



Three *Chaetomium* species (Chaetomiaceae, Ascomycota) from the semi-arid region of Brazil

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Abstract – During surveys for decomposer ascomycetes of plant debris, three previously described species of *Chaetomium* were collected: *C. funicola*, *C. homopilatum*, and *C. longicolleum*. Descriptions, taxonomic comments, geographical distributions, and illustrations are presented for the species.

Additional key words: Bahia State, leaf litter, saprobic fungi, submerged wood, taxonomy.

Resumo (Três espécies de *Chaetomium* (Chaetomiaceae – Ascomycota) da região semiárida do Brasil) – Durante pesquisa com ascomicetos decompositores de substratos vegetais, três espécies de *Chaetomium* foram coletadas: *C. funicola*, *C. homopilatum* e *C. longicolleum*. São apresentadas descrições, comentários taxonômicos, distribuição geográfica e ilustrações para as espécies encontradas.

Palavras-chave adicionais: Bahia, fungos sapróbios, madeira submersa, serrapilheira, taxonomia.

Chaetomium Kunze is a widespread genus and possesses about 100 accepted species (Rodríguez et al. 2002; Kirk et al. 2008; Zhang et al. 2010). The species are characterized by having superficial ascomata attached to the substrate by rhizoidal hyphae and are usually covered with hairs or setae mainly surrounding a rather broad apical ostiolar pore. Ascospores are aseptate, brown or gray-olivaceous with one or two germ pores (Rodríguez et al. 2002). Some species of *Chaetomium* that have long necked ascomata and produce anamorphs comparable to species of *Botryotrichum* Sacc. & Marchal were transferred to the genus *Farrowia* D.Hawksw. (Hawksworth 1975). This taxonomic separation based on morphology is not supported with molecular data and has not been accepted by some mycologists (Untereiner et al. 2001).

Chaetomium species play a variety of biological and biotechnological roles in areas such as medical mycology (Zhang et al. 2010), biotechnology (Soni & Soni 2010), taxonomy (Arx et al. 1986; Wang & Zheng 2005), and molecular studies (Aggarwal et al. 2008), making it an important genus of Ascomycota. They are found on different substrates such as plant debris (Duncan & Eslin 1966; Gene & Guarro 1996; Chavarria et al. 2010), seeds (Cook 1969), dung (Lodha 1964), soil (Goos 1963; Pornsuriya et al. 2008), and in the air (Harvey et al. 1969). Only 14 species of *Chaetomium* have been reported from freshwater habitats so far (Shearer & Raja 2011) and approximately 12 species were reported for Brazil, from different states, including Alagoas, Bahia, Ceará, Distrito

Federal, Maranhão, Minas Gerais, Paraíba, Paraná, Pernambuco, Rio Grande do Sul, and São Paulo States (Grandi 1992; Silva & Minter 1995; Lima et al. 1997; Mendes et al. 1998; Strapasson et al. 2002; Silva Júnior & Pereira 2007).

During an on-going investigation of freshwater and terrestrial ascomycetes in the semi-arid region of Brazil, we found three additional taxa belonging to *Chaetomium* from submerged substrates (wood and leaf) and terrestrial leaf litter. This study will contribute to the knowledge of the taxonomy of ascomycetes in Brazil and will help broaden our understanding of their geographical distribution patterns.

MATERIALS AND METHODS

Submerged and terrestrial plant substrates were collected from Serra da Jibóia (12°51'S, 39°28'W) and Serra Negra do Norte (06°39'S, 37°24'W), in the Caatinga Biome, northeastern Brazil, and placed in plastic bags containing paper towels. In the laboratory, substrates were incubated in petri dishes with moistened paper towels at 25°C. Samples were examined periodically using a dissecting microscope. Ascospores were placed on glass slides containing PVL resin (polyvinyl alcohol, lactic acid, and phenol) or a drop of distilled water. The slides made using distilled water were preserved in glycerin following the double cover glass method of Volkmann-Kohlmeyer & Kohlmeyer (1996). Measurements and digital images were obtained using an Olympus microscope equipped with bright field and Nomarski interference optics and a Spot RT digital camera. Specimens were deposited in the herbarium of Feira de Santana State University (HUEFS).

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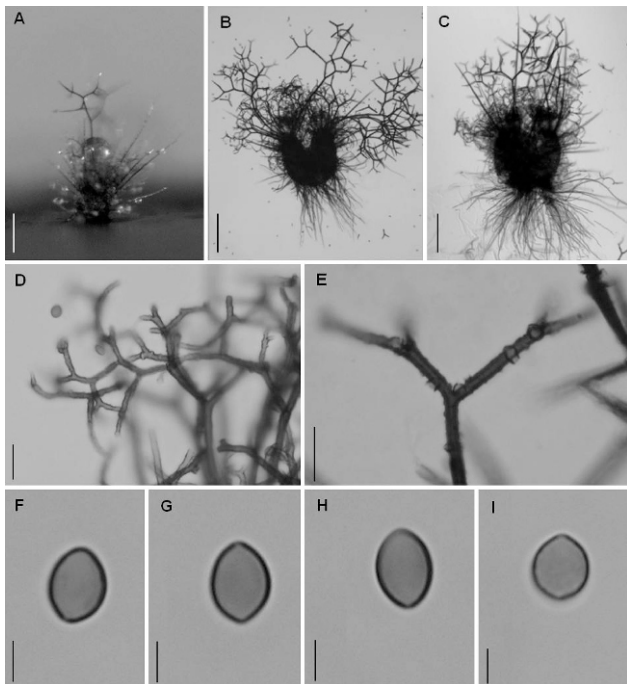
TAXONOMY

Chaetomium funicola Cooke, Grevillea 1(11): 176. 1873.
Figures A–I.

Ascomata 100–210 × 100–200 µm, superficial, solitary, hairy, globose to ovoid, brown; terminal hairs dichotomously branched forming a dense head, up to 4–5 µm wide at base, septate, verrucose, tapering at apex, brown; lateral hairs straight, up to 4–5 µm wide at base, septate, smooth or verrucose, spine-like, brown. **Peridium** composed of angular cells. **Paraphyses** not observed. **Asci** not observed. **Ascospores** 5–6 × 4–5 µm, smooth, aseptate, rather thin-walled, ovate, slightly apiculate at both ends with a distinct brown germ pore.

Material examined – BRAZIL. RIO GRANDE DO NORTE: Serra Negra do Norte, on plant debris, 16 May 2006, *S.M. Leão-Ferreira s.n.* (HUEFS 169133).

Known distribution. Brazil (Silva & Minter 1995), Canadá, Congo, Denmark, Germany, Japão, Nairobi (Ames 1961), Chile, Malaysia, Pakistan, Philippines, Poland, Tanzania (Farr & Rossman 2011), England (Cooke 1873), Ethiopia (Mengistu & Sinclair 1979), India (Rai et al. 1981), Japan (Matsushima 1975), Panama (Piepenbring et al. 2007), Papua New Guinea (Matsushima 1971), Spain (Márquez et al. 2007), United States of America (Shearer & Crane 1986)



Figures A–I. *Chaetomium funicola*: **A**–ascoma in culture; **B–C**– ascomata with characteristic hairs; **D–E**– details of the dichotomously branched, verrucose hairs; **F–I**– ascospores (Bars: A–C = 100 µm; D = 25 µm; E = 20 µm; F–I = 3 µm).

Comments. *Chaetomium funicola* is a widespread species and has been found as an endophyte of grass (Márquez et al. 2007), an opportunistic fungus causing cutaneous lesions (Piepenbring et al. 2007), a plant pathogen (Swarup et al. 1962), as a decomposer on plant

debris in soil (Matsushima 1971), and in dung of various animals (Ames 1961). Although *C. funicola* is common in terrestrial habitats, it has been previously reported from wood in fresh water from North America (Shearer & Crane 1986) and in a mangrove swamp from India (Rai et al. 1981).

The perithecial development of *C. funicola* was studied by Cook (1969) who observed that it does not present marked differences in the general *Chaetomium* pattern of development. Investigating the activity of plants extract against the growth of *C. funicola* in PET bottle, Sato et al. (2000) concluded that hot water and methanol extracts of five different plants showed high efficiency.

The collection from Rio Grande do Norte agrees well with other published descriptions (Cooke 1873; Ames 1961; Matsushima 1971, 1975; Arx et al. 1986). However, the description by Ames (1961) showed slightly smaller ascomata (130–160 × 130–160 µm) when compared with our material (100–210 × 100–200 µm). In Brazil, *C. funicola* has been previously recorded from Maranhão, Paraíba, and Pernambuco States (Silva & Minter 1995). This is the first record of *C. funicola* for Rio Grande do Norte.

Chaetomium homopilatum Omvik, Mycologia 47(5): 749. 1955.

Figures J–O.

Ascomata 150–206 × 84–120 µm, superficial, membranous, solitary, hairy, ovoid, brown; terminal hairs forming a dense tuft around the ostiole, up to 4 µm wide at base, septate, verrucose, tapering at apex, light brown; lateral hairs shorter, up to 4 µm wide at base and randomly distributed over the perithecium, light brown. **Peridium** composed of angular cells. **Paraphyses** not observed. **Asci** not observed. **Ascospores** 6–7 × 4.5–6 µm, discharged as a cirrus, smooth, aseptate, rather thin-walled, broadly oval, apiculate at both ends with a brown germ pore.

Material examined – BRAZIL. BAHIA: Santa Terezinha, Serra da Jibóia, on submerged wood, 5 Sep. 2007, *F.R. Barbosa & L.F.P. Gusmão s.n.* (HUEFS 158100).

Known distribution. Brazil (Silva & Minter 1995), Congo, China, Japan, United States (Arx et al. 1986), Greenland, Honduras (Ames 1961), Norway (Omvik 1955).

Comments. Our collection from Bahia State agrees with the protologue of *C. homopilatum* (Omvik 1955). However, the original description showed larger ascomata (242–345 × 127–196 µm) (Omvik 1955) when compared with our material (150–206 × 84–120 µm). *Chaetomium homopilatum* has been synonymized several times. Some synonymous species such as *C. distortum* L.M.Ames and *C. pinnatum* L.M.Ames differ from our collection in having branched hairs on the ascomata (Ames 1961). Another synonym, *C. brevopilium* L.M.Ames, shows straight hairs as noted in our collection (Ames 1961). *Chaetomium homopilatum* resembles *C. seminudum* L.M.Ames, but can be distinguished by its larger ascomata, dark colored, partly roughened hairs and smaller ascospores (Omvik 1955).

Chaetomium homopilatum can be found on different substrates, such as dung, leaves, wood, and soil in terrestrial

habitats (Arx et al. 1986). In Brazil, this species was found on *Saccharum officinarum* L., in Maranhão and Paraíba States (Silva & Minter 1995). Our material is the first record of *C. homopilatum* from freshwater habitats and from Bahia State.

Chaetomium longicolleum Krzemien. & Badura, Acta Soc. Bot. Pol. 23: 748. 1954.

Figures P–S.

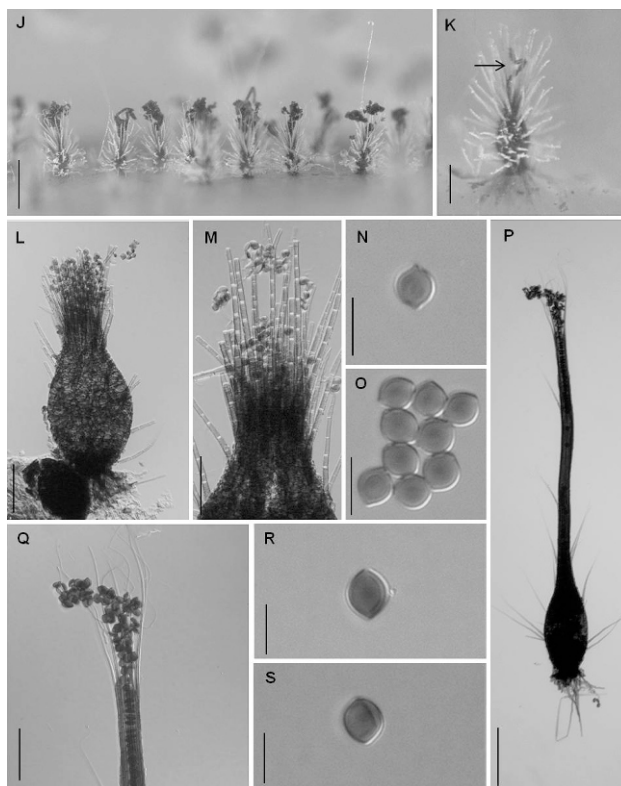
Ascomata up to $560 \times 73 \mu\text{m}$, superficial, membranous, solitary, hairy, vase-shaped, brown; terminal hairs surrounding the ostiole forming a channel through which a column of ascospores emerge from the perithecium, up to $3 \mu\text{m}$ wide at base, tapering at apex, septate, light brown. **Peridium** composed of angular cells. **Neck** up to $433 \times 22 \mu\text{m}$, cylindrical, straight, hairy; terminal hairs long, septate, forming a channel through which ascospores emerge from the ascoma. **Paraphyses** not observed. **Asci** not observed. **Ascospores** $8\text{--}10 \times 7\text{--}8 \mu\text{m}$, smooth, aseptate, thin-walled, limoniform, apiculate at both ends, brown.

Material examined – BRAZIL. BAHIA: Santa Terezinha, Serra da Jibóia, on submerged leaf, 12 Sep. 2007, F.R. Barbosa & L.F.P. Gusmão s.n. (HUEFS 158131).

Known distribution. Brazil (Grandi 1992), Congo (Meyer 1959), Costa Rica, Panama (Farrow 1955; Goos 1960), Honduras (Goos 1963), India (Agnihotrudu 1958), Japan (Matsushima 1975), Poland (Krzemieniewska & Badura 1954), Venezuela (Castañeda-Ruiz et al. 2003).

Comments. *Chaetomium longicolleum* is a species most commonly found in soil (Agnihotrudu 1958; Goss 1960, 1963), however, it has also been reported from leaf litter in Venezuela (Castañeda-Ruiz et al. 2003). This species was transferred to the genus *Farrowia*, typified by *F. longicollis* (Krzemien. & Badura) D.Hawksw., when Hawksworth (1975) established a new genus for members of the Chaetomiaceae with *Botryotrichum*-like anamorphs and long-necked ascomata. Nevertheless, many mycologists (Arx et al. 1986; Decock & Hennebert 1997; Castañeda-Ruiz et al. 2003) disagree with Hawksworth's concept of *Farrowia* and a molecular phylogenetic study using rRNA sequence data (Untereiner et al. 2001) did not support the recognition of *Farrowia* as a separate genus in the Chaetomiaceae.

The examined collection agrees in most aspects with published descriptions of the species (Farrow 1955; Ames 1961; Arx et al. 1986). However, our collection has smaller ascospores when compared with the description of *C. longicolleum* by Ames (1961) ($10\text{--}12 \times 9.5\text{--}10.5 \mu\text{m}$) and the original description of the synonym *Chaetoceratostoma longirostre* (Krzemien. & Badura) Badura ($8.9\text{--}12 \times 8.5\text{--}10.2 \mu\text{m}$) (Farrow 1955). In addition, the species described by Farrow (1955) had longer necks ($1012\text{--}2080 \times 34\text{--}36 \mu\text{m}$). *Chaetomium longicolleum* is morphologically similar to *C. cuyabenoensis* Decock & Hennebert and *C.*



Figures J–O. *Chaetomium homopilatum*: J- ascomata in culture; K- detail of ascoma in culture with a long cirrus (arrow); L- ascoma; M- details of the terminal hairs; N–O- ascospores. **P–S.** *C. longicolleum*: P- ascoma; Q- terminal hairs forming a channel; R–S- limoniform ascospores (Bars: J = 250 μm ; K, P = 100 μm ; L, M, Q = 50 μm ; N, O, R, S = 10 μm).

malaysiense (D.Hawksw.) Arx. All species have the same type of long neck. However, the ascospores are strongly limoniform to quadrangular in face view in *C. cuyabenoensis* (Decock & Hennebert 1997), and the neck is much shorter in *C. malaysiense* (Arx et al. 1986).

Our collection from Bahia State and other tropical areas suggests that *C. longicolleum* is widespread in tropical regions. This species was previously found from Brazil on dead root of *Euterpe edulis* Mart. and *Calathea zebrina* (Sims) Lindl. from São Paulo State (Grandi 1992). Here, we report *C. longicolleum* for the first time from a freshwater habitat in the Bahia State.

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