Microfungi on the *Pandanaceae*: *Nakatopsis* gen. nov., a new hyphomycete genus from Malaysia

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A new hyphomycete genus, *Nakatopsis* is described from *Pandanus* leaves collected in Malaysia. The genus is similar to the disputed genus, *Nakataea*, but possess setae. The two new species, *N. malaysiana* and *N. skittleus* are described and illustrated. *Nakatopsis* is compared to similar hyphomycete genera.

Key words: mitosporic fungi, *Nakatopsis malaysiana*, *Nakatopsis skittleus*, *Pandanus*, systematics, taxonomy.

Introduction

Two species of dematiaceous hyphomycete were collected from an unidentified species of *Pandanus* in Malaysia. Both species were found growing in association with necrotic areas on green leaves, however, it is not known if these fungi are responsible for the leaf spots. In both species the conidiophores, and frequently the setae, were fertile with sympodial, denticulate apices that tend to become somewhat geniculate. Conidia were 2-septate, fusiform, smooth and versicoloured, with a persistent portion of the separating cell remaining at their base.

The conidial shape, conidial pigmentation and denticulate conidiogenous cells suggest a similarity to species within genera such as *Brachysporium*, *Camposporium*, *Curvularia*, *Kramasamuha*, *Nakataea*, *Pleurophragmium*, *Pyricularia*, *Pyriculariopsis* and *Ramichloridium* (Ellis, 1971, 1976; Subramanian and Vittal, 1973; de Hoog, 1977; Kirk, 1983; Zucconi and Onofri, 1986; Castañeda and Kendrick, 1990b; Castañeda *et al.*, 1996). Conidia in *Curvularia* are morphologically similar to the current specimens and the conidiogenous cells are sympodial, however, conidiogenesis is enteroblastic and tretic, not holoblastic and denticulate (Ellis, 1971). *Kramasamuha* was

introduced with the single species, *K. sibika* Subram. and Vittal, for species that produce 3-4 celled, versicoloured conidia with a persistent portion of the separating cell at the base. However, in *Kramasamuha* the conidiogenous cells are short and discrete, not integrated into the apex of conidiophores and setae (Subramanian and Vittal, 1973). *Ramichloridium* produces sympodially proliferating denticulate conidiophores. However, most species have 0 or 1-septate conidia, that are often verrucose and characterised by having broadly-obtuse apices (de Hoog, 1977). Conidia in *Pleurophragmium* and *Pyriculariopsis* are fusiform, narrowly-ellipsoid, obclavate or subclavate, multiseptate and versicoloured, and the conidiogenous cells are denticulate and sympodial. However, in both these genera the denticulate portion of the conidiogenous cells do not act as separating cells and, therefore, the conidia do not have a persistent portion at the base (Ellis, 1971; Castañeda and Kendrick, 1990b). The current specimens have similar conidiogenous cells to species in *Brachysporium*, *Camposporium*, *Nakataea* and *Pyricularia*, genera which are also characterised by multiseptate, versicoloured conidia. In *Brachysporium* the conidia are typically pendulous, broadly rounded at the apex and straight (Ellis, 1971). The conidia in species of *Camposporium* are typically elongate-cylindrical, and have appendages at or near the apex (Hughes, 1951; Rao and Rao, 1964; Ellis, 1971; Ichinoe, 1971). Conidia in *Nakataea* and *Pyricularia* are similar to those in the current specimens, however, neither of these genera nor those discussed above, produce setae or setiform conidiophores (Hughes, 1951; Ellis, 1971, 1976; Subramanian and Vittal, 1973; de Hoog, 1977; Kirk, 1983; Zucconi and Onofri, 1986; Castañeda and Kendrick, 1990b; Castañeda *et al.*, 1996).

To treat the current specimens in *Nakataea* would widen the generic concept by the inclusion of setae. This in itself is not a major problem, except that the taxonomic validity of *Nakataea* has been questioned by Kirk (1983). Kirk (1983) suggested that *Nakataea* should be considered a synonym of *Pyricularia*, as both have morphologically similar types (*Nakataea sigmoidea* Hara, *Pyricularia grisea* Sacc.), and *Magnaporthe* teleomorphs (Krause and Webster, 1972; Barr, 1977). Although this synonymy is reported by Hawksworth *et al.* (1995), not all authors accept it. *Nakataea curvularioides* G.R.W. Arnold was introduced in a paper by Arnold and Castañeda (1987), and Castañeda and Kendrick (1990b) introduced *N. rarissima*. Mouchacca (1990) and Castañeda and Kendrick (1990a) reported on specimens of *N. fusispora* (Matsush.) Matsush., a species introduced by Matsushima (1971, 1975), despite its transferal to *Pyricularia* as *P. fusispora* (Matsush.) Zucconi, Onofri and Persiani (Zucconi *et al.*, 1984). Castañeda *et al.* (1996) described *N. cylindrospora* and produced a key to the genus.

With this taxonomic confusion and disagreement in mind, the presence of setae, and the absence of a known *Magnaporthe* teleomorph, it seems prudent to introduce a new genus for the current specimens.

This work originates from an ongoing study of the saprophytic microfungi that inhabit members of the monocotyledon family *Pandanaceae* (eg. McKenzie, 1995; McKenzie and Hyde, 1996; Hyde, 1997; Whitton *et. al.*, 1999, 2000).

Taxonomy

Nakatopsis Whitton, McKenzie and K.D. Hyde, **gen. nov.**

Setae erecta, non-ramosa, laevia, septata, cylindrica, frequenter fertilis, frequenter proliferationibus percurrentibus. *Conidiophora* macronemata, mononemata, palide brunnea, laevia, septata, frequenter proliferationibus percurrentibus. *Cella conidiogena* holoblastica, polyblastica, sympodiales, ad apicem in conidiophoris et seta incorporatae, terminales et intercalaria, geniculata, denticulata; denticulis tenuitunicata, crassa, conica vel cylindrica, pro cellula separatrice agentes. *Conidia* solitaria, sicca, fusiformia, 2-septata, recta vel curvata, ad apicem et basis attenuatum, cellula interioris brunneae, cum cellulis extremis pallide brunneae.

Etymology: *Nakatopsis*, refers to the similarity of this genus to *Nakataea*.

Type species (designated here): *Nakatopsis malaysiana* Whitton, McKenzie and K.D. Hyde.

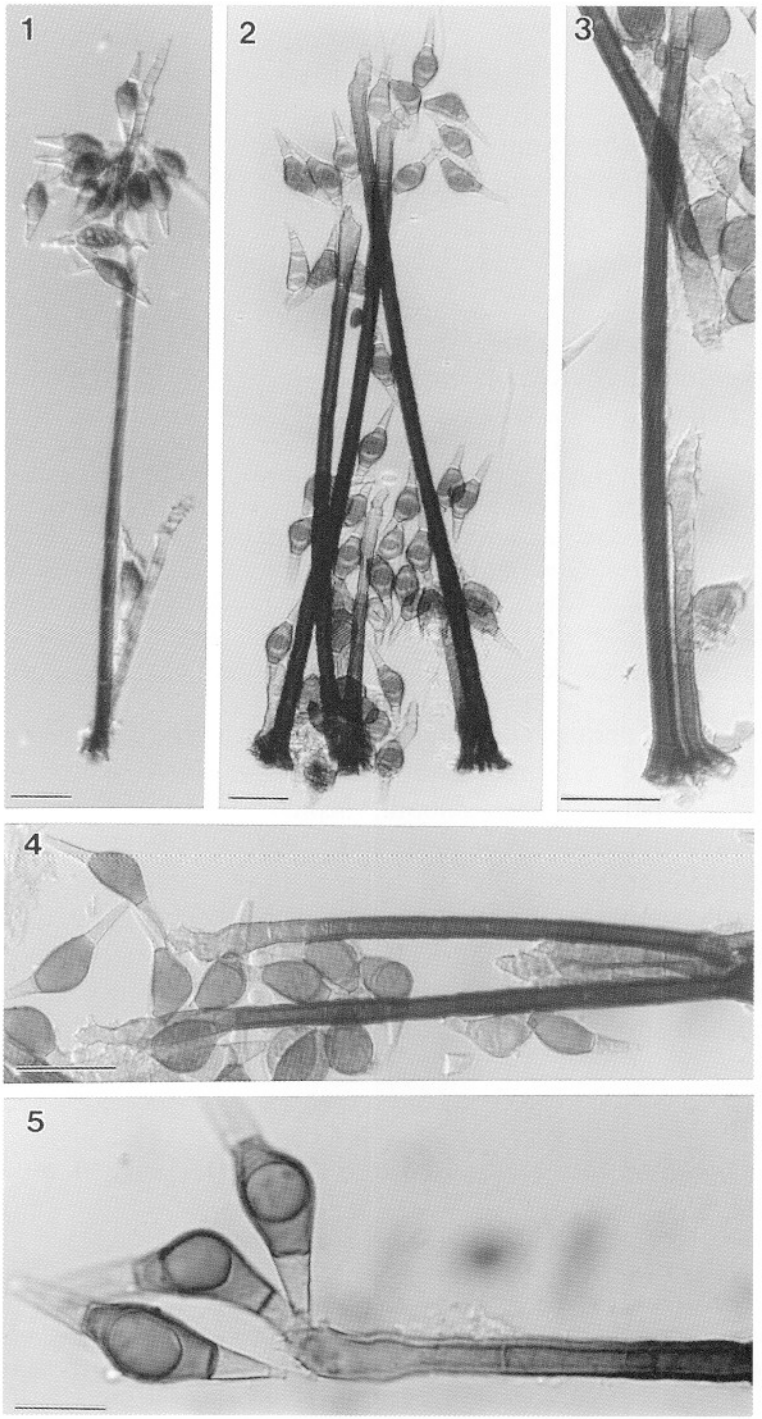
Setae erect, unbranched, smooth, septate, cylindrical, often fertile, often undergoing multiple percurrent proliferation. *Conidiophores* macronematous, mononematous, pale brown, smooth, septate, often undergoing multiple percurrent proliferation. *Conidiogenous cells* holoblastic, polyblastic, sympodial, integrated into the apical region of conidiophores and setae, terminal but becoming intercalary, often geniculate, denticulate; denticles thin-walled, broad, conical or cylindrical, each cut off by a septum to form a separating cell. *Conidia* solitary, dry, detached via a thin-walled separating cell, 2-septate, fusiform, straight or curved, central cell darker in pigmentation, base with persistent portion of separating cell, apical and basal cells tapering and conical.

Nakatopsis malaysiana Whitton, McKenzie and K.D. Hyde, **sp. nov.**

(Figs. 1-5)

Etymology: *malaysiana*, refers to the type locality, Malaysia.

Setae 90-270 µm longa, ad basim 4-7µm crassa, non-ramosa, erecta, ± recta, fusca brunnea, apicem versus pallidiora, laevia, crassitunicata, 4-13 septata, cylindrica vel apicem versus angusta, ad apicem obtusa, fertilis, rarus proliferationibus percurrentibus, inflatum ad basim. *Conidiophora* 52-110 × 4-5 µm, pallide brunneae, laevia, 2-5 septata, cylindrica, ± recta, erecta, ad apicem obtusa, tenuitunicata, rarus proliferationibus percurrentibus. *Cellulae conidiogenae* holoblasticae, polyblasticae, sympodiales, ad apicem in conidiophoris et seta incorporatae, terminales et intercalares, cylindricae, paulum geniculatae in conidiophoris et



Figs. 1-5. *Nakatopsis malaysiana*. **1-4.** Conidiophores and setae. Note conidiophores shorter than setae. **5.** Conidia attached to conidiophores via denticles. Bars: 1-4 = 20 µm; 5 = 10 µm.

setae, denticulatae; denticulis tenuitunicata, pallidea brunnea, laevia, late cylindricae, pro cellula separatrice agentes, 1.5-2 µm diam. *Conidia* 29-37 × 8.5-10 µm, solitaria, sicca, fusiformia, recta vel falcatus, laevia, 2-septata; cellulae centrales fusca brunneae, crassitunicata, fusiformia; ad apicem cellulae pallide brunnea, tenuitunicata, conica, truncata vel paulum obtusa; ad basim cellulae pallide brunnea, tenuitunicata, conica, truncata.

Colonies on natural substrate aggregated into fascicles of typically one seta with 0-3 conidiophores, scattered on substrate surface or in small groups. *Setae* 90-270 µm long, 4-7 µm wide towards the base, simple, erect, ± straight, dark brown, fading to pale brown towards the apex, smooth, walls thickened, lower 2-3 septa slightly thickened, 4-13 septate, cylindrical or tapering slightly towards the apex, apex rounded, always fertile, sometimes undergo percurrent proliferations, basal cell slightly swollen. *Conidiophores* 52-110 µm long, 4-5 µm wide towards the base, pale brown, smooth, 2-5 septate, cylindrical, ± straight, erect, apex rounded, walls and septa thin, sometimes undergo percurrent proliferation. *Conidiogenous cells* holoblastic, polyblastic, sympodial, integrated into the apical region of both setae and conidiophores, terminal but becoming intercalary, cylindrical, sometimes geniculate in both setae and conidiophores, denticulate; denticles thin-walled, very pale brown, smooth, broadly cylindrical, each denticle cut off by a thin-walled septum to form a separating cell, 1.5-2 µm diam. *Conidia* 29-37 µm long, 8.5-10 µm wide at widest point, solitary, dry, becoming detached from the denticle via a thin-walled separating cell, simple, fusiform, straight or slightly curved, smooth, 2-septate; central cell dark brown, thick-walled and fusoid; apical cell pale brown, thin-walled, conical, tip truncate or slightly rounded; basal cell pale brown, thin-walled and conical, base truncate and terminated by the persistent portion of the separating cell.

Habitat: Known to inhabit necrotic areas on green leaves of *Pandanus* sp.

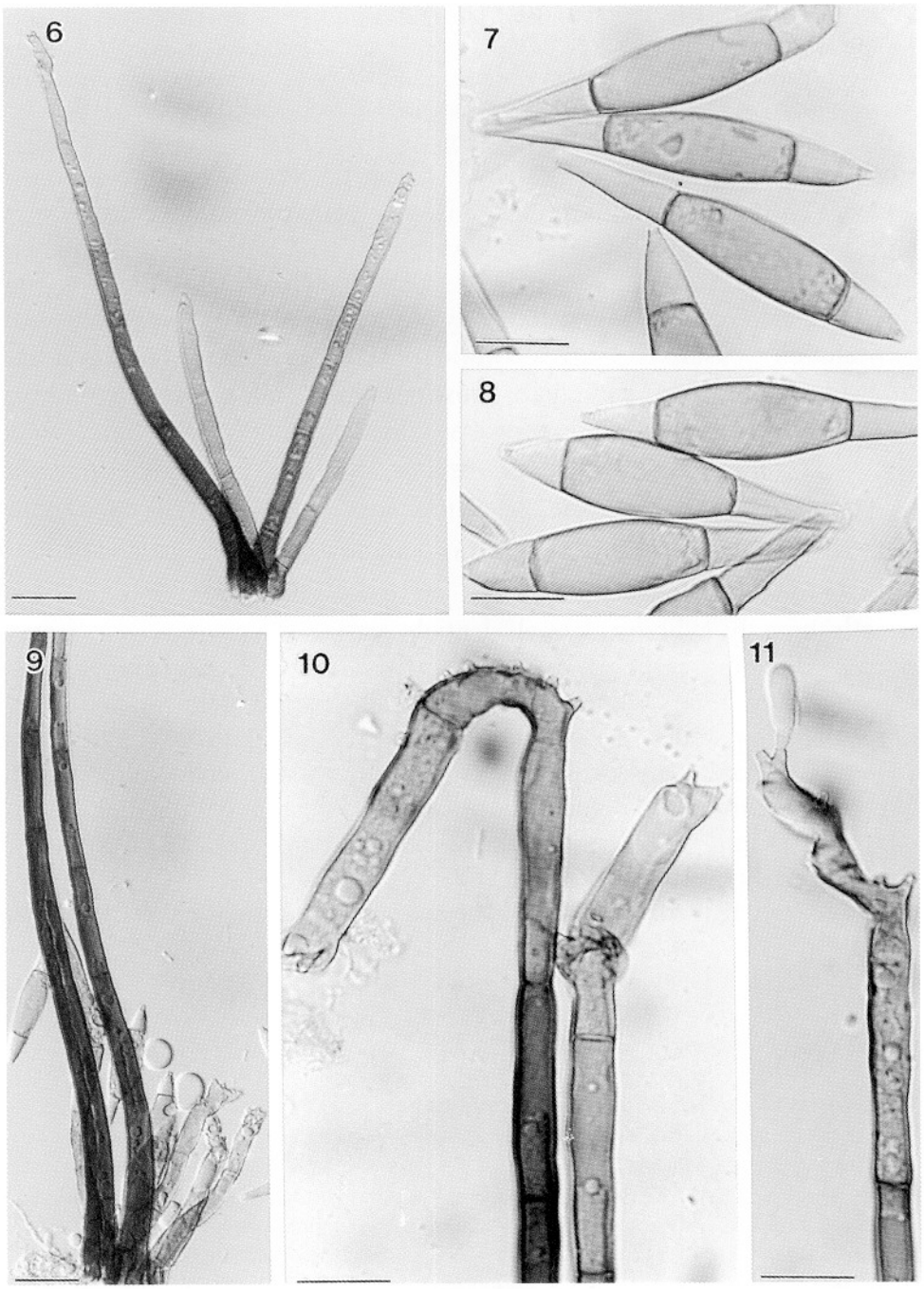
Distribution: Malaysia.

Holotype (designated here): MALAYSIA, Negiri Sembilan, near Lipur Hatang, on living leaves of *Pandanus* sp., 25 Aug. 1995, K.D. Hyde [HKU(M) 5093].

Nakatopsis skittleus Whitton, McKenzie and K.D.Hyde, **sp. nov.** (Figs. 6-11)

Etymology: *skittleus*, refers to the shape of the conidia, resembling skittles.

Setae 150-466 µm longa, ad basim 6.5-11 µm crassa, ad apicem 5.5-7 µm crassa, non-ramosa, erecta, ± recta, fusca brunnea, apicem versus pallidiora, laevia, crassitunicata, 5-12 septata, cylindrica vel apicem versus angusta, ad apicem obtusa, fertilis, frequenter proliferationibus percurrentibus, ad basim cellula inflatus. *Conidiophora* 40-153 × 5.5-9 µm, pallide brunneae, laevia, 1-6 septata, cylindricae, tenuitunicata, recta vel flexuosa, erecta, ad apicem obtusa, fertilis, frequenter geniculatae, frequenter proliferationibus percurrentibus, ad basim cellula inflatus. *Cellulae conidiogenae* holoblasticae, polyblasticae, sympodiales, ad apicem in conidiophoris et seta incorporatae, terminales et intercalares, ± cylindricae, frequenter geniculatae in conidiophoris et seta, denticulatae; denticulis tenuitunicata, pallidia



Figs. 6-11. *Nakatopsis skittleus*. **6.** Young conidiophores and setae. **7, 8.** Conidia. **9.** Conidiophores and setae. Note small size of the conidiophores. **10, 11.** Conidiogenous cells. Note denticles and the developing conidium in Fig. 11. Bars: 6, 9 = 20 µm; 7, 8, 10, 11 = 10 µm.

brunnea, laevia, late conicae, pro cellula separatrice agentes, 1.2-2 µm diam. *Conidia* 36-47 × 6.5-10.2 µm, solitaria, sicca, recta, laevia, 2-septata; cellulae centrales fusiformia, brunneae; ad apicem cellulae pallide brunnea, tenuitunicata, conica, obtusa; ad basim cellulae pallide brunnea, tenuitunicata, conica, truncata.

Colonies consist of fascicles of 1-2 setae and 1-6 conidiophores, scattered or in groups on the substrate surface. *Setae* 150-466 µm long, 6.5-11 µm wide towards the base, 5.5-7 µm wide at the apex, simple, erect, ± straight, dark brown, fading to pale brown towards the apex, smooth, walls and septa thickened especially towards the base, 5-12 septate, cylindrical or tapering slightly towards the apex, apex rounded, always fertile, often undergo percurrent proliferation, basal cell swollen. *Conidiophores* 40-153 µm long, 5.5-9 µm wide towards the base, pale brown, smooth, 1-6 septate, cylindrical, walls and septa thin, straight or flexuous, erect, apex rounded, frequently geniculate, often undergo percurrent proliferation, basal cell swollen. *Conidiogenous cells* holoblastic, polyblastic, sympodial, integrated into the apical region of both setae and conidiophores, terminal but becoming intercalary through multiple sympodial proliferations, more or less cylindrical, often geniculate in both setae and conidiophores, denticulate; denticles thin-walled, pale brown, smooth, broadly conical, each denticle cut off by a septum to form a separating cell, 1.2-2 µm diam. *Conidia* 36-47 µm long, 6.5-10.2 µm wide at widest point, solitary, dry, becoming detached from the denticle via a thin-walled separating cell, straight when viewed from above or from the side, smooth, 2-septate; central cell fusoid, with slightly thicker walls and slightly darker pigmentation than the end cells; apical cell conical, thin-walled, pale brown, obtuse; basal cell conical, thin-walled, pale brown, truncate and terminated by a persistent part of the separating cell.

Habitat: Known to inhabit necrotic areas on green leaves of *Pandanus* sp.

Distribution: Malaysia.

Holotype (designated here): MALAYSIA, Negiri Sembilan, near Lipur Hatang, on living leaves of *Pandanus* sp., 25 August 1995, K.D. Hyde [HKU(M) 5092].

Additional material examined: *ibid.* [HKU(M) 14082].

Notes: The two species of *Nakatopsis* are similar, the setae, conidiophores and conidiogenous cells having no significant dimensional or morphological differences (Table 1). *Nakatopsis malaysiana* and *N. skittleus* differ primarily in conidial morphology. In both species conidia comprise three cells, a brown central cell and paler end cells, and a basal frill resulting from detachment via a separating cell. However, in *N. malaysiana* the central cell is darker in pigmentation, has thicker walls and is shorter than the central cell of *N. skittleus*. Overall, the conidia of *N. skittleus* are longer than those of *N. malaysiana*. Also, in *N. malaysiana* the conidia are often curved, whilst in *N.*

Table 1. Synopsis of *Nakatopsis*.

Species	Setae	Conidio -phores	Conidia	Apical cells	Central cells	Basal cells
N. malaysiana	90-270 × 4-7	52-110 × 4-5	29-37 × 8.5-10	9-13.5 × 3.5-5	13-17 × 8.5-10	5.5-10 × 1.5-2
N. skittleus	150-466 × 6.5-11	40-153 × 5.5-9	36-47 × 6.5-10.2	12-15.5 × 4-5	17.5-24.5 × 6.5-10.2	5-9 × 1.5-2

NB: all measurements are in µm.

skittleus the conidia are always straight. The length of the central cells are also different, those of *N. skittleus* being longer.

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References

Arnold, G.R.W. and Castañeda Ruiz, R.F. (1987). Neue hyphomyzeten-arten aus Kuba II. *Verticillim antilanum*, *Nakataea curvularioides* und *Cladobotryum cubitense*. Feddes Repertorium 98: 411-417.

Barr, M.E. (1977). *Magnaporthe*, *Telimenella*, and *Hyponectria* (Physoporellaceae). Mycologia 69: 952-966.

Castañeda Ruíz, R.F. and Kendrick, B. (1990a). Conidial fungi from Cuba: I. University of Waterloo Biology Series 32: 1-53.

Castañeda Ruíz, R.F. and Kendrick, B. (1990b). Conidial fungi from Cuba: II. University of Waterloo Biology Series 33: 1-61.

Castañeda Ruíz, R.F., Saikawa, M. and Hennebert, G.L. (1996). Some new conidial fungi from Cuba. Mycotaxon 59: 453-460.

de Hoog, G.S (1977). *Rhinocladiella* and allied genera. Studies in Mycology 15: 1-140.

Ellis, M.B. (1971). Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, UK.

Ellis, M.B. (1976). More Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, UK.

Hawksworth, D.L., Kirk, P.M., Sutton, B.C. and Pegler, D.N. (1995). Ainsworth and Bisby's Dictionary of Fungi. 8th edn. International Mycological Institute, London, UK.

Hughes, S.J. (1951). Studies on micro-fungi. III. *Mastigosporium*, *Camposporium*, and *Ceratophorum*. Mycological Papers 36: 1-43.

Hyde, K.D. (1997). Ascomycetes described on *Freycinetia*. Sydowia 49: 1-20.

Ichinoe, M. (1971). *Camposporium* species from Japan. Transactions of the Mycological Society of Japan 12: 79-88.

Kirk, P.M. (1983). New or interesting microfungi X. Hyphomycetes on *Laurus nobilis* leaf litter. Mycotaxon 18: 259-298.

Krause, R.A. and Webster, R.K. (1972). The morphology, taxonomy, and sexuality of the rice stem rot fungus, *Magnaporthe salvinii* (*Leptosphaeria salvinii*). Mycologia 64: 103-114.

Matsushima, T. (1971). Some interesting fungi imperfecti. Bulletin of the Natural Science Museum, Tokyo 14: 460-480.

Matsushima, T. (1975). Icones Microfungorum a Matsushima Lectorum. Kobe, Japan.

McKenzie, E.H.C. (1995). Dematiaceous hyphomycetes on *Freycinetia* (*Pandanaceae*). 5. *Sporidesmium* sensu lato. Mycotaxon 56: 9-29.

McKenzie, E.H.C. and Hyde, K.D. (1996). Index of fungi described from the *Pandanaceae*. Mycotaxon 57: 125-144.

Mouchacca, J. (1990). Champignons de Nouvelle-Calédonie - 1. Quelques démátiées intéressantes de littére forestiére. Persoonia 14: 151-160.

Rao, P.R. and Rao, D. (1964). Some species of *Camposporium* Harkn. from India. Antonie van Leeuwenhoek 30: 60-64.

Subramanian, C.V. and Vittal, B.P.R. (1973). Three new hyphomycetes from litter. Canadian Journal of Botany 51: 1127-1132.

Whitton, S.R., McKenzie, E.H.C. and Hyde, K.D. (1999). Microfungi on the *Pandanaceae*. *Troposporopsis* gen. nov. Fungal Diversity 3: 173-177.

Whitton, S.R., McKenzie, E.H.C. and Hyde, K.D. (2000). *Dictyochaeta* and *Dictyochaetopsis* species from the *Pandanaceae*. Fungal Diversity 4: 133-158.

Zucconi, L. and Onofri, S. (1986). Two new dematiaceous hyphomycetes from tropical forest litter. Mycotaxon 27: 147-153.

Zucconi, L., Onofri, S. and Persiani, A.M. (1984). Hyphomycetes rari o interessanti della foresta tropicale. II. *Pyricularia fusispora* comb. nov., nuova combinazione per la specie *Nakataea fusispora*. Micologia Italiana 2: 7-10.

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