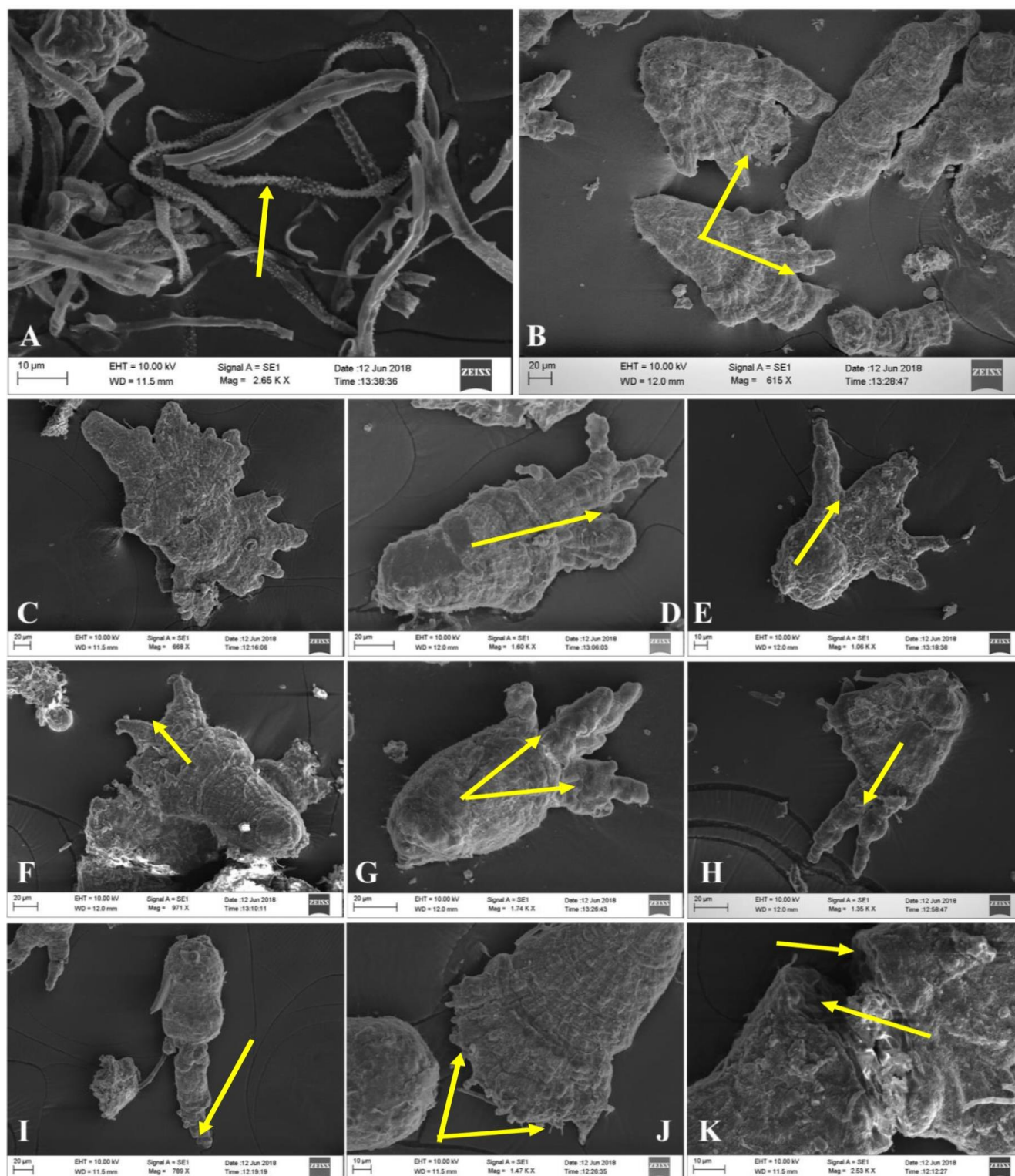


Figure 3. Scanning Electron Microscopic images of *Dictyosporium matherense* sp. nov. (A) verrucose mycelium (arrow), (B) digitate conidia (arrow), (C) discoid conidia, (D-H) conidia having prolongations/arms with deep constrictions (arrow), (I) figure-like conidia (arrow), (J) wider apical end of conidia armed with rounded hyaline conidia (arrow), (K) broken conidia showing internal cells (arrow)

Table 1. List of doubtful/excluded species under *Dictyosporium***Doubtful/excluded species of *Dictyosporium* sp. (Goh et al. 1999)**

D. binatum (Sacc.) S. Hughes 1958, *D. boydii* A.L. Sm. & Ramsb. 1915, *D. castaneum* Gonz. Frag. 1924, *D. circinatum* Cooke & Harkn., 1884, *D. crustaceum* (P. Karst.) S. Hughes 1958, *D. hymenaeorum* Bat. & J.L. Bezerra 1960, *D. intermedium* Subram. 1971, *D. minus* Sacc. 1918, *D. minus* (Sacc.) Damon [as 'minor'], 1952, *D. opacum* Cooke & Harkn. 1884, *D. pelagicum* (Linder) G.C. Hughes ex E.B.G. Jones 1963, *D. prolificum* Damon 1952, *D. secalinum* Delacr. 1891, *D. solanii* A.D. Sharma, Munjal & Jandaik 1983, *D. verrucosum* Tzean & J.L. Chen (1989), *D. yerbae* Speg. 1909.

Table 2. List of *Dictyosporium* species transferred to other genera (Boonmee et al. 2016; Yang et al. 2018)

Former species name	Accepted species
<i>Dictyosporium australiensis</i> B. Sutton 1985	<i>Vikalpa australiensis</i> (B. Sutton) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium freycinetiae</i> McKenzie 2008	<i>Vikalpa freycinetiae</i> (McKenzie) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium giganticum</i> Goh & K.D. Hyde 1999	<i>Dictyocheiropora gigantea</i> (Goh & K.D. Hyde) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium heptasporum</i> (Garov.) Damon 1952	<i>Dictyocheiropora heptaspora</i> (Garov) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium hydei</i> Prasher & R.K. Verma 2014	<i>Dictyocheiropora hydei</i> (I.B. Prasher & R.K. Verma) J. Yang & K.D. Hyde, in Yang, Liu, Hyde, Jones & Liu 2018
<i>Dictyosporium indicum</i> I.B. Prasher & R.K. Verma 2015	<i>Dictyocheiropora indica</i> (I.B. Prasher & R.K. Verma) J. Yang & K.D. Hyde 2018
<i>Dictyosporium inflatum</i> (Matsush.) Kirschner R, Pang KL, Gareth Jones EB 2013	<i>Jalapriya inflata</i> (B. Sutton) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium micronesiacum</i> Matsush 1981	<i>Vikalpa micronesiaca</i> (Matsush.) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium musae</i> Photita 2002	<i>Dictyocheiropora musae</i> (Photita) J. Yang, K.D. Hyde & Z.Y. Liu, 2018
<i>Dictyosporium pseudomusae</i> Kaz. Tanaka, G. Sato & K. Hiray 2015	<i>Dictyocheiropora pseudomusae</i> (Kaz. Tanaka, G. Sato & K. Hiray.) Kaz. Tanaka, K. Hiray, Boonmee & K.D. Hyde 2016
<i>Dictyosporium subramanianii</i> B. Sutton 1985	<i>Dictyocheiropora subramanianii</i> (B. Sutton) D'souza, Boonmee & K.D. Hyde 2016
<i>Dictyosporium toruloides</i> (Corda) Guég 1905	<i>Jalapriya toruloides</i> (Corda) M.J. D'souza, Hong Y. Su, Z.L. Luo & K.D. Hyde 2016
<i>Dictyosporium tetraploides</i> L. Cai & K.D. Hyde, in Cai, Zhang, McKenzie & Hyde (2003)	<i>Dictyocheiropora tetraploides</i> (L. Cai & K.D. Hyde) J. Yang & K.D. Hyde, in Yang, Liu, Hyde, Jones & Liu 2018

The present collection differs from other species in having large conidia, V to Y shaped or multfigured or feathery, and widened apical ends with tightly appressed prolongations/arms. Each conidium possesses 600-3000 individual cells arranged in 15-80 rows, each row with 40-50 cells; tips of some rows are armed with jelly-like, hyaline, rounded appendages, which latter on produce 8-20 hyaline, long, hypha-like septate 50 µm long and 3-4 µm thick appendages. As evident, no such significant features are observed in other species of *Dictyosporium*; therefore, the present collection deserves the rank of a noble species and is described here as a new species (Table 3).

Although 53 species are accepted under the genus *Dictyosporium* (Table 3), no infrageneric classification is available for the genus. *D. matherense* shows a close affinity to *D. palmae*, *D. digitatum*, and *D. stellatum* in having a large size of conidia. However, the new collection is morphologically distinct from them in their conidial

morphology. *D. matherense* differs from *D. palmae* by having longer and broader conidia (172-271 x 68-244 µm vs. 75-15 x 18-32 µm) and having larger no. of cell rows (15-80 vs. 4-6) for *D. matherense* and *D. palmae* respectively. *D. matherense* differs from *D. digitatum* by having longer and narrower conidia (172-271 x 68-244 µm x vs. 46.5-88 x 26-46 µm) and a large no. of cell rows (15-80 vs. 5-7 rows) for *D. matherense* and *D. digitatum* respectively. *D. matherense* differs from *D. stellatum* by having longer and broader conidia (172-271 x 68-244 µm vs. 50-175 x 27.5-52.5 µm) and having larger no. of cell rows (15-80 vs. 5-7) for *D. matherense* and *D. stellatum* respectively. Apical hyaline, hypha-like appendages are found in *D. matherense* and *D. palmae*, and *D. digitatum* but are absent in *D. stellatum*. We could not match this collection with any other; therefore, we established this collection as a novel species based on morphological differences.

Table 3. Comparison of *Dictyosporium matherense* sp.nov. with 53 accepted species of the genus *Dictyosporium*

Species	Conidial size (µm)	No. of rows	Cells per conidium	Cells per row	Conidial vesicles appendages	References
<i>D. acroinflatum</i>	28–52×23–35	4–8	39–68	5–13	0	Whitton et al. (2012)
<i>D. alatum</i>	26–32×15–25	5	26–37	4–6	0–2	van Emden (1975)
<i>D. amoenum</i>	20–30×12–15	4	24–28	5–7	4–5	Silva et al. (2015)
<i>D. appendiculatum</i>	30–40×12–25	4–5	30–40	6–8	1–3	Tibpromma et al. (2018)
<i>D. aquaticum</i>	60–85×20–30	5–6	66–82	13–16	5	Liu et al. (2015)
<i>D. araucariae</i>	12–27×14–24	4–6	15–27	3–6	4–(5)–6	Silva et al. (2016)
<i>D. biserialae</i>	22–30×9–10	2	10–17	5–8	0	Hu et al. (2010)
<i>D. brahmaswaroopii</i>	17–24×12.5–19	3–5	9–21	3–5	0	Mehrotra (1990)
<i>D. bulbosum</i>	27–46×11–30	5–6	12–48	6–10	1–2	Tzean and Chen (1989)
<i>D. campaniforme</i>	22–40×20–30	4–8	20–60	5–9	0	Matsushima (1975)
<i>D. canisporum</i>	27–47×20–25	4–5	20–44	5–9	2	Cai et al. (2003a)
<i>D. cocophilum</i> Bat. 1951	53–76×19–22	7	70–100	10–14	0	Batista (1951)
<i>D. digitatum</i> J.L.	47–77×22–39	5–7	65–90	7–13	4–5	Chen et al. (1991)
<i>D. dkagarwalii</i>	30–40×9.5–11.5	2–3	19–37	6–13	0	Manoharachary et al. (2007)
<i>D. elegans</i> Corda 1836,	40–80×24–31	5	51–96	9–13	0	Goh et al. (1999)
<i>D. foliicola</i>	34–56×20–38	5–7	37–60	3–14	0	Kirk and Spooner (1984)
<i>D. gauntii</i>	40–50×18–25	4–6	40–50	8–10	1	Goh et al. (1999)
<i>D. guttulatam</i>	30–40×16–23	4–5	40–44	9–10	1–2	Tibpromma et al. (2018)
<i>D. hongkongensis</i>	28–41×18–26	4–5	16–30	4–6	0	Tibpromma et al. (2018)
<i>D. hughesii</i>	33–50×23–32	7	45–50	7–8	1	McKenzie (2010)
<i>D. krabiense</i>	14–17×15–20	4–5	16–30	4–6	1–2	Tibpromma et al. (2018)
<i>D. lakefuxianense</i>	15–22 × 10–16.5	3	9–13	Middle 3(– 4); outside two rows 4– 5	0	Cai et al. (2003b)
<i>D. matherense</i> sp. nov.	172–271×68–244	15–80	600–3000	40–50	hypha-like septate appendages	<i>Present study</i>
<i>D. manglietiae</i>	22–28×12.5–18	3	16–18	5–6	1	Kodsueb et al. (2006)
<i>D. marinum</i>	34–50×22–28	4–5	35–40		0	Dayarathne et al. (2020)
<i>D. meiosporum</i>	17–28×6–8.5	3–4	4–16	4–7	0	Liu et al. (2015)
<i>D. muriformis</i>	20–30×11–14.5	3–5	14–27	3–8	0	Hyde et al. (2020)
<i>D. nigroapice</i>	28–41×15–20	4	20–32	7–8	2	Goh et al. (1999)
<i>D. oblongum</i>	30–50×12–30	3–6	22–46	9–11	0	Goh et al. (1999)
<i>D. olivaceosporum</i>	32–42(–44)×20– 28	5–6	28–43	6–7	2–4	Boonmee et al. (2016)
<i>D. palmae</i>	75–165×15–33	3–6	95–144	17–26	Hyaline appendages on the tip	Abdel-Aziz (2016)
<i>D. pandani</i>	22–48×14–28	4–5	29–49	4–10	0	Whitton et al. (2012)
<i>D. pandanicola</i>	30–50×15–33	5–6	34–62	6–8	0	Tibpromma et al. (2018)
<i>D. polystichum</i>	26–34×23–34	7–9	33–40	3–6	0	Damon (1952)
<i>D. rhopalostylidis</i>	28–48×20–29	5–6	5–6	30–40(48)	0	McKenzie (2010)
<i>D. schizostachyfolium</i>	15–17×11–12	4	13–16	2–4	0	Goh et al. (1999)
<i>D. sexuale</i>	Only teleomorph forms known					Boonmee et al. (2016)
<i>D. sinense</i>	50–130×20–35	4–7	50–93	7–15	0	Zhang (2009)
<i>D. splendidum</i>	22–29×11–14	2–3	16–27	8–9	2–3	Alves-Barbosa et al. (2017)
<i>D. stellatum</i>	50–175×27.5–52	5–7	(59–)110 –165(– 180)	14–33	0	Crous et al. (2011)
<i>D. strelitziae</i>	(30–)40–46(–55)× (20–)21–23(–25)	4–6	28–66	7–11	1–2	Crous et al. (2009)
<i>D. taishanense</i>	27–43×15–30	(3–)5(–7)	24–55	4–9	0	Zhao and Zhang (2003)
<i>D. tetraseriale</i>	24–40×14–20	4	24–38	7–9	2	Goh et al. (1999)
<i>D. tetrasporum</i>	23.5–40×16–21.5	4	12–27	5–7*	0	Cai and Hyde (2007)
<i>D. thailandicum</i>	15–35×15–21	5	28–32	6–9	0–2	Liu et al. (2015)
<i>D. tnlahanpalii</i>	80–120×25–36	(4–)6(–8)	90–100+*	16–22*	0	Manoharachary et al. (2007)
<i>D. tratense</i>	40–57×20–36	4–6	39–68	9–11	Sometimes 1–2	Yang et al. (2018)
<i>D. triramsum</i>	40–60×10–13.5	(2–)3	26–30	9–10	0	Arambarri et al. (2001)
<i>D. triseriale</i>	26–32×16–18	3	15–21	5–7	0	Goh et al. (1999)
<i>D. tubulatum</i>	25–38×14–22	4 (–)5	28–30	7–8	2–3	Yang et al. (2018)
<i>D. wuyiense</i>	Type -1 33–52×27–43 Type -2 42–70×20–33	4– (5)–6	28	8–12	0–3	Zhang et al. (2017)
<i>D. yunnanense</i>	25–45×22–38	(5–)6(–7)	19–47 *	5–9	0	Cai et al. (2003b)
<i>D. zeylanicum</i>	26–40×13–25	5	28–34*	4–8*	0	Goh et al. (1999)
<i>D. zhejiangense</i>	25–35×17–24	(4–)5	22–33	4–6	1–3	Wongsawes et al. (2009)

Note: *After Whitton et al. (2012)

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