

## ***Corynespora subcylindrica* sp. nov., a new hyphomycete species from Brazil and a discussion on the taxonomy of corynespora-like genera**

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The new hyphomycete species *Corynespora subcylindrica*, isolated as an endophyte living in leaves of *Lippia sidoides* in Pernambuco, Brazil, is described and illustrated. The intricate generic affinity of the new species is discussed in detail, and a survey of the current taxonomy of corynespora-like genera as well as a key to the genera concerned is given.

Keywords: anamorphic fungi, corynesporoid hyphomycetes, new species, South America, key.

An endophytic hyphomycete has recently been isolated from asymptomatic leaves of *Lippia sidoides* growing in the Experimental Station of the Agropecuary Search Company of Pernambuco in Brazil. Due to the presence of monotretic, determinate or occasionally percurrently proliferating conidiogenous cells, this fungus is identified as a member of the *Corynespora* Güssow generic complex (Güssow 1906, Wei 1950, Ellis 1957, 1971, 1976; Mercado Sierra *et al.* 1997). A comparison of the hyphomycete isolated from *Lippia sidoides* with the numerous species assigned to *Corynespora* and allied genera suggested it to represent an undescribed species. The characters of the conidia with few distosepta which are, however, regularly formed in chains, rendered it difficult to find an appropriate genus for this species. The inclusion into *Corynespora* s. lat. (sensu Ellis 1971) is at present the best solution.

## Material and Methods

Endophytes were isolated from living leaves of *Lippia sidoides* using the methods described by Araújo *et al.* (2002) and cultivated on 2 % Potato Dextrose Agar (PDA; Sigma, P 2182). For describing colony characteristics, cultures were grown on PDA in 90 mm Petri dishes at 28 °C. Dried material was deposited in the herbaria HAL and URM (Holmgren *et al.* 1990) and cultures at URM. Examinations of microscopic features and measurements were made using standard light microscopy (Olympus BX40) in distilled water without any staining.

## Taxonomy

***Corynespora subcylindrica*** V.M. Siqueira, U. Braun & C.M. Souza-Motta, **sp. nov.** – Fig. 1. Mycobank no.: MB 511295

*Corynesporae laevistipitatae* similis, sed endophytica, conidiophoris brevioribus, 10–85 µm longis, conidiis semper catenatis, saepe subcylindraceis.

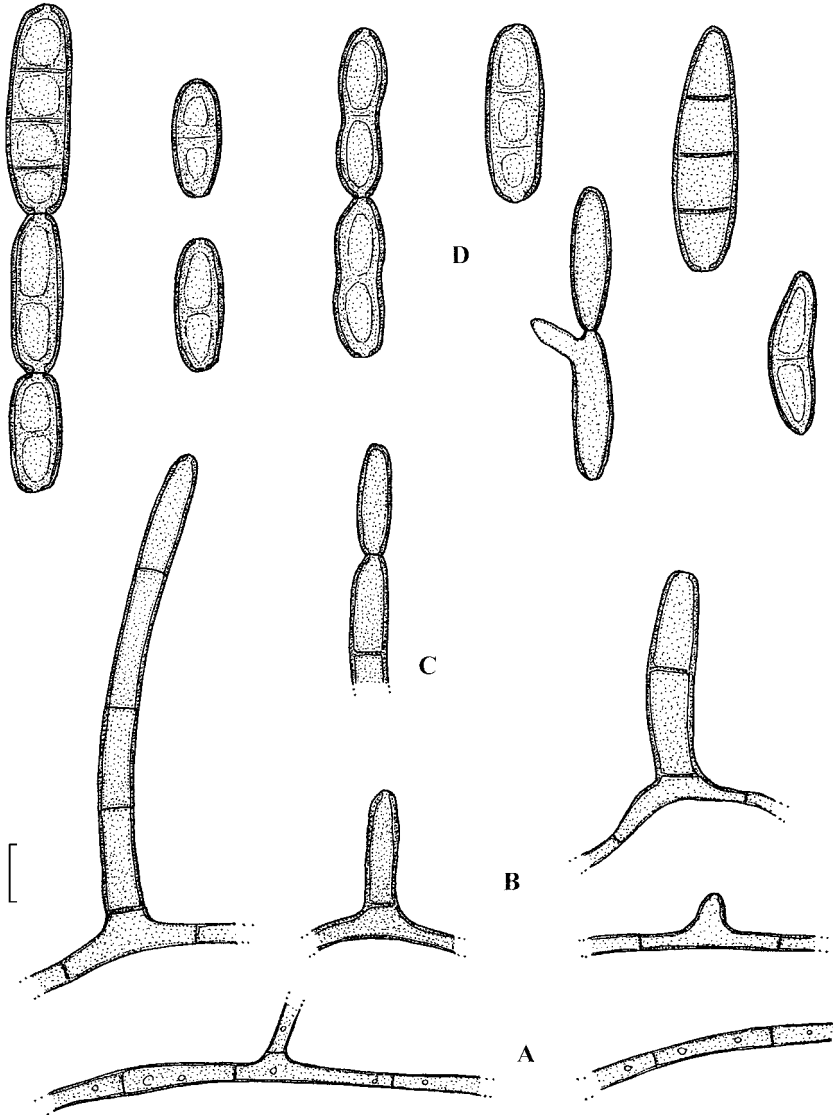
**Etymology.** – Referring to the conidial shape.

**Holotypus.** – BRAZIL: Pernambuco, Carpina, Experimental Station of the Agropecuary Search Company (IPA), isolated as endophyte from leaves of *Lippia sidoides* Cham. (Verbenaceae), 20 Jul. 2006, V. M. Siqueira (URM), dried culture. **Isotypus.** – HAL 2102 F, dried culture.

**Ex-type culture:** URM 5550 (under mineral oil and lyophilisation).

**In vitro (PDA).** – Colonies effuse, smooth, velvety, greyish white, mouse-grey to grey-brown, reverse brown, margin almost entire to irregular, somewhat feathery, reaching 30 mm diam. within seven days, 60 mm after 10 days. – Hyphae branched, 1.5–8 µm wide, sometimes with swollen hyphal cells, up to 15 µm diam., septate, subhyaline to pale olivaceous (narrower hyphae) to medium olivaceous-brown or brown (wider hyphae), occasionally guttulate, wall thin, up to 1 µm thick, smooth. – Conidiophores arising from hyphae, lateral, usually macronematous, occasionally short and semi-macronematous, erect, straight to slightly curved, subcylindrical, unbranched, 10–85 × 5–7 µm, 0–4-septate, pale to medium brown or olivaceous-brown, wall thin, ≤ 1 µm thick, smooth or almost so. – Conidiogenous cells integrated, terminal, 10–30 µm long, monotretic, determinate (conidiophores occasionally with rejuvenation, visible by having terminal and subterminal conidiogenous cells which are somewhat constricted at the septa), monotretic, i.e. with a single terminal porus, 1–3 µm diam., neither significantly thickened, nor

darkened around the porus. – Conidia catenate (with up to eight conidia per chain), broadly ellipsoid, subcylindrical, occasionally obovoid or short obclavate, straight to slightly curved,  $18\text{--}60\text{--}90 \times 5\text{--}13 \mu\text{m}$ , 0–3(6)-distoseptate (with constricted lumina), rarely with a slight median constriction, pale brown, wall thin,  $< 1 \mu\text{m}$  thick, but usually appearing two-layered, caused by a paler inner



**Fig. 1.** – *Corynespora subcylindrica* sp. nov. – **A.** hyphae. – **B.** conidiophores. – **C.** conidiogenous cell with rejuvenation. – **D.** conidia. – Bar =  $10 \mu\text{m}$ .

layer, up to 1.5 µm thick, smooth or almost so, both ends obtuse, rounded, with conspicuous pores, 1–3 µm diam., neither significantly thickened, nor darkened around the pore.

### Discussion

The genus *Corynespora* was introduced by Güssow (1906). Wei (1950) redescribed the type species of this genus, *C. mazei* Güssow [= *C. cassiicola* (Berk. & M.A. Curtis) C.T. Wei], which is characterized by having monotretic, often percurrently proliferating conidiogenous cells and pluridistoseptate conidia formed singly or occasionally in short chains. Later the concept of *Corynespora* was widened by adding species with few to numerous euseptate conidia, solitary or in short chains (Ellis 1971, 1976).

*Corynesporella* Munjal & Gill (Munjal & Gill 1961) was proposed for an Indian corynesporoid hyphomycete also with monotretic conidiogenous cells and distoseptate conidia, but differing from *Corynespora* in having several conidiogenous cells formed as terminal, lateral branchlets. Castañeda (1985) altered the concept of *Corynesporella* by adding *C. pinarensis* R.F. Castañeda, characterized by having unbranched conidiophores with terminal and intercalary monotretic conidiogenous cells. The differentiation between *Corynespora* and *Corynesporella* is rather obscure. Both genera have monotretic conidiogenous cells and distoseptate conidia. The occurrence of terminal and intercalary conidiogenous cells as well as unbranched and branched conidiophores is not uncommon and known from numerous hyphomycete genera, e.g., *Alternaria* Nees (Ellis 1971, 1976), *Cladosporium* Link (Heuchert *et al.* 2005, Schubert 2005, Schubert *et al.* 2007), *Drechslera* S. Ito (Ellis 1971, 1976), etc.

*Hemicorynespora* M.B. Ellis (Ellis 1972) comprises corynespora-like hyphomycetes with aseptate conidia [*H. deightonii* M.B. Ellis, the type species; *H. aseptata* Hol.-Jech. (Hobubová-Jechová 1987)] or 1-euseptate conidia [*H. mitratae* (Penz. & Sacc.) M.B. Ellis (Ellis 1972)].

*Corynesporopsis* P.M. Kirk (Kirk 1981a,b, Mercado Sierra *et al.* 1997) was introduced to accommodate species with monotretic, terminal conidiogenous cells, but catenate, euseptate conidia, usually didymo- to phragmosporous. *C. indica* P.M. Kirk (Kirk 1983) is an unusual species with a single, more or less median, dark, band-like septum. Morgan-Jones (1988a) reallocated *Corynespora bisepitata* M.B. Ellis to *Corynesporopsis*, discussed the taxonomy of the latter genus and morphologically similar genera, and emphasized that 'other than the septa, the conidial shape and the fact that the conidia catenate, there is little difference between *Corynesporopsis*

and *Hemicorynespora*'. *Monotretomyces* Morgan-Jones, Sinclair & Eicker (Morgan-Jones *et al.* 1987), characterized by its clavate conidiophores with integrated, terminal, monotretic conidiogenous cells and catenate didymosporous, euseptate conidia, is little differentiated from *Corynesporopsis* and should be reduced to synonymy with the latter genus. Stromata and caespitose, thin-walled, paler conidiophores are not sufficient to maintain *Monotretomyces*.

Castañeda & Kendrick (1990) introduced the new genus *Solicorynespora* R.F. Castañeda & W.B. Kendr., consisting of former *Corynespora* species with euseptate conidia formed singly. Castañeda *et al.* (2004) described a new species of *Solicorynespora*, proposed a further new combination, and provided a key to the species of this genus. However, there is a morphological continuum from *Hemicorynespora* with 0-1-septate conidia to *Solicorynespora* characterized by having two- to pluriseptate conidia. *Corynesporopsis* only differs in having catenate conidia. Based on experiences in other hyphomycete genera, e.g. *Cladosporium* (David 1997, Schubert 2005, Crous *et al.* 2007), *Passalora* Fr. and other cercosporoid *Mycosphaerella* Johanson anamorphs (Crous & Braun 2003), characters like conidial shape and formation (solitary or in chains) are of little importance on generic level. Therefore, the separation of *Corynesporopsis*, *Hemicorynespora* and *Solicorynespora* is also doubtful. Furthermore, these genera, characterized by having euseptate conidia, are closely connected with *Corynespora* (s. str.) in which the conidia are distoseptate, by numerous intermediate species. *C. obclavata* Dyko & P. Sutton (Dyko & Sutton 1979) was described to have 4-6-euseptate, but occasionally also distoseptate conidia. *C. rhapsidis-humilis* X.G. Zhang & M. Ji (Zhang & Ji 2005) is characterized by its 12-16-distoseptate or 1-4-euseptate conidia, and *C. toonae* X.G. Zhang & Ch. K. Shi (Zhang & Shi 2005) possesses 0-4-distoseptate or 4-14-euseptate conidia. Wulandari (2006) described *C. hamata* Wulandari with 14-19-distoseptate conidia, interspaced with 3-8 eusepta, *C. acalyphae* Wulandari with 8-16 distosepta and 3-8 eusepta, and *C. gracilis* Wulandari having 10-22-distoseptate conidia with 1-2 interspaced eusepta. Siboe *et al.* (1999) introduced *C. kenyensis* Siboe, P.M. Kirk & P.F. Cannon characterized by conidia with 3-8 distosepta mixed with 3-4 eusepta. *Corynespora* species with mixed disto- and euseptation are undoubtedly not uncommon and render the differentiation between *Corynespora* and *Solicorynespora* and similar genera difficult and doubtful.

Due to catenate, distoseptate conidia the new species *Corynespora subcylindrica* is close to *Corynesporina elegans* Subram., the type species of the monotypic genus *Corynesporina* Subram. (Subramanian 1994), but could not be assigned to the latter genus since it was described to produce conidia in basipetal chains. The

conidia in species of *Corynespora* and allied genera, if catenate at all, are formed in acropetal chains. The new species described from Brazil, characterized by having integrated, terminal monotretic conidiogenous cells and distoseptate conidia formed in acropetal chains, fits well into the current concept of *Corynespora*, although the conidia are formed in chains of up to eight conidia (versus conidia formed singly or at most in short chains in the type species of *Corynespora* and most other species assigned to this genus). Some species with regularly catenate conidia have also been described in *Corynespora*, e.g. *C. matuszakii* Morgan-Jones (Morgan-Jones 1988b), which is, however, quite distinct from *C. subcylindrica* by its very long, pluriseptate conidia, up to 260 µm in length, with strongly reduced cell lumina. The conidia of *C. catenulata* N. Sharma *et al.* (Sharma *et al.* 2002), described from India on *Clerodendrum indicum*, are formed singly, but may form few secondary conidia causing short conidial chains. This species is, however, characterized by having very long and broad, 1–24-distoseptate conidia, 27.5–225.5 × 11–19 µm.

Most species of *Corynespora* possess larger, pluriseptate conidia formed singly or at most occasionally in very short chains, and resemble in this respect the foliicolous as well as saprobic *C. cassiicola*, the type species (Yen 1980, Guo 1984, Meenu & Kamal 1998, Sharma & Srivastava 2003). Many of them strongly resemble the latter species and are morphologically barely distinct, e.g., *C. erianthemi* J.M. Yen & Lim, *C. hemigraphidis* J.M. Yen & Lim, *C. heterospora* J.M. Yen, *C. ruelliae* J.M. Yen & Lim (Yen 1980), *C. ligustri* Y.L. Guo, *C. merremiae* Y.L. Guo, *C. millettiae* Y.L. Guo and *C. viticis* Y.L. Guo (Guo 1984), *C. morindae-tinctoriae* Meenu & Kamal, *C. nana* Meenu & Kamal and *C. rosacearum* Meenu & Kamal (Meenu & Kamal 1998).

Most species of *Corynespora* (s. lat.) with smaller conidia and few septa have been excluded from this genus due to euseptate or catenate conidia. The conidia of the lichenicolous *C. laevistipitata* (M.S. Cole & D. Hawksw.) Heuchert & U. Braun (Heuchert & Braun 2006) resemble those of *C. subcylindrica*, but differ in having much longer conidiophores, up to 228 µm, and conidia formed singly or only occasionally in very short chains. Furthermore, the wall around the conidiogenous locus (pore) is often somewhat darkened. *Corynespora pauciseptata* Bat. & Bezerra (Batista *et al.* 1965), described from Brazil on an unknown living plant, has also rather small conidia, 19–37 × 5.5–7.5 µm, with only 1–3 septa (not described whether eu- or distoseptate), but the conidiophores are very long, 300–510 µm. With regard to size and septation of the conidia, *C. gymnocladi* Jian Ma & X.G. Zhang (Ma & Zhang 2007) is close to *C. subcylindrica* (conidia 15–40 × 7–10.5 µm, 2–6-distoseptate), but the conidia are

more obclavate and formed singly. The North American *C. arctespora* (Cooke & Ellis) Carries (Carries 1987) is a further species resembling *C. subcylindrica* by its small cylindrical to obclavate conidia, 13–63 µm long, formed singly or in chains, but the conidia are narrower, 4–7 µm wide, and possess up to 20 distosepta.

**Key to corynespora-like genera (hyphomycetes with monotretic conidiogenous cells)**

In the discussion, it has been shown that the differentiation between *Corynespora* and allied, segregated genera is rather weak, i.e., there is a continuum with regard to morphological characters, and the particular genera are connected by numerous intermediate species. However, at present it does not make any sense to formally propose any taxonomic changes and new synonymies. A taxonomic revision of corynesporoid genera is urgently necessary, but should be based on phylogenetic affinities derived from molecular sequence analyses. There is presently a strong tendency to define anamorph genera by a combination of morphology and phylogenetic data (Crous *et al.* 2007). Segregate genera should only be maintained when phylogenetically distinct from *Corynespora* (s. str.), based on its type species, but such data are not yet available. Therefore, the genera concerned can be tentatively maintained just as morphological entities, which can be keyed out as follows. Some additional genera with monotretic conidiogenous cells are also included in the key, e.g., *Briansuttonia* R.F. Castañeda, Minter & Saikawa (Castañeda *et al.* 2004), *Dendryphiopsis* S. Hughes, *Didymobotryum* Sacc. and *Podosporium* Schwein. (Ellis 1971, Kiffer & Morelet 2000), and *Paradendryphiopsis* M.B. Ellis (Ellis 1976).

- 1. Conidia dictyosporous (with several transverse, longitudinal and oblique distosepta) . . . . . *Briansuttonia*
- 1. Conidia aseptate or transversely eu- or distoseptate . . . . . 2
- 2. Conidiophores mononematous, unbranched . . . . . 3
- 2. Conidiophores mononematous, but frequently branched or syn-nematous . . . . . 8
- 3. Conidia distoseptate or with distosepta and eusepta mixed . . . 4
- 3. Conidia aseptate or euseptate (distosepta lacking) . . . . . 6
- 4. Conidiogenous cells integrated, terminal and intercalary . . . . . *Corynesporella pinarensis*
- 4. Conidiogenous cells integrated, but strictly terminal . . . . . 5
- 5. Conidia formed singly or in short to long acropetal chains . . . . . *Corynespora*
- 5. Conidia solitary and in short basipetal chains . . . *Corynesporina*
- 6. Conidia catenate . . . . . *Corynesporopsis*

6. Conidia solitary . . . . .	7
7. Conidia aseptate or with a single septum (obovoid-ellipsoid, mitre-shaped, limoniform, navicular) . . . . .	<i>Hemicorynespora</i>
7. Conidia two- to pluriseptate . . . . .	<i>Solicorynespora</i>
8. Conidiophores in synnemata . . . . .	9
8. Conidiophores mononematous, frequently branched . . . . .	10
9. Conidia solitary . . . . .	<i>Podosporium</i>
9. Conidia catenate . . . . .	<i>Didymobotryum</i>
10. Conidia distoseptate . . . . .	<i>Corynesporella</i>
10. Conidia euseptate . . . . .	11
11. Conidia solitary, thick-walled . . . . .	<i>Dendryphiopsis</i>
11. Conidia catenate, thin-walled . . . . .	<i>Paradendryphiopsis</i>

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