Intertidal fungi from Australia. The genus *Swampomyces* including *S. triseptatus* sp. nov.

K. D. Hyde[1] & A. Nakagiri[2]

[1] Plant Pathology Branch, Queensland Department of Primary Industries, P.O. Box 1054, Mareeba, Qld. 4880, Australia
[2] Institute for Fermentation, Osaka, 17–85, Juso–honmachi 2–chome, Yodogawa–Ku, Osaka 532, Japan

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The genus *Swampomyces* is reported from Australia and Papua New Guinea, with *Swampomyces triseptatus* sp. nov. described and illustrated. *S. triseptatus* differs from *S. armeniacus* in having 3–septate ascospores and ascomata developing under a pseudostroma. The fungus is compared with *Marinosphaera mangrovei* and *Mangrovispora pemphii*, marine taxa with similar ascospores.

Keywords: taxonomy, Polystigmataceae, Phyllachoraceae, marine fungi.

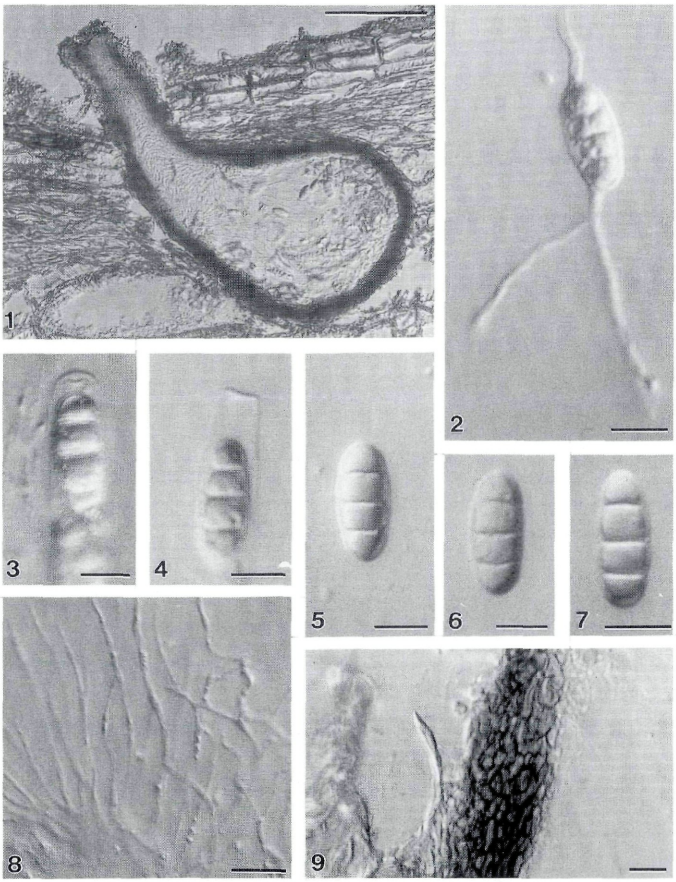
During studies of the intertidal mangrove fungi of Australia, a taxon with 3–septate ascospores was repeatedly collected and could not be allocated to any existing taxon. The fungus was also collected in Brunei, north Sumatra and Thailand (Hyde, 1988, 1989, 1990; Hyde & al., 1990; as *Sphaerulina oraemaris*-like). In this paper, the fungus *Swampomyces triseptatus* sp. nov. is described and compared with *S. armeniacus* Kohlm. & Volkm.-Kohlm. (Kohlmeyer & Volkmann-Kohlmeyer, 1987).

Taxonomy

Swampomyces triseptatus Hyde & Nakagiri, sp. nov.– Figs. 1–13.

Ascomata 240–320 µm alta, 175–200 µm diametro, subglobosa vel pyriformia, immersa, brunnea vel nigra, coriacea, ostiolata, solitaria, pseudostromatica. Asci 120–150 x 10–12 µm, octospori, cylindrici, leptodermi, breviter pedunculati, apparato apicali praediti. Ascosporae 18–25 x 8–11 µm, uniseriatae, hyalinae vel flavidae, ellipsoideae, triseptatae, ad septa constrictae, granulatae.

Ascomata 240–320 µm high, 175–200 µm diam, subglobose or pyriform, immersed, with long axis horizontal, oblique or vertical to the host surface, brown–black, coriaceous, ostiolate, contents apricot coloured in mass, occurring mostly singly (Fig. 1), developing under a thin darkened superficial pseudostroma, up to 20 µm thick, covering



Figs. 1–9. Interference contrast micrographs of *Swampomyces triseptatus*.– 1. Longitudinal section through ascoma, with long axis horizontal to the host surface and neck bending upwards. Note the periphyses.– 2. Germinating ascospore with germ-tubes developing from the poles. – 3, 4. Asci. Note the thickened apex.– 5–7. Ascospores.– 8. Branching paraphyses in a gel.– 9. Peridium. The cells are elongate in the ascoma wall (lower region) and are angular in the area between the peridium and neck (upper region).– Bars: 1=100 µm; 2–9=10 µm.

area where ascomata develop and composed of host cells with darkened fungal hyphae.– Neck up to 70 µm diam, dark, with periphyses (Fig. 1).– Peridium up to 25 µm thick, composed of 6–8 layers of brown flattened angular cells (Fig. 9), these cells being less flattened near the ostiole.– Paraphyses 1.5–2.5 µm wide, branching, appearing to anastomose, numerous, filamentous, hyaline, in a gel, and fusing with the periphyses in the neck.– Asci 120–150 x 10–12 µm, 8–spored, cylindrical, thin-walled, short pedunculate, apically thickened with indication of a pore and non-amyloid (Figs. 3,4). In some asci with released ascospores, splitting of the asci had occurred at the apex.– Ascospores 18–25 x 8–11 µm, overlapping uniseriate, hyaline-yellowish, ellipsoidal, 3–septate, weakly constricted at the septa, without sheaths or appendages and with granular ornamentation visible under SEM (Figs. 5–7).

Saprobic on intertidal mangrove wood of *Aegiceras*, *Rhizophora* and *Xylocarpus* spp.

Known distribution.– Australia, Brunei, North Sumatra, Thailand, Papua New Guinea.

Holotype.– Papua New Guinea, Western Province, Mabaduaun, on prop roots of *Xylocarpus granatum* König, Dec 1990, K.D. Hyde (BRIP 19381).

Etymology.– from the Latin *triseptatus*, meaning having three septa.

Other material examined.– AUSTRALIA: north Queensland, Bathurst Heads, mangrove wood, July 1991, K.D. Hyde (IFO H-12129); Cairns mangrove, near airport, on mangrove wood, Nov 1990, K.D. Hyde (BRIP 19703).– BRUNEI: Kampong Kapok Mangrove, *Xylocarpus granatum* wood, May 1987, K.D. Hyde (BRIP 19702).– THAILAND: Phang Nga Bay Mangrove, on intertidal *Xylocarpus*, Jan 1988, K.D. Hyde (BRIP 19704); Ranong mangrove, on intertidal *Rhizophora apiculata* Blume, Dec 1988, K.D. Hyde (BRIP 19291).

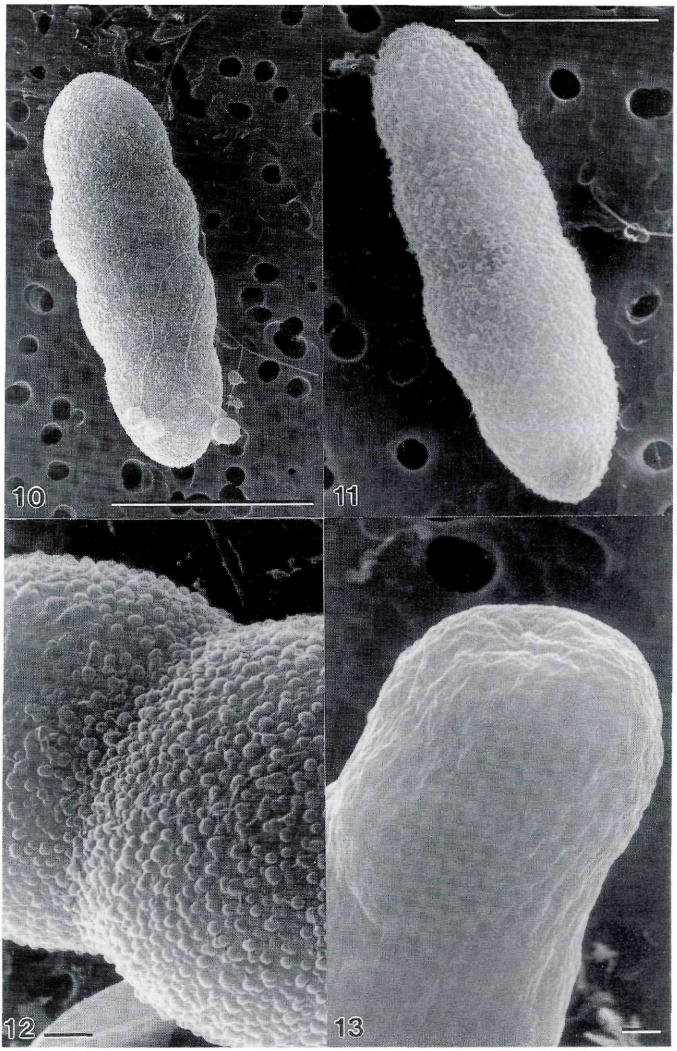
Colonies on seawater cornmeal agar (SWCMA) were brown to dark olive green. Monospore isolates became 13–15 mm in diam after 30 days incubation at 20–27 C (IFO 32437 and 32438).

Swampomyces armeniacus Kohlm. & Volkm.-Kohlm.– Figs. 14–21.

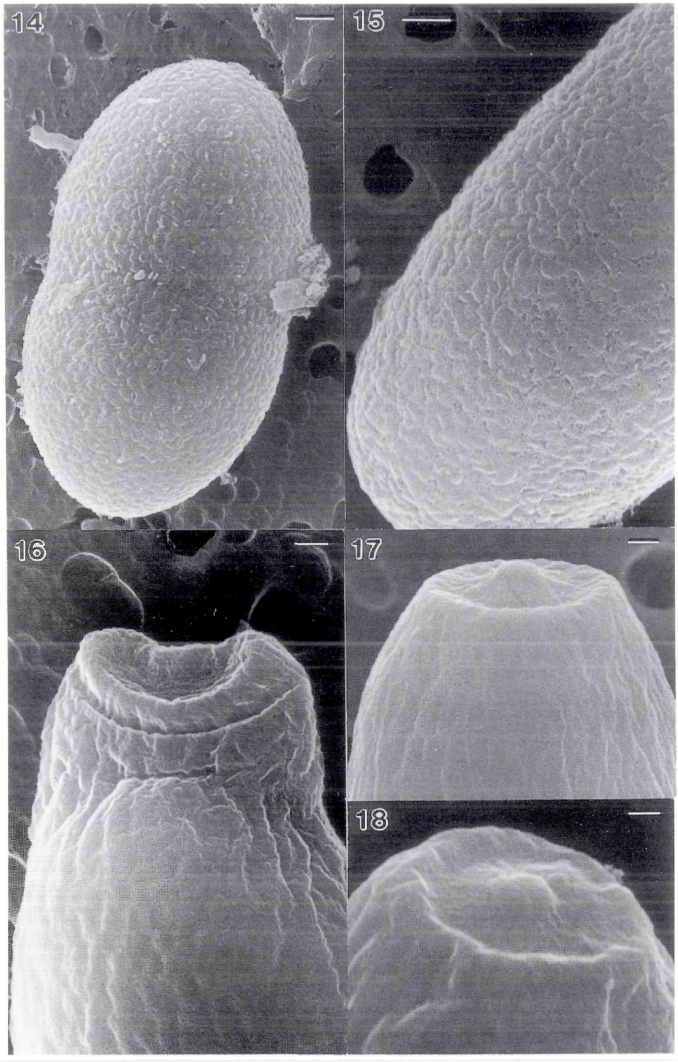
Material examined.– Australia, north Queensland, Bathurst Heads, on intertidal mangrove wood, July 1991, K.D. Hyde (IFO H-12128).

Monospore isolates grew very slowly on SWCMA; colony white, 2–3 mm in diam after 30 days incubation at 20–27 C. On cornmeal agar (CMA, freshwater medium) almost no growth was observed.

Swampomyces triseptatus is strikingly reminiscent of *S. armeniacus* (Kohlmeyer & Volkmann-Kohlmeyer, 1987). The ascoma con-



Figs. 10–13. Scanning electron micrographs of *Swampomyces triseptatus*. – 10–12. Ascospores. Note the granular wall ornamentation (12). – 13. Ascus which appears to be thickened with a small central indentation.– Bars: 10, 11=10 µm; 12, 13=1 µm.



Figs. 14–18. Scanning electron micrographs of *Swampomyces armeniacus*. – 14, 15. Ascospores with verruculose walls. – 16–18. Tip of ascus comprised of a thickened ring with a small projection in the center.– Bars = 1 μm.

tents, in mass, are apricot coloured, the peridium is thin and composed of flattened angular cells, the paraphyses are branched and in a gel, while the asci have a thickened apex. The presence of a pseudostroma, but lack of a clypeus and the 3–septate ascospores separate these two taxa, but do not justify further separation at the generic level. The morphological characteristics of *Swampomyces armeniacus* and *S. triseptatus* are listed for comparison in Tab. 1.

The ascus apices in *S. armeniacus* and *S. triseptatus* are difficult to differentiate with the light microscope. In *S. armeniacus* the tip is slightly thickened and treatment with ink produced a slightly staining blue zone (Kohlmeyer & Volkmann-Kohlmeyer, 1987). We have seen holotype material (Herb J K 4387a) of *S. armeniacus* and exam-

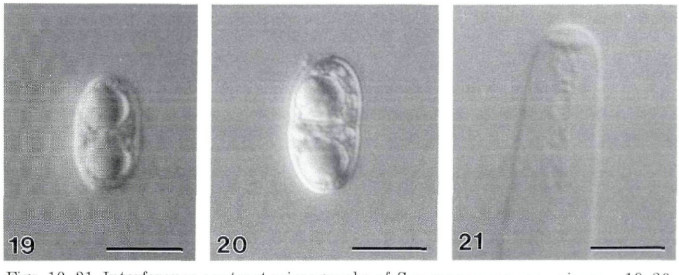
Tab. 1.– Comparison of morphological characteristics of *Swampomyces armeniacus* and *S. triseptatus*.

	S. armeniacus	*S. triseptatus*
Ascomata	Clypeate	Under a pseudostroma
	Immersed	Immersed
	Coriaceous	Coriaceous
	Light-brown	Brown-black
	Epapillate	Long immersed neck
	Periphysate	Periphysate
Peridium	Hyaline	Brown-black
	5–8 layers of flat cells	6–8 layers of flattened angular cells
Contents	Apricot coloured in mass	Apricot coloured in mass
Paraphyses	Rarely branched	Branched and anastomosing
	In a gel	In a gel
Asci	99–132 x 13–17 µm	120–150 x 10–12 µm
	8–spored	8–spored
	Cylindrical	Cylindrical
	Apical ring-like structure	Thickened apex
	Unitunicate	Unitunicate
	Semifissitunicate dehiscence	Splitting
Ascospores	13–20 x 6–9 µm	18–25 x 8–11 µm
	Hyaline-yellowish	Hyaline-yellowish
	Ellipsoid	Ellipsoid
	1–2-seriate	Uniseriate
	1–septate	3–septate
	Verruculose	Granulate
	Not constricted at the septa	Weakly constricted at the septa

ined the ascus with interference light contrast microscopy. At the tip of the ascus is a slightly thickened refractive area behind which is a diffuse hyaline area. Beneath this are the cytoplasmic contents of the ascus and these form indentations into the diffuse hyaline area which give the indication that this is an apical ring. In fresh material from Australia the ascus tip comprised a thickened apex with a faintly visible ring (Fig. 21). In some specimens the ring was inverted (semi-fissitunicate dehiscence *sensu* Samuels & Rossman, 1987). In the SEM a thickened ring was also apparent (Figs. 16–18) with a small projection in the center (Figs. 17,18). In *S. triseptatus* a similar apical thickening is present (Fig. 3), while in asci where spores have been released, a split occurs at the tip. In the SEM the ascal apex of *S. triseptatus* appears to be thickened with a small central indentation (Fig. 13). Because both species have a similar ascus apex with a ring-like structure, we prefer to place these fungi in one genus. However, some differences were observed in ascus dehiscence and structures of the ascus apex at the SEM level. Therefore, further studies with fluorescence microscopy or TEM are needed to confirm the ascus structure variation and to evaluate the taxonomic significance.

Ascospores of *S. triseptatus* are granulate, as illustrated in the SEM (Figs. 10–12), while those of *S. armeniacus* are reported to be smooth-walled (Kohlmeyer & Volkmann-Kohlmeyer, 1987). However, verruculose ornamentation was observed under phase contrast LM and in the SEM in fresh material from Australia (Figs. 14,15). Kohlmeyer & Volkmann-Kohlmeyer (1987) state that *S. armeniacus* is epapillate, while in *S. triseptatus* the ascomata are quite deeply immersed with a neck leading to the surface.

The taxonomic position of *Swampomyces* is unclear. Kohlmeyer & Volkmann-Kohlmeyer (1987) placed the genus in the Polystigmataceae, but with reservation. Eriksson & Hawksworth (1987) sug-



Figs. 19–21. Interference contrast micrographs of *Swampomyces armeniacus*.– 19, 20. Ascospores.– 21. Tip of ascus with apical ring.– Bars: = 10 µm.

gested that it should be included in "Unitunicate Ascomycetes inc. sed." until more is known of the genus. Since the ascus is provided with an apical ring and paraphyses are in a gel we feel that *Swampomyces* could be placed in the Polystigmataceae (now called Phyllachoraceae).

Swampomyces must also be compared with *Marinosphaera* Hyde and *Mangrovispora* Hyde & Nakagiri, marine genera with 3–septate ascospores (Hyde, 1989; Hyde & Nakagiri, 1991). In *Marinosphaera* the ascomata are immersed or superficial with a long bushy neck, paraphyses are wide, hyphae-like, unbranching and lack a gel, asci have a subapical plate, while ascospores are unicellular, becoming 3–septate very late and are distinctly ornamented (Hyde, 1989; E.B.G. Jones, personal communication). In *Mangrovispora* ascospores have a distinct spore ornamentation and a torulose sheath, while asci have an apical canal-like structure and paraphyses are sparse (Hyde & Nakagiri, 1991).

Swampomyces triseptatus may be confused with *Leptosphaeria avicenniae* Kohlm. & Kohlm., but differs in having wider ascospores (8–11 µm, vs. 5.5–8 µm) and unitunicate asci (Kohlmeyer & Kohlmeyer, 1979). We have seen type material of *L. avicenniae* (Herb JK 1737a) and it is unlikely that this taxon belongs in *Leptosphaeria*, since its differs markedly from the type species, *L. doliolum* (Pers.: Fr.) Cesati & De Notaris (Shearer & al., 1990; Shoemaker, 1984). However, fresh material is required to establish the nature of the ascus, before taxonomic revision can be considered.

Swampomyces triseptatus is commonly collected on decayed buttress roots of *Xylocarpus granatum* (Hyde, 1990), but has also been recorded on *Rhizophora apiculata* and *Aegiceras corniculatum* (L.) Blanco (Hyde & al., 1990, as *Sphaerulina* cf. *oraemaris* Linder).

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