



Conidial fungi from the semi-arid Caatinga biome of Brazil. New and interesting *Zanclospora* species

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Abstract

During inventory of saprotrophic conidial fungi carried out in the Brazilian semi-arid region, four interesting *Zanclospora* species were found on plant litter. *Zanclospora bonfinensis* sp. nov. is characterized by presence of sterile setae, setiform conidiophores, with a verruculose, dark brown apex; conidiogenous cells adpressed and arranged in verticils at the single fertile regions which is restricted to middle part of the setiform conidiophores; conidia bacilliform, 0-septate, hyaline. Descriptions, comments and illustrations are presented for the new species and for *Z. brevispora* var. *brevispora*, *Z. indica* and *Z. novae-zelandiae*. A key and a synoptic table for all known species are included.

Key words – hyphomycetes – taxonomy – tropical microfungi

Introduction

Zanclospora was erected by Hughes & Kendrick (1965) to accommodate two species, *Z. novae-zelandiae* S. Hughes & W.B. Kendr. (type species) and *Z. brevispora* S. Hughes & W.B. Kendr. collected on lignicolous substrates (branches and barks) in New Zealand. The genus is characterized by setiform conidiophores, simple or branched, brown; conidiogenous cells phialidic, discrete, arranged in multiple verticils; conidia falcate or narrowly obovoid, 0-septate, hyaline (Hughes & Kendrick 1965, Subramanian & Vittal 1973, Sutton & Hodges 1975, Zucconi & Rambelli 1982). To date, eight taxa have been described: *Z. brevispora* var. *brevispora* S. Hughes & W.B. Kendr., *Z. novae-zelandiae*, *Z. indica* Subram. & Vittal (Subramanian & Vittal 1973), *Z. austroamericana* B. Sutton & Hodges (Sutton & Hodges 1975), *Z. mystica* Zucconi & Rambelli (Zucconi & Rambelli 1982), *Z. brevispora* var. *transvaalensis* Morgan-Jones, R.C. Sinclair & Eicker (Morgan-Jones et al. 1992), *Z. stelata* M. Caldusch, Gené & Guarro (Caldusch et al. 2002) and *Z. ureweri* J.A. Cooper (Cooper 2005).

Zanclospora has a predominantly tropical and subtropical distribution, with only two record in temperate region (*Z. brevispora* and *Z. novae-zelandiae*, Hughes & Kendrick 1965). Most species have been commonly found on leaf litter, except *Z. austroamericana*, *Z. brevispora* var. *brevispora*, *Z. brevispora* var. *transvaalensis* and *Z. novae-zelandiae*, which were recorded on decaying wood or bark (Hughes & Kendrick 1965, Sutton & Hodges 1975, Morgan-Jones et al.

1992, Haja et al. 2007). There are three known teleomorph-anamorph connections between *Zanclospora* and *Chaetosphaeria* Tul. & C. Tul. *Chaetosphaeria brevispora* Shoemaker was connected to *Z. brevispora* var. *brevispora* by Hughes & Kendrick (1967) and *C. lateriphiala* F.A. Fernández & Huhndorf and *C. minuta* F. A. Fernández & Huhndorf were connected to two unidentified species of *Zanclospora* (Fernández & Huhndorf 2005, Fernández et al. 2006).

In this paper we describe a new species and three interesting species based on morphological characters.

Methods

Samples of decaying plant material from the Caatinga biome of Brazil were collected, placed in separate paper bags and transported to the laboratory. The plant material was washed in flowing water and placed in Petri dish moist chambers (100 × 15 mm). The dishes were placed inside polystyrene containers (150 L capacity) with 200 mL of sterile water and 2 mL of glycerol, and incubated at room temperature. After 72 hours, and at subsequent regular intervals, the samples were examined for the presence of conidial fungi. Fungal structures were placed on slides with PVL resin (polyvinyl alcohol + lactic acid + phenol) and examined. All material has been deposited in the Herbarium of Universidade Estadual de Feira de Santana (HUEFS). Measurements and digital images were made using a BX51 Olympus microscope equipped with brightfield and Nomarski interference optics and a DP25 Olympus digital camera. Images were processed using Adobe Photoshop. Drawings were made directly from digital images using the technique described by Barber & Keane (2007).

Results

Zanclospora bonfinensis D.A.C. Almeida, Gusmão & M.F.O. Marques, **sp. nov.** Figs 1–2
MycoBank 804289

Etymology – Referring to the county in which it was collected, Senhor do Bonfim.

Setae straight or flexuous, septate, dark brown, tapering towards the pointed and verrucose apex, 140–350 × 4.5–9 µm. Setiform conidiophores, arising singly or in groups, erect, straight or flexuous, simple, septate, smooth, brown, apex verrucose and dark brown, 110–210 × 3.5–6 µm. Fertile region single, restricted to middle part, with wider and shorter cells than other cells of conidiophore, (9–)24–39 × 4–10 µm. Conidiogenous cells monophialidic, discrete, sessile, lageniform, adpressed to the fertile region, arise just below the distal septa of cells, arranged in verticils, pale brown to subhyaline, 6–9 × 3–4 µm; collarete cylindrical to funnel-shaped, 1.5–3 × 1–2 µm. Conidia simple, bacilliform, straight or slightly curved, 0-septate, hyaline, 3–5.5 × 1–2 µm, aggregated into slimy masses.

Teleomorph – Unknown.

Known distribution – Brazil

Material examined – Brazil, Bahia, Senhor do Bonfim, Serra de Santana, on decaying leaves of unidentified dicotyledonous plant, 12 Sep 2006, D.A.C. Almeida (HUEFS 192223 – holotype). Ibid., Ceará, Crato, on decaying leaves of unidentified dicotyledonous plant, Jan 2011, D.A.C. Almeida (HUEFS 192224).

Notes – The setiform conidiophores of *Z. bonfinensis* with a pointed apex are comparable to those of *Z. novae-zelandiae*, *Z. mystica* and *Zanclospora stelata*, but differ in being unbranched. *Zanclospora bonfinensis* can be also differentiated by shape and size of the conidia (Table 1). *Zanclospora austroamericana*, *Z. brevispora* var. *brevispora* and *Z. brevispora* var. *transvaalensis* can be separated from *Z. bonfinensis* by conidiophores with rounded, smooth and pale brown apex, position of the fertile regions, shape and size of the conidia. *Zanclospora indica* and *Z. urewerae* are easily differentiated from *Z. bonfinensis* by conidiogenous cells not adpressed to the setiform conidiophore. Additionally, *Z. bonfinensis* is the unique species in the genus in that it also produces sterile setae.

Table 1 Synopsis of *Zanclospora* species

Species	Conidiophores		Conidiogenous cells		Conidia		References
	Branch	Size (µm)	Arrangement	Size (µm)	Shape	Size (µm)	
<i>Z. austroamericana</i>	Absent	Up to 260 × 6	Adpressed	10–13.5 × 3.5–4.5	Falcate	12–19 × 2–3	Sutton & Hodges (1975)
<i>Z. bonfinensis</i>	Absent	110–210 × 3.5–6	Adpressed	6–9 × 3–4	Bacilliform	3–5.5 × 1–2	This paper
<i>Z. brevispora</i> var. <i>Brevispora</i>	Absent	100–296 × 5.2–10	Adpressed	6.4–12 × 2–4	Narrowly obovoid	3.5–9.4 × 1–2.1	Hughes & Kendrick (1965), Mercado-Sierra et al. (1997), Whitton et al. (2012), this paper
<i>Z. brevispora</i> var. <i>Transvaalensis</i>	Absent	Up to 140 × 5–6	Adpressed	6.5–8 × 3–4	Narrowly obovoid or clavate	8–10 × 2.5	Morgan-Jones et al. (1992)
<i>Z. indica</i>	Absent	85–180 × 5–8	Divergent	6–14 × 4–6	Bacilliform	5.5–8 × 0.5–1.0	Subramanian & Vittal (1973), this paper
<i>Z. mystica</i>	Present	135–175 × 4.5	Adpressed	4.5–7 × 2–3.5	Falcate	12.5–16.5 × 1.5–2.5	Zucconi & Rambelli (1982)
<i>Z. novae-zelandiae</i>	Present or absent	140–750 × 4.4–7.5	Adpressed	7.5–17.5 × 2.2–5.5	Falcate	10–35 × 1–3.5	Hughes & Kendrick (1965), Matsushima (1975), Schoknecht & Crane 1983, Chang (1990), this paper
<i>Z. stelata</i>	Present	105–157 × 5–5.5	Adpressed	6–7.5 × 2.5–3.5	Bacilliform to allantoid	2–3.5 × 0.5–1.5	Calduch et al. (2002)
<i>Z. urewerae</i>	Absent	Up to 150 × 5	Divergent	–	Falcate	4–6 × 1–1.5	Cooper (2005)

Zanclospora brevispora var. *brevispora* S. Hughes & W.B. Kendr., N.Z. Jl. Bot. 3: 156. 1965.

Figs 3 a–c

Conidiophores 120.5–275 × 5.5–8 µm. Conidiogenous cells 7.5–11.5 × 2.5–3.5 µm. Conidia 3.5–6.5 × 1–1.5 µm.

Teleomorph – *Chaetosphaeria brevispora* Shoemaker (Hughes & Kendrick 1967).

Known distribution – Brazil (Santa Izabel et al. 2011), Brunei (Whitton et al. 2012) China (Tsui et al. 2000), Cuba (Mercado-Sierra et al. 1997), Kenya (Kirk 1985), New Zealand (Hughes & Kendrick 1965), Seychelles (Whitton et al. 2012) and Thailand (BIOTEC Culture collection 2013).

Material examined – Brazil, Bahia, Abaíra, Serra do Barbado, on decaying bark and twig, 18 Aug 2008, A.C.R. Cruz (HUEFS 192228). Ibid. Morro do Chapéu, on decaying leaf of unidentified dicotyledonous plant, 6 Jun 2008, T.S. Santa Izabel (HUEFS 155160).

Notes – *Zanclospora brevispora* var. *brevispora* differs from *Z. brevispora* var. *transvaalensis* by fertile regions with more conidiogenous cells and shorter, regularly curved conidia (Morgan-Jones et al. 1992). *Zanclospora austroamericana* is similar to *Z. brevispora* var. *brevispora*, but differs by having two fertile regions and larger, falcate conidia (Sutton & Hodges 1975).

Zanclospora indica Subram. & Vittal, Can. J. Bot. 51(6): 1132. 1973

Figs. 3 d–f

Conidiophores 85–135 × 5–7 µm. Conidiogenous cells 7.5–13 × 4.5–5.5 µm. Conidia 5.5–7 × 1 µm.

Teleomorph – Unknown

Known distribution – Brazil (Marques et al. 2008), Cuba (Castañeda-Ruiz 1986, Mercado-Sierra et al. 1997), India (Subramanian & Vittal 1973) and Ivory Coast (Rambelli et al. 2004).

Material examined – Brazil, Bahia, Lençóis, “caminho Serrano”, on dead leaf of *Chamaecrista desvauxii* (Collad.) Killip, 25 Jul 2000, L.F.P. Gusmão (HUEFS 56681). Ibid. Rio de Contas, “estrada Real”, on dead leaf of *Croton* sp., 21 Apr 2001, L.F.P. Gusmão (HUEFS 56593). Ibid. Santa Terezinha, on dead stem of unidentified dicotyledonous plant, 2 Jan 2006, M.F.O. Marques (HUEFS 107273).

Notes – *Zanclospora indica* and *Z. ureweri* are the two species that produce diverging conidiogenous cells from the setiform conidiophore. *Zanclospora ureweri* was described by Cooper (2005) in having phialides adpressed to the setiform conidiophore, however, in the illustration the divergent condition of phialides is observed. *Zanclospora indica* can be differentiated by conidiophore terminating in a bulbous apical cell and larger conidia. Furthermore, *Z. indica* produces secondary phialides by percurrent extension.

Zanclospora novae-zelandiae S. Hughes & W.B. Kendr., N.Z. Jl Bot. 3: 152. 1965.

Figs. 3 g–j

Conidiophores 150–250 × 5–7 µm. Conidiogenous cells 7.5–11 × 3.5–5.5 µm. Conidia 10–16.5 × 1–2 µm.

Teleomorph – Unknown.

Known distribution – Brazil (Marques et al. 2008), New Zealand (Hughes & Kendrick 1965), Japan (Matsushima 1975), Taiwan (Chang 1990), USA (Schoknecht & Crane 1983, Haja et al. 2007).

Material examined – Brazil, Bahia, Santa Terezinha, on dead bark of unidentified dicotyledonous plant, 19 Apr 2006, M.F.O. Marques (HUEFS 107299).

Notes – The Brazilian specimen has smaller conidia than reported in previous descriptions of *Z. novae-zelandiae* (Hughes & Kendrick 1965, Matsushima 1975, Schoknecht & Crane 1983, Chang 1990). *Zanclospora novae-zelandiae* has phialides adpressed and arranged in the fertile region which is located at the middle part of the conidiophore, as in *Z. austroamericana* and *Z. bonfinensis*. However, *Z. austroamericana* has a second fertile region in the apical part of the setiform conidiophore, while *Z. bonfinensis* differs by smaller, bacilliform conidia.

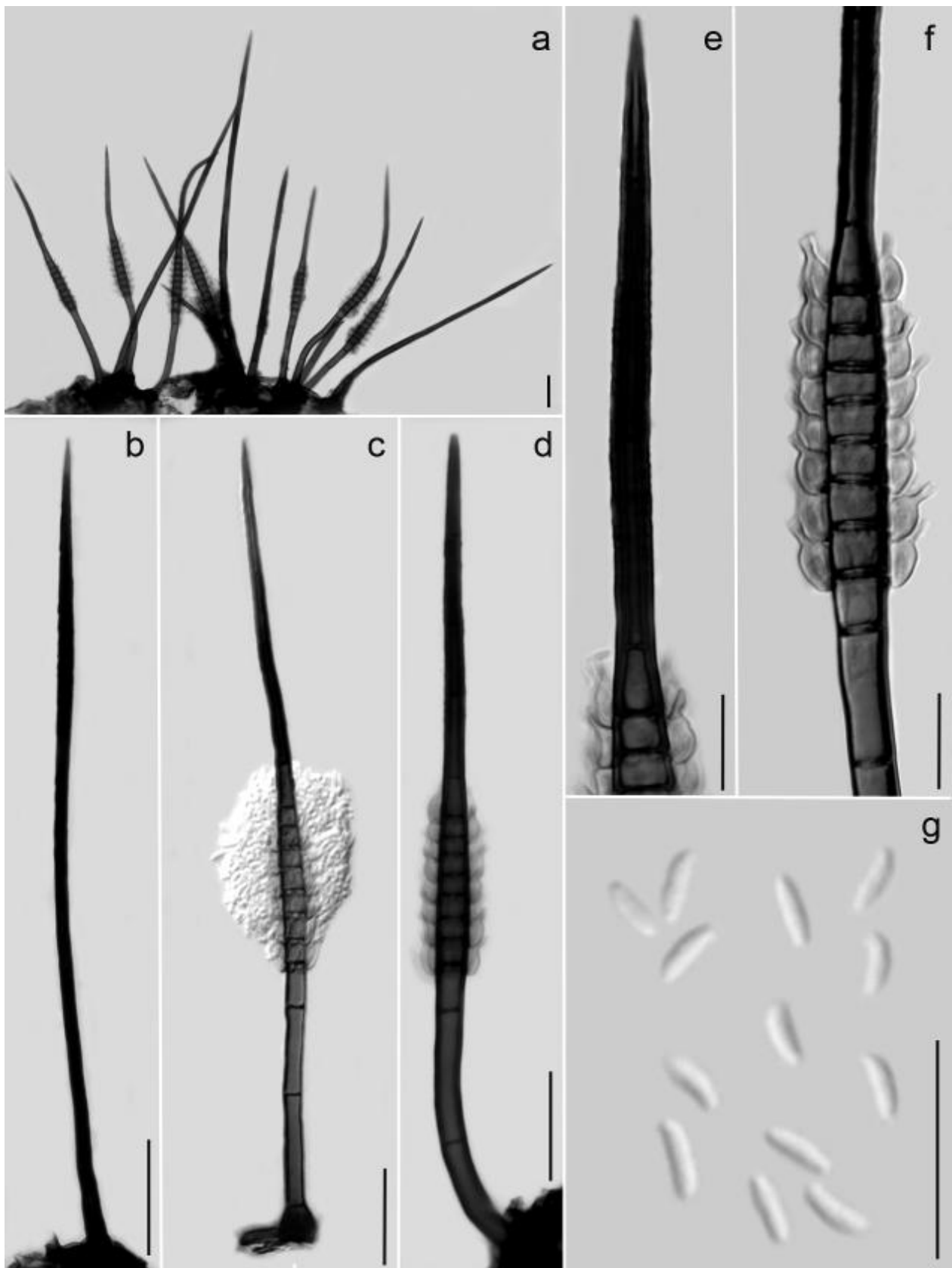


Fig. 1 – a–g *Zanclospora bonfinensis* a. General aspect. b. Setae. c, d. Conidiophores. e. Apex of the conidiophore. f. Fertile region. g. Conidia. Bars = 50 μm (b); 20 μm (a, c, d); 10 μm (e, f, g)

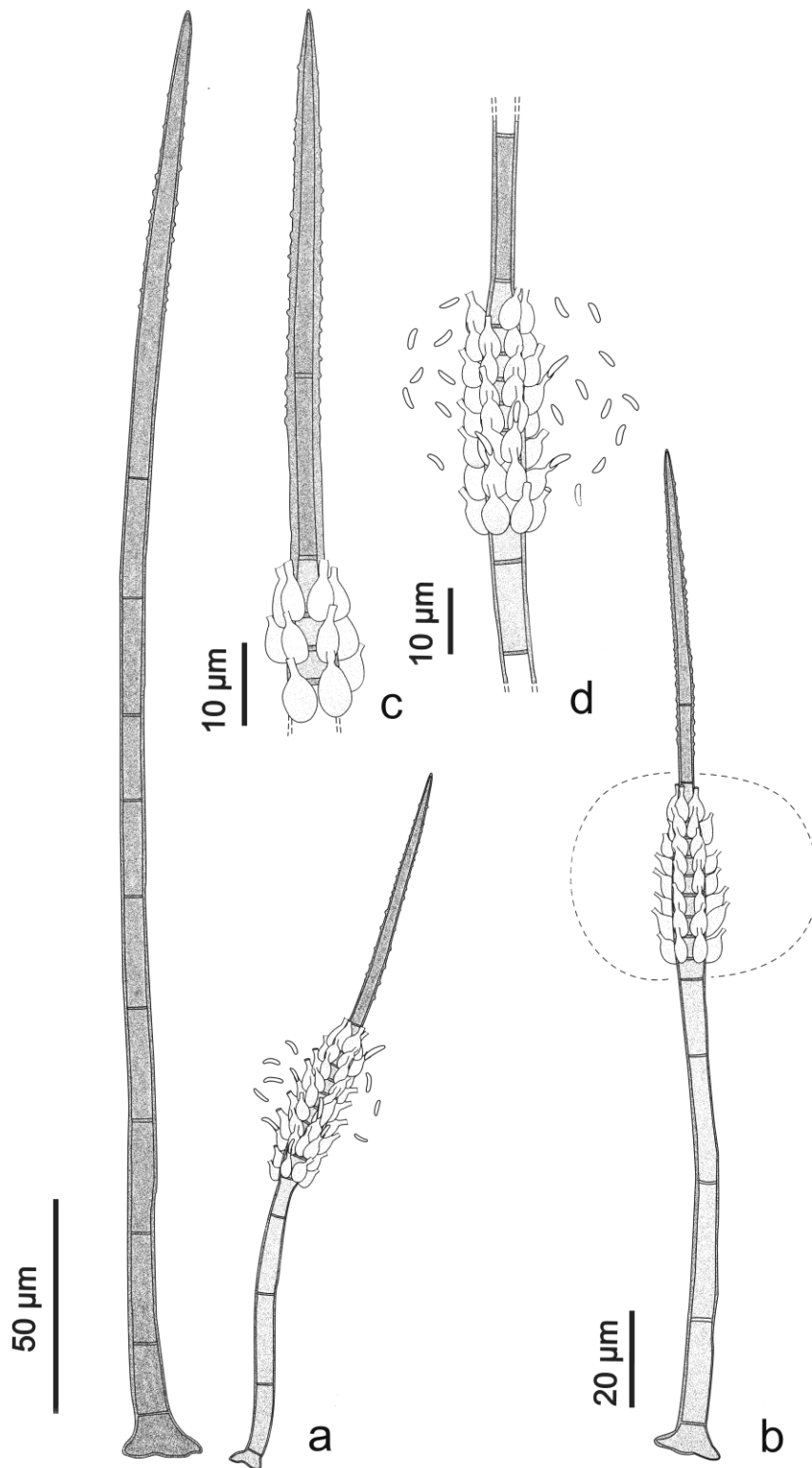


Fig. 2 – a–d *Zanclospora bonfinensis* a. General aspect. b. Conidiophore. c. Apex of the conidiophore. d. Fertile region and conidia.

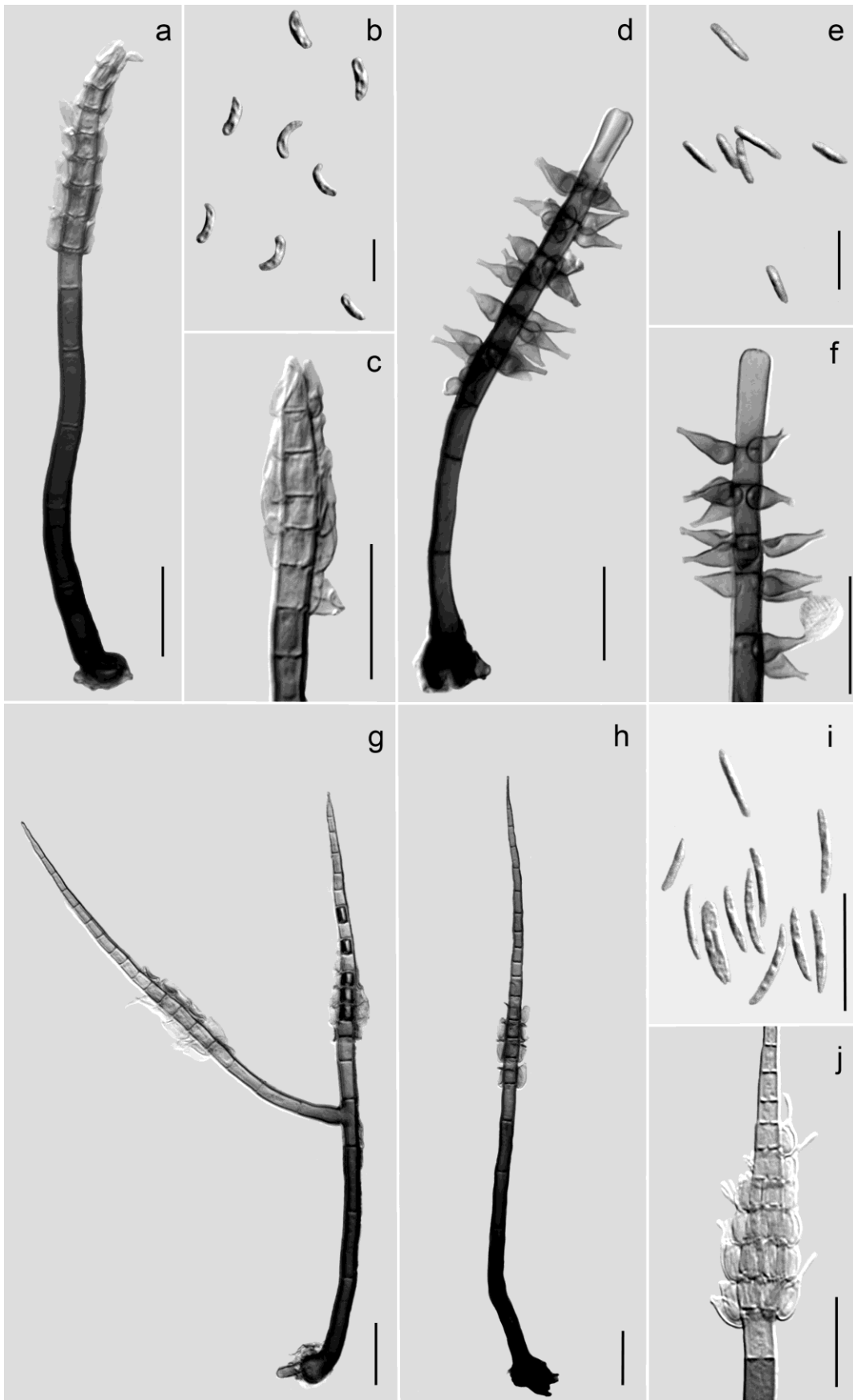


Fig. 3 – a–j *Zanclospora* spp. a–c. *Zanclospora brevispora* var. *brevispora*. a. Conidiophore. b. Conidia. c. Fertile region. d–f. *Zanclospora indica*. d. Conidiophore. e. Conidia. f. Conidiogenous cells. g–j. *Zanclospora novae-zelandiae*. g–h. Conidiophores. i. Conidia; j. Fertile region. Bars = 20 μm (a, c–d, f–j); 5 μm (b, e).

Key to species of *Zanclospora*:

1. Phialides divergent from the setiform conidiophore..... 2
- 1'. Phialides adpressed to the setiform conidiophore 3
2. Setiform conidiophores with bulbous apex, conidia bacilliform, $5.5\text{--}8 \times 0.5\text{--}1.0$ *Z. indica*
- 2'. Setiform conidiophores with pointed apex, conidia falcate, $4\text{--}6 \times 1\text{--}1.5$ *Z. urewieri*
3. Setiform conidiophores branched 4
- 3'. Setiform conidiophores unbranched or with fertile branches 5
4. Conidia bacilliform, $2\text{--}3.5 \times 0.5\text{--}1.5$ μm ; branches above the fertile region *Z. stellata*
- 4'. Conidia falcate, $12.5\text{--}16.5 \times 1.5\text{--}2.5$ μm ; branches on the fertile region *Z. mystica*
5. More than one fertile region *Z. austroamericana*
- 5'. Only one fertile region 6
6. Terminal or subterminal fertile zone 7
- 6'. Middle fertile zone 8
7. Conidia curved, $3.5\text{--}9.4 \times 1\text{--}2.1$ μm *Z. brevispora* var. *brevispora*
- 7'. Conidia straight to slightly curved, $8\text{--}10 \times 2.5$ μm *Z. brevispora* var. *transvaalensis*
8. Conidia falcate, $10\text{--}35 \times 1\text{--}3.5$ μm ; fertile region on branches *Z. novae-zelandiae*
- 8'. Conidia bacilliform, $3\text{--}5.5 \times 1$ μm ; conidiophores without fertile branches *Z. bonfinensis*

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