Subulispora biappendiculata, anamorph sp. nov. from Borneo (Malaysia) and a review of the genus

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A new species of *Subulispora* is described from leaves collected in a stream in Borneo. It differs from other species of *Subulispora* by conidia with a typically two-armed terminal appendage. On the basis of literature, a review of the hitherto described species is presented. A great heterogeneity with respect to the conidial morphology is pointed out. *Subulispora africana* is transferred to *Cylindrosympodium*. Seven species (*Subulispora* ´in the narrow sense´) are considered to correspond relatively well to the original concept of the genus and are keyed out.

Key words: key to *Subulispora* species, morphology, submerged leaves, *Subulispora* genus, *Cylindrosympodium*

Introduction

During a visit to Borneo in May 2006, a few decaying leaves from broad-leaved trees and pieces of plant stems submerged in a stream were collected. After incubation in distilled water, conidia of several stauro- and scolecosporous taxa were produced. Some, which belonged to a new species of *Subulispora*, were isolated into pure culture and a description is presented below.

As with many other dematiaceous anamorphic genera, *Subulispora* is morphologically heterogeneous (cf. Srivastava *et al*., 1995; Sinclair *et al*., 1997). Following the establishment of *Subulispora* by Tubaki and Yokoyama (1971), some species originally accommodated in *Mycocentrospora* (as *Centrospora*) or *Parasympodiella* were added, while other species formerly classified in *Subulispora* have been transferred to *Polyscytalum*, *Cylindrosympodium* and *Dactylaria*.

In the second part of this article we present a review, based on literature, of *Subulispora* with notes on the taxonomic status of all species. *Subulispora*

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africana, omitted in Castañeda and Kendrick (1990) is recombined here in *Cylindrosympodium*. According to our opinion, only seven species, are more or less in accordance with the original concept of the genus. Data on their geographical distribution and habitats are compiled.

Material and methods

Plant debris was collected in a small, slow flowing forest stream in the Banjaran Crocker mountain range at *ca* 1600-1700 m altitude and placed in a plastic bag. In the laboratory, the material was thoroughly rinsed in tap water, distributed according to individual plant parts into Petri dishes with distilled water, incubated for several days and checked daily for released conidia. All procedures were performed at ambient temperature. The suspension of conidia was inoculated on thin layers of 2% malt agar (MA) with chloramphenicol and incubated for 1-2 days. The germinating conidia were located under a low power compound microscope, and with a flamed needle aseptically transferred to fresh 2% MA with chloramphenicol. To induce sporulation, pieces of agar culture were half-submerged in Petri dishes with sterile distilled water and incubated in dark. Alternatively, 2-week-old cultures on 2% MA in plastic Petri dishes were irradiated with NUV light for two days at *ca* 10 °C.

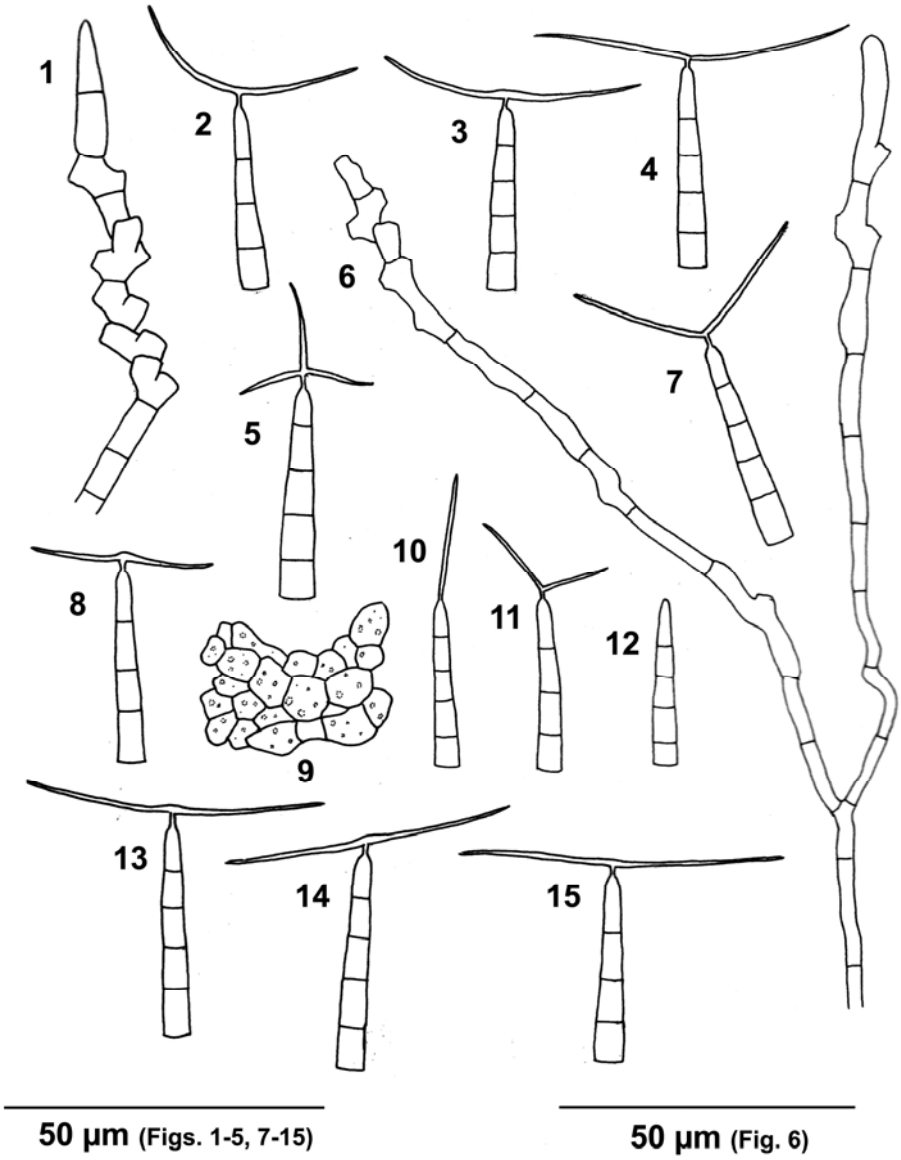
Colony colouration is characterised according to Rayner (1970).

Taxonomy

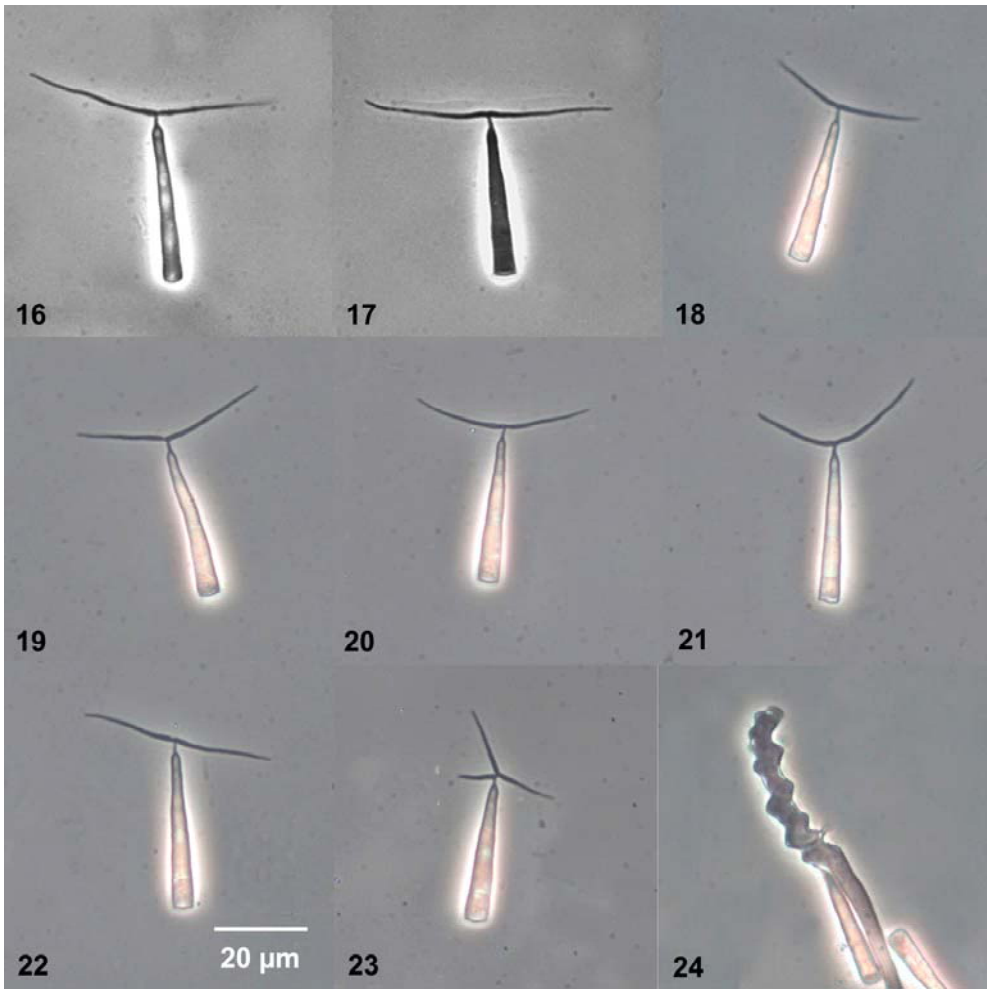
Subulispora biappendiculata Marvanová, anam. **sp. nov.** (Figs 1-27)
MycoBank: 510545.

Etymology: *´bi-´* (L.) = two, *´appendiculatus´* (L.) = with small appendages.

Fungi anamorphosi, hyphomycetosi. *Coloniae* in agaro maltoso leniter crescentes, post 20 dies 15-22 mm in diametro, pallide griseae vel griseae, villosae, leviter zonatae, nonnumquam sulcatae, margine integro vel lobato, submerso; reversum atrogriseum vel fuscoatrum. Sporulatio emersa vel submersa. *Hyphae* hyalinae, ramificatae, glabrae, septatae, tenuitunicatae, circa 1 µm latae, vel leviter crassitunicatae, fuscae vel brunneae, 2-4 µm latae, nonnumquam cum cellulis inflatis, catenatis. In cultura artificiali stratum superficiale e cellulis inflatis brunneis, usque ad 7 µm latis, adest. *Conidiophora* singularia vel aggregata, simplicia vel pauce ramosa, terminalia vel raro lateralia, glabra, septata, recta vel flexuosa, usque ad 200 µm longa in aqua, valde brevior in cultura agarosa, 2-5 µm lata, parietibus subcrassis, nonnumquam sinuosis, brunneis, ad apicem versus pallescentia. *Cellulae conidiogenae* in conidiophoris incorporatae, sympodialiter prolificantes, rhachidem terminalem, geniculatam, usque ad 80 µm longam, formantes, cicatrices elevatae, denticulatae, planae, leviter incrassatae, circa 4 µm latae, densiter aggregatae vel remotae. *Conidia* acropleurogena, hyalina, anguste conoidea, sine appendice 26-38 µm longa, typice 3-4 septata, basi truncata vel leviter convexa, 3.5-5(-6) µm lata, cicatrix pariete subincrassato; apice rotundata, 2 µm lata, appendix setosa, plerumque, dichotoma, ad collum brevem angustamque 1-2(-3) × 0.5-1 µm



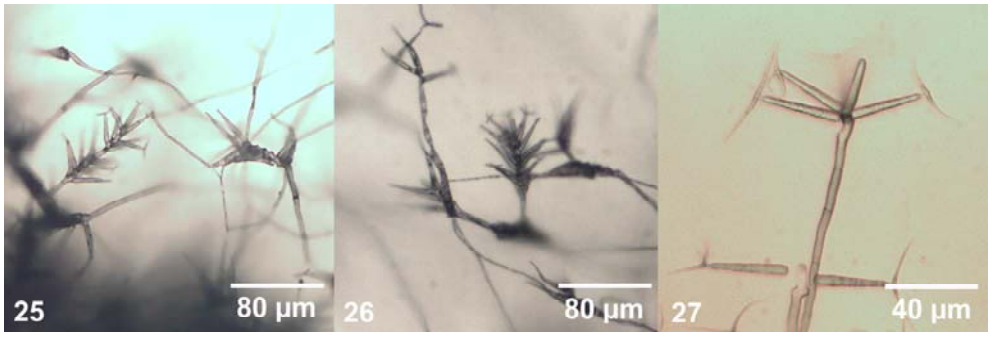
Figs 1-15. *Subulispora biappendiculata* sp. nov. **1.** Conidiophore with young conidium. **2-4, 7, 8.** Detached conidia. **6.** Branched conidiophore from submerged culture. **9.** Inflated cells from the agar surface. **5, 10, 11.** Aberrant conidia. **12.** Aborted conidium. **13-15.** Conidia from the natural substrate. (6 = CCM F-10306, 1-5, 7-12 = CCM F-10406).



Figs 16-24. *Subulispora biappendiculata* sp. nov. **16-17.** Conidia from the natural substrate. **18-23.** Conidia from CCM F-10406. **24.** Conidiophore with conidiiferous rachis.

inserta, rami simul crescentes, furcati vel late divergentes, attenuati ad apicem versus, 10-28 µm longi, latitudine maxima 1.5 µm ad insertionem. Dehiscentia conidiorum schizolytica. Appendices cum ramis tribus vel conidia sine appendice, apice acutiformia etiam adsunt in cultura artificiali.

Anamorphic fungi, hyphomycetes**.** *Colonies* on 2% MA slow growing, reaching 15-22 mm diam. in 20 days at *ca* 22°C, pale to mouse grey, hairy, indistinctly zonate, in some isolates radially and transversely sulcate, margin entire or somewhat lobate, submerged, reverse dark mouse grey to fuscous black. Sporulation on semisubmerged pieces of agar culture above or rarely under water level, or directly on agar after irradiation. *Hyphae* hyaline,



Figs 25-27. Conidiophores with conidia *in situ*; CCM F-10406 on MA 2%, after irradiation.

branched, smooth, septate, thin-walled, *ca* 1 µm wide, or with somewhat thickened walls, fuscous to brown, 2-4 µm wide, sometimes with chains of inflated cells. On the agar surface, there is a dark layer of *textura angularis* consisting of short, up to 7 µm wide inflated cells (Fig. 9). *Conidiophores* single or grouped, simple or sparsely branched, terminal or rarely lateral on long hyphae or growing from the dark layer of inflated cells, smooth, septate, straight or flexuous, up to *ca* 200 µm long in water, but usually much shorter on agar, 2-5 µm wide, brown, paler distally, walls sometimes sinuous, subthickened. *Conidiogenous cells* integrated, polyblastic, proliferating sympodially, typically forming a terminal geniculate rachis up to *ca* 80 µm long, scars raised, often on denticles, flat to slightly convex, subthickened, *ca* 4 µm wide, densely grouped in agar cultures or often more distant when submerged (Figs 1, 6, 24). *Conidia* acropleurogenous (Figs 25-27)**,** hyaline, narrow conoid, the conidial body 26-38 × 3.5-5(-6) µm at the base, tapering distally to *ca* 2 µm**,** typically 3-4 septate, base truncate, scar flat or slightly bulged, subthickened, apex rounded, typically bearing a two-armed setose appendage on a short and thin neck 1-2(-3) × 0.5-1 µm, with more or less broadly outstretched arms usually perpendicular to the conidial body (conidia appearing T- or Y-shaped (Figs. 2-4, 7, 8, 11, 13-22), arms synchronously formed, tapering towards ends, straight or slightly curved upwards or one arm curved upwards, one downwards, of nearly equal length 10–28 µm, maximum width 1.5 µm at insertion. At maturity, the point of dichotomous branching becomes obscured and the appendage on typical conidia looks like a transverse needle with two sharp ends, attached in its central part to the conidial body. Conidial secession schizolytic. Germination from the base or from the apex of the conidial body, rarely from the arms of the appendage. Three-armed appendage (Figs 5, 23) or conidia with simple acute appendage (Fig. 10) appear in pure culture. Such appendage may bear a lateral branch, simulating

the true dichotomies (Fig. 11). Aborted conidia with rounded apex, lacking appendage, may also be released from pieces of agar culture in standing distilled water (Fig. 12). Microcycle conidiation (free-floating conidium bearing a short conidiophore with several detachment scars) was seen in one isolate. On the natural substrate, the conidia are somewhat larger and practically only T-shaped with appendages broadly diverging, in preparations sometimes appearing oblique (Figs 13-17).

Teleomorph: unknown.

Habitat: on decaying frondose leaves of woody plants in a small, slow flowing rainforest stream.

Material examined: Malaysia, Sabah (northwest Borneo), Banjaran Crocker mountain range, on a saddle near the road from Kota Kinabalu to Tambunan, *ca* 1600-1700 m elevation, May 2006, coll. I. Sedláček, isolated L. Marvanová (**holotype** PRM 846950).

Living cultures: *Subulispora biappendiculata*: CCM F-10206, CCM F-10306, CCM F-10406 (ex holotype), CCM F-10506, all pure cultures isolated from plant debris collected in Borneo.

The main differentiating character from other *Subulispora* species is the perpendicular, typically two-armed appendage. The conidial body is similar to that of *S. longirostrata*, the branched appendage on a thin neck resembles that of *S. elegantissima*, which, however, is four-armed.

The conidia of *S. biappendiculata* are superficially similar to those of *Miniancora allisoniensis* Marvanová & Bärl. However, the culture of *M. allisoniensis* is orange, conidiophores are hyaline, conidiogenous cells have frilled scars and conidial body is cylindrical, shiny, only 1-1.5 μm wide and the apical cell with two dichotomous arms perpendicular to the axis is devoid of cytoplasm at maturity (Marvanová and Bärlocher, 1989).

Review of *Subulispora*

(Authors of the epithets are cited in Table1)

Subulispora Tubaki is based on *S. procurvata*, a species with subulate conidia bearing a setose, terminal appendage smoothly bent at an angle of 40-90° (Tubaki and Yokoyama, 1971). In the same publication, Tubaki described a second species, *S. rectilineata*, with straight, awl-shaped conidia with an acute terminal extension. Sutton (1973) published *S. britannica* with conidia similar to *S. rectilineata*, but wider and considerably longer, with rounded apex. Later he added *S. hareae* (Sutton 1978) with thin cylindrical conidia. This species was then recombined in *Polyscytalum* Riess (Kirk, 1981a) as *Polyscytalum hareae*. *Polyscytalum* is characterised by catenate arthroconidia. Kirk (1981a) found chains of arthroconidia in his new collections of *Subulispora hareae* and had discovered them also in the holotype material of

this species. Some of the septa (presumably those where fragmentation occurred), had double walls.

Further species with cylindrical conidia were described or recombined by Kirk (1981b, 1985): *S. minima*, *S. cylindrospora*, *S. africana*; the latter was originally classified in *Parasympodiella* Ponappa by Morgan-Jones *et al*. (1985), a genus characterised by catenate arthroconidia (Ponnappa, 1975; Castañeda *et al*., 1997).

This broadened concept of *Subulispora* was accepted by de Hoog (1985), who added *S. variabilis* and *S. gracilis*, the latter originally described as *Centrospora gracilis*. de Hoog also pointed out the close similarity of the cylindrosporous species of *Subulispora* to *Solosympodiella* Matsush. (Matsushima 1971) but did not formally recombine any species of the latter with *Solosympodiella* (cf. de Hoog and van Oorschot 1985). In any case, the conidial morphology in *Solosympodiella* is considerably heterogeneous and very different from that in the original concept of *Subulispora* (Tubaki and Yokoyama, 1971).

Castañeda and Kendrick (1990) did not accept de Hoog´s broad concept. They relocated four species of *Subulispora* with cylindrical conidia and hyaline to pale brown conidiogenous structures to their new genus *Cylindrosympodium* W.B.Kendr. & R.F. Castañeda based on *Subulispora variabilis*. They differentiated *Subulispora* and *Solosympodiella* from *Cylindrosympodium* on the basis of "scattered, solitary, robust conidiophores which are heavily pigmented at the base" in *Solosympodiella* and *Cylindrosympodium* and on the shape of conidia, which "in *Subulispora* are attenuated towards their angled apical appendage"; whereas "those of *Solosympodiella* are clavate, 0-1 septate". In contrast "in *Cylindrosympodium* the conidiophores are hyaline or subhyaline, are always crowded .." and the conidia "are cylindrical and one- to several-septate". They included four new combinations: *Cylindrosympodium variabile*, *C. cylindrosporum*, *C. gracile* and *C. minimum*. Castañeda and Kendrick (1990, Fig, 3) give their own description and illustration of *C. variabile*, based on two collections from Cuba, slightly differing from the type by more prominent denticles on a longer rachis. *Subulispora africana*, although very similar to *S. cylindrospora* (Kirk, 1985), but with darker conidiogenous structures was neither recombined, nor mentioned by Castañeda and Kendrick (1990). We propose a new combination in *Cylindrosympodium* (see Table 1).

Srivastava *et al*. (1995) in their review of the genus *Mycocentrospora* (Hartig) Deighton mentioned the cylindrosporous species of *Subulispora* in the broad sense of de Hoog. They considered the possibility of transferring *Subulispora minima* to *Mycocentrospora*, but did not do any formal

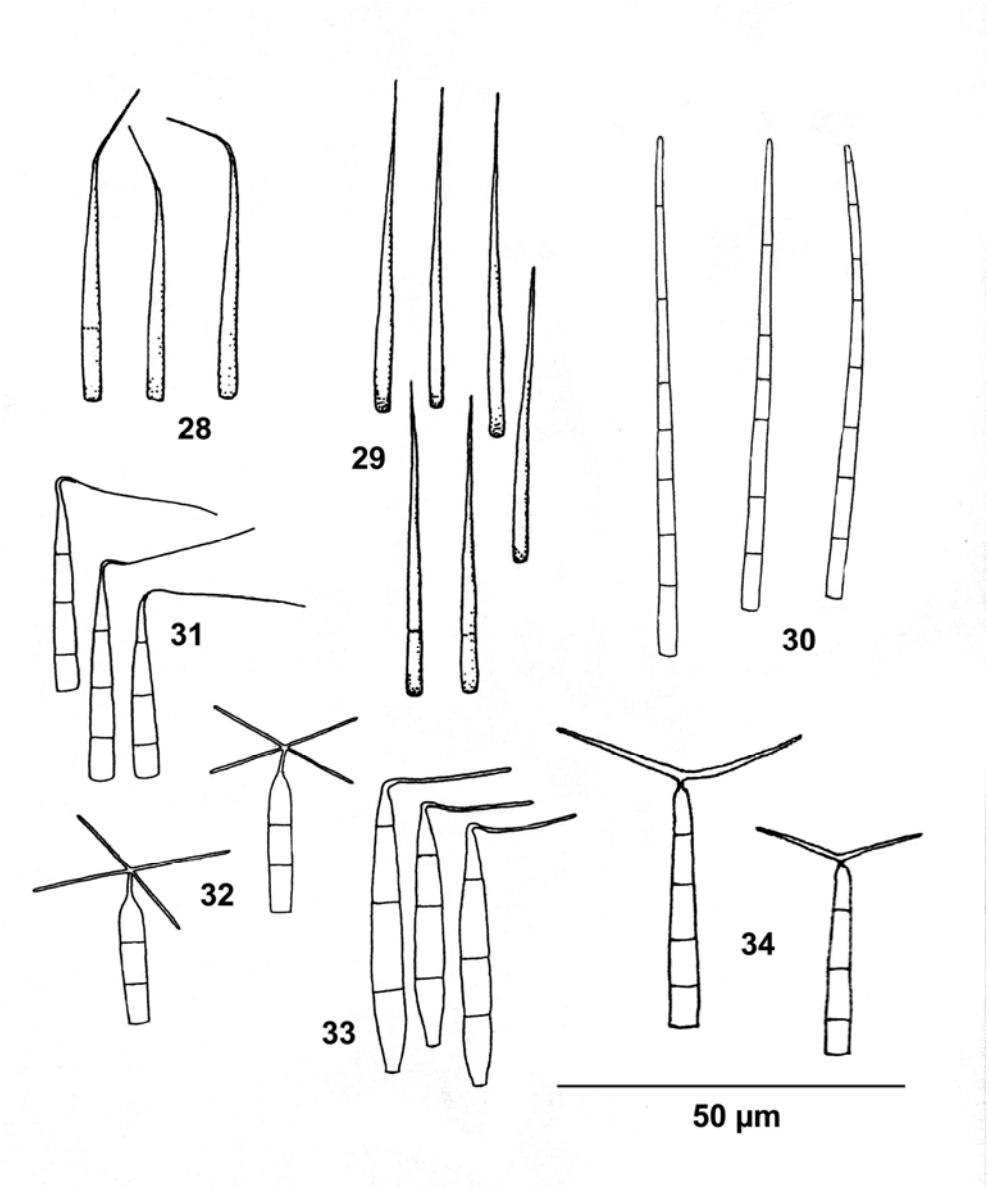
reclassification. No *Subulispora* species was considered to be related to *Mycocentrospora* by Braun (1995) in his revision of the latter genus.

Sinclair *et al*. (1997) discussed *Subulispora* in connection with their new anamorph genus *Sympodioplanus* R.C. Sinclair & Boshoff. They pointed out the original concept of *Subulispora*, which emphasized the subuliform shape of conidia (long, narrow conoid, broadest at the base, tapering gradually to the apex) and the presence of a terminal appendage. Surprisingly, although they must have been aware of Castañeda and Kendrick´s recombinations of the cylindrosporous *Subulispora* species when comparing *Cylindrosympodium* with *Sympodioplanus*, they treated *Subulispora* in the broad sense of de Hoog.

Grandi and Gusmão (2002b) reported three species of *Subulispora* as fairly frequent leaf litter decomposers in the São Paulo State in Brazil and gave a brief survey of the genus, also in the broad sense including the cylindrosporous species.

Besides the two original species, *S. procurvata* (Fig. 28) and *S. rectilineata* (Fig. 29), the non-cylindrosporous species comprise *S. britannica* (Fig. 30), with non-appendiculate subulate conidia of variable length (Sutton, 1973), *S. elegantissima* (Fig. 32) with a four-armed terminal appendage on a bottle-shaped conidial body (Kirk 1985), *S. longirostrata* (Fig. 31) with a long conoid conidial body and terminal appendage typically bent at right angle (Nawawi and Kuthubutheen 1987) and *S. malaysiana* (Fig. 33) superficially similar to *S. longirostrata*, but with fusoid conidial body, rather narrow conidiiferous denticles and shorter terminal appendage also bent at right angle (Nawawi and Kuthubutheen 1990). A fusoid conidial body is also characteristic for *S. argentina*, invalidly recombined in *Dactylaria* (see Table 1), but here the terminal appendage is in line with the conidial axis (Arambarri *et al*. 1987). A very similar species with larger conidia was described as *Dactylaria appendiculata* (Cazau *et al*., 1990). Both are keyed within other species of *Dactylaria* in Goh and Hyde (1997). *Subulispora malaysiana* may also be accommodated in *Dactylaria* in the broad sense as presented in Paulus *et al*. (2003); a possibility to classify it in *Dactylaria* was already mentioned in the protologue (Nawawi and Kuthubutheen, 1990). According to our opinion, the discrete, distinctly bent terminal appendage is an alien element even in *Dactylaria sensu lato*. For the present, we prefer not to alter the classification of *S. malaysiana* until the heterogeneous *Dactylaria sensu lato* becomes resolved. The newly described *S. biappendiculata* (Fig. 34) has its conidial body similar to that in *S. longirostrata*.

The abovementioned genera need a thorough comparative studies based on morphology as well as on molecular methods capable of revealing



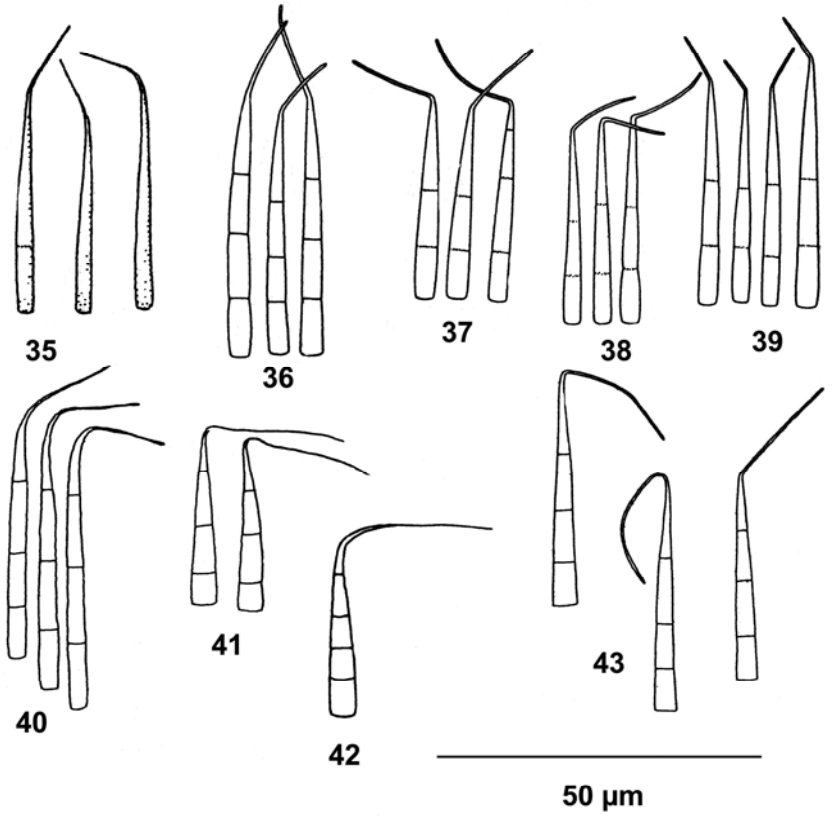
Figs 28-34. Conidia of *Subulispora* spp. in the narrow sense **28.** *S. procurvata*. **29.** *S. rectilineata*. **30.** *S. britannica*. **31.** *S. longirostrata*. **32.** *S. elegantissima*. **33.** *S. malaysiana*. **34.** *S. biappendiculata*. (28-33 from the respective protologues, 34 from CCM F-10306).

phylogenetic relationships. A hindrance is the absence of cultures for most of the species.

More collections on the substrate, from geographically distant localities, and a few isolations into pure culture may obscure the delimitation of some species, so that morphological differences become less clear-cut. For example, Nawawi and Kuthubutheen (1987) suggested that the shorter and basally wider conidial body and relatively more abruptly bent, long appendage (typically at an angle less than 90°, 15-20 µm long and with a little arcuate notch near the point of bend) are the discriminating characters of *S. longirostrata* (our Fig. 41), while for *S. procurvata* the conidial body is longer and narrower and the appendage typically 10-12 µm long, smoothly bent at an angle 90° and more (our Figs 35, 40). However, if we compare the conidial shapes of *S. procurvata* published by Matsushima (1971, Solomon Islands, our Figs 36, 37) and Matsushima (1975, Japan, our Figs 38, 39), a considerable variation of the appendage length, its bend and of the angle contained by the appendage and the conidial body become apparent. There are conidia with short appendages matching the protologue (Figs 36 and 39, from pure culture and from nature, respectively) and other with abruptly bent, relatively long appendages deflected at various angles (Figs 37 and 38, from the same sources as Figs. 36 and 39). Such conidia can be interpreted as intermediate between those of *S. procurvata* and *S. longirostrata*. There are more examples in the literature, e.g. the fungus depicted in Kirk (1985, as *S. procurvata*, *cf.* our Fig. 43) with *ca* 4 µm wide conidia at the base and an abruptly bent appendage. Also the conidium from Brazil, drawn by Grandi and Attili (1996, Fig. 17, wrong magnification!) as *S. procurvata*, is more close to *S. longirostrata*; the same collection labelled SP250836 is later listed under *S. longirostrata* in Grandi and Gusmão (2002b).

The conidium from Malaysia, illustrated in Nawawi (1985, as *S. procurvata*, cf. our Fig. 42) shows a long appendage smoothly bent at *ca* 90°, but with the rather short and basally wide conidial body fits better the more recently described *S. longirostrata*. A short conidial body is also reported in a specimen collected in Mexico (Heredía, 1994, Fig. 8a,b, as *S. procurvata*): 17.5-27 × 2-3 µm, with appendix up to 18 µm long. Also here the conidial shape is more similar to *S. longirostrata*. None of the intermediate conidia show the arcuate notch illustrated in Nawawi and Kuthubutheen (1987, Fig. 1B), but as shown on Fig. 2C in the same publication, it is not present on all conidia.

The conidiophores or conidiogenous cells are usually not of great diagnostic value. Some species produce darker and more thick-walled conidiogenous structures in pure culture than on the natural substrate, e.g. *Cylindrosympodium variabile* (de Hoog, 1985). In contrast, these structures



Figs 35-43. Variations in conidia of *Subulispora procurvata* and *S. longirostrata*. **35.** *S. procurvata* from the protologue. **36, 37.** *S. procurvata* from Matsushima (1971, Figs 2 and 3, respectively; from pure culture, Solomon Islands). **38, 39.** *S. procurvata* from Matsushima (1975, Fig. 2, from natural substrate, Japan). **40.** *S. procurvata* from Nawawi and Kuthubutheen (1987, Fig. 1C). **41.** *S. longirostrata* from Nawawi and Kuthubutheen (1987, Fig. 1B). **42.** Conidium labelled *Subulispora procurvata* in Nawawi (1985, Fig. 63). **43.** Conidia labelled *Subulispora procurvata* in Kirk (1985, Fig. 11B).

may be pale and thin-walled in pure culture (e.g. *Subulispora procurvata* in Matsushima, 1971, Fig. 65, 1-3).

If we respect the transfer of cylindrosporous species and *Subulispora argentina* to other genera, there remain seven species assignable to *Subulispora* ´in the narrow sense´, with the following common characters: *Conidiophores* macronematous, with brownish thickened walls, paler and thinner distally.

Conidiogenesis thalloblastic in the sense of Hennebert and Sutton (1994). *Conidiogenous cells* integrated, proliferating sympodially, typically forming a distinct rachis with flat scars on more or less distinct denticles. *Conidia* mostly hyaline to pale fuscous, subulate, long conoid, fusoid or bottle-shaped, with or without terminal appendage. Even so the genus is still morphologically heterogeneous.

Key to *Subulispora* species (in the narrow sense)

1a) Conidia subulate to long conoid (broadest at the base, tapering distally), with or without terminal appendage 2
1b) Conidia fusoid (tapering towards both ends), with simple terminal appendage ..... ***S. malaysiana***
1c) Conidia bottle-shaped, with 4-pronged cruciate terminal appendage on a short neck, perpendicular to the conidial axis ..... ***S. elegantissima***

2a) Appendage absent 3
2b) Appendage present..... 4

3a) Rachis up to 40 µm long, with prominent, densely packed denticles, conidia subulate with acute apex, few-septate, 34-42 × 2-2.5 µm ..... ***S. rectilineata***
3b) Rachis up to 23 µm long , denticles few, less prominent or inconspicuous, conidia subulate, straight or gently curved, multiseptate, 44-86 × 2.5-3 µm, apex rounded..... ***S. britannica***

4a) Appendage integrated, simple, bent 5
4b) Appendage on a short neck, typically broadly dichotomous, perpendicular to the conidial body, (in culture also 3-armed or simple, acicular)..... ***S. biappendiculata***

5a) Conidial body 34-45 × 2-2.5 µm, appendage typically smoothly bent at angle 90° and more ..... ***S. procurvata***
5b) Conidial body 25-34 × 3-4 µm, appendage typically abruptly bent at angle 90° and less ..... ***S. longirostrata***

Notes on distribution and ecology

Most of the species of *Subulispora* in the narrow sense have been reported from the tropics or subtropics, often on the Southern Hemisphere: Brazil (Grandi and Attili, 1996; Gusmão *et al*., 2001; Grandi and Gusmão, 2002a,b); Peru (Matsushima, 1993); Kenya (Kirk, 1985); Tanzania (Pirozynski, 1972); Mauritius (Dulymamode *et al*., 2001); Malaysia (Nawawi, 1985; Nawawi and Kuthubutheen, 1987, 1990; Marvanová and Laichmanová, this article); Australia (Matsushima, 1989; Paulus *et al*., 2003, 2006); New Zealand (Cooper, 2005); Solomon Islands (Matsushima, 1971). Fewer records are from the Northern Hemisphere: Cuba, Mexico, French Guayana (Heredía,

Table 1. Annotated list of 13 species described or recombined in *Subulispora***.**

1. ***Cylindrosympodium africanum*** (Morgan-Jones, Sinclair & Eicker) Marvanová **comb. nov.** MycoBank: 510546.
≡ *Parasympodiella africana* Morgan-Jones, Sinclair & Eicker, Mycotaxon 17: 312, (1983), basionym
≡ *Subulispora africana* (Morgan-Jones, Sinclair & Eicker) P.M. Kirk, Mycotaxon 23: 342 (1985)
2. *Dactylaria argentina* (Aramb. & Mengasc.) Cazau, Aramb. & Cabello, Mycotaxon 38: 22 (1990) (nom. inval., Art 33.2 ICBN)
≡ *Subulispora argentina* Aramb. & Mengasc., Mycotaxon 30: 264 (1987)
3. *Subulispora britannica* B. Sutton, Trans. Br. mycol. Soc. 61: 422 (1973)
Similar to *S. rectilineata*, but with shorter conidiophores, less prominent detachment scars on conidiogenous cells and longer conidia with rounded apex
4. *Cylindrosympodium cylindrosporum* (P.M. Kirk) W.B. Kendr. & R.F. Castañeda, Univ. Waterloo Biol. Ser. 32: 13 (1990)
≡ *Subulispora cylindrospora* P.M. Kirk, Mycotaxon 23: 340 (1985)
5. *Subulispora elegantissima* P.M. Kirk, Mycotaxon 23: 342 (1985)
6. *Cylindrosympodium gracile* (Matsush.) W.B. Kendr. & R.F. Castañeda, Univ. Waterloo Biol. Ser. 32: 13 (1990)
≡ *Centrospora gracilis* Matsush., Ic. Microf. a Matsush. Lect.: 21 (1975)
≡ *Subulispora gracilis* (Matsush.) de Hoog, Stud. Mycol. 26: 5 (1985)
7. *Polyscytalum hareae* (B. Sutton) P.M. Kirk, Trans. Br. mycol. Soc 76: 81 (1981)
≡ *Subulispora hareae* B. Sutton, Trans. Br. mycol. Soc. 74: 171 (1978)
8. *Subulispora longirostrata* Nawawi & Kuthub., Mycotaxon 30: 459 (1987)
This species, with a bent terminal appendage and long conoid conidial body, matches well the original concept of the genus
9. *Subulispora malaysiana* Nawawi & Kuthub., Mycotaxon 37: 389 (1990)
According to the morphology of the fertile structures it is similar to *Dactylaria argentina* or *D. appendiculata* Cazau, Aramb. & Cabello
10. *Cylindrosympodium minimum* (P.M. Kirk) W.B. Kendr. & R.F. Castañeda, Univ. Waterloo Biol. Ser. 32: 13 (1990)
≡ *Subulispora minima* P.M. Kirk, Trans. Br. mycol. Soc. 77: 466 (1981)
11. *Subulispora procurvata* Tubaki, Trans. Mycol. Soc. Japan 12: 20 (1971)
12. *Subulispora rectilineata* Tubaki, Trans. Mycol. Soc. Japan 12: 221 (1971)
13. *Cylindrosympodium variabile* (de Hoog) W.B. Kendr. & R.F. Castañeda, Univ. Waterloo Biol. Ser. 32: 13 (1990)
≡ *Subulispora variabilis* de Hoog, Stud. Mycol 26: 56 (1985)
This species, though with relatively uniform 3-septate conidia on the natural substrate, shows great variability of conidial length and septation in pure culture.

1994); Venezuela (Castañeda *et al*., 2003); India (Rao and de Hoog, 1986); Taiwan (Matsushima, 1980); Japan (Tubaki and Yokoyama, 1971; Matsushima, 1995). One species is known from temperate climate (UK, Sutton, 1973; Kirk, 1982).

Subulispora species are saprobic, occurring on dead plant tissues, especially on tree leaf litter. No substrate preference for *S. longirostrata*, *S. procurvata* and *S. rectilineata* was considered by Grandi and Gusmão (2002b), and by Schoenlein-Crusius and Grandi (2003).

Subulispora species are considered terrestrial (Grandi and Gusmão, 2002b), but there are records from localities with constantly humid conditions - in tropical cloud forest: *S. britannica* (Venezuela: Castañeda *et al*., 2003) in mountain cloud forest: *S. procurvata* (Mexico: Heredía (1994, but see the note above) in atlantic rainforests: *S. longirostrata* (Brazil: Grandi and Attili, 1996 [as *S. procurvata*]; Gusmão *et al*., 2001; Grandi and Gusmão, 2002b); *S. procurvata* (Brazil: Grandi and Gusmão, 2002b); *S. rectilineata* (Brazil: Grandi and Attili, 1996; Grandi and Gusmão, 2002b); in tropical mesophyll rainforest (Australia: Paulus *et al*., 2006) In such environments, members of terrestrial genera may occur on currently wetted plant debris as ´facultative aquatic fungi´ (Schoenlein-Crusius and Grandi, 2003).

Some species were collected on submerged leaves from streams or rivers: *S. biappendiculata* (Malaysia, Borneo: Marvanová and Laichmanová, this article), *S. britannica* (New Zealand: Cooper 2005), *S. longirostrata* (Malaysia: Nawawi and Kuthubutheen 1987), *S. malaysiana* (Malaysia: Nawawi and Kuthubutheen 1990), *S. procurvata* (Malaysia: Nawawi 1985, but see the note above, Nawawi and Kuthubutheen 1987, Peru: Matsushima 1993).

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