



New species of *Asterina* and *Balladyna* (black mildew fungi) from Mahabaleshwar, Maharashtra, India

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Abstract

Two new black mildew fungal species, *Asterina rubiacearum* sp. nov. and *Balladyna canthiigena* sp. nov., which infect the leaves of *Canthium dicoccum* var. *umbellatum* (Rubiaceae) are described from Mahabaleshwar, Maharashtra (India). Taxonomic descriptions, photomicrographs, line drawings and comparative account of close associate species are provided.

Keywords: 2 new species, *Asterina*, asterinaceous, *Balladyna*, meliolaceous

Introduction

India has a rich diversity of black mildew fungi with about 1159 taxa reported. Many of the black mildews belong to the meliolaceous and asterinaceous fungi with 745 and 300 taxa, respectively, in the world (Hosagoudar 1999, 2008). These fungi are characterised by forming black, ectoparasitic, superficial colonies on the host leaf surface. They are host specific in nature producing septate branched hyphae with appressoria; ascospores develop inside the thyriothecia or perithecia (Hosagoudar 2012). The family Rubiaceae is infected by many of these fungi. Especially so the genus *Canthium* on which eleven meliolaceous fungi, two asterinaceous fungi and five species of *Balladyna* have been reported (Hosagoudar 2013).

During the exploration of foliicolous fungi from Mahabaleshwar and its adjoining forest area (located in Satara District, Maharashtra State, India), a new species of *Asterina* and another of *Balladyna* were discovered on *Canthium*. These two new species are presented here with detailed description and illustration and they are compared with their closely related taxa.

The species of *Asterina* and *Balladyna* were collected from various localities in the study area during several field trips in 2012–2014. The host plant was identified with the aid of flora of Maharashtra and prepared as herbarium material (Hosagoudar 2004). The dried leaf material was processed to observe fungal specimen and after critical examination, the fungi were identified as new species by using standard literature (Hosagoudar 2009, Deshpande *et al.* 1995, Farr & Rossman 2014). The new species were deposited in Herbarium Cryptogamae Indiae Orientalis (HCIO), IARI, New Delhi (India). Biometric data was recorded with at least 20 measurements of structures; illustrations were prepared with Camera Lucida and photomicrographs taken using a digital camera attached to a Leica DM2000 fluorescence microscope.

Taxonomy

Asterina rubiacearum M.R. Bhise, C.R. Patil, C.B. Salunkhe & S.V. Kambhar *sp. nov.* (Fig. 1) MycoBank: MB 811797.

Colonies amphigenous, dark black, circular to spreading, dense to sparse, confluent, up to 9 mm diameter, forming dark brown blotches below the colony. Hyphae dark brown, straight to undulate, branching opposite to alternate, mostly alternate at wide angles, loosely reticulate. Hyphal cells $24\text{--}32 \times 7 \mu\text{m}$. Appressoria alternate to unilateral, moderately placed, unicellular, subglobose to shallowly lobed, margin rough, $6\text{--}12 \times 7\text{--}14 \mu\text{m}$. Thyriothecia scattered on mycelium, globose to orbicular, stellately dehisced at the center, margin fimbriate with fringed hyphae, up to 238 μm diameter. Asci numerous, initially globose, ovate at maturity, 8-spored, $47\text{--}55 \times 32\text{--}41 \mu\text{m}$. Ascospores oblong, conglobate, olivaceous brown, uniseptate, deeply constricted at the septum, upper cell obovate, lower globose, $31\text{--}38 \times 14\text{--}19 \mu\text{m}$, wall smooth.

Type:—INDIA. Maharashtra: Satara, Mahabaleshwar, Machutar-Tetawali, on leaves of *Canthium dicoccum* var. *umbellatum* (Wight) Sant. & Merch. (Rubiaceae), 11 December 2013, Bhise M.R., MHB0406 (b), holotype (HCIO 51666).

Additional specimens examined:—INDIA. Maharashtra: Satara, Mahabaleshwar, Linghmal, on leaves of *Canthium dicoccum* var. *umbellatum*, 22 December 2012, Bhise M.R., MHB0071, HCIO 51665; Kharoshi, Mahabaleshwar, 7 February 2014, Bhise M.R., MHB0532, HCIO 51667.

Etymology:—the specific epithet refers to the host plant family Rubiaceae.

Notes:—*Asterina canthiigena* Hosag., Archana & Agarwal and *A. canthii-dicocci* Hosag. are known on *Canthium* sp. from Karnataka, India, but are not reported from elsewhere (Hosagoudar 2012). *Asterina rubiacearum* differs from these two species and closely related species in having larger size colonies, forming dark brown blotches below the colony; single-celled and smaller appressoria, and larger thyriothecia, asci and ascospores (Table 1). Hence, *A. rubiacearum* is proposed as a new species.

TABLE 1. Comparison of *Asterina rubiacearum* with *A. canthii-dicocci* and *A. canthiigena*.

Characters	<i>A. canthiigena</i>	<i>A. canthii-dicocci</i>	<i>A. rubiacearum</i>
Host plant	<i>Canthium</i> sp.	<i>Canthium dicoccum</i>	<i>C. dicoccum</i> var. <i>umbellatum</i>
Colonies	Amphigenous, up to 2 mm diam.	Amphigenous, up to 2 mm diam.	Amphigenous, up to 9 mm diam.
Hyphae	Substraight to flexuous, cells $8\text{--}29 \times 3\text{--}5 \mu\text{m}$	Straight, cells $32\text{--}36 \times 5\text{--}7 \mu\text{m}$	Straight to undulate, cells $24\text{--}32 \times 7 \mu\text{m}$
Appressoria	Two-celled, oblong, angular to sublobate, $9\text{--}19 \mu\text{m}$ long	Single-celled, ovate, oblong, cylindrical, often attenuated at the apex, $11\text{--}16 \times 8\text{--}10 \mu\text{m}$	Single-celled, subglobose to shallowly lobed, $6\text{--}12 \times 7\text{--}14 \mu\text{m}$
Thyriothecia	Up to 176 μm	Up to 160 μm	Up to 238 μm
Asci	Globose to slightly ovate, up to 25 μm diam.	Globose, up to 35 μm diam.	Initially globose, ovate at maturity, $47\text{--}55 \times 32\text{--}41 \mu\text{m}$
Ascospores	$16\text{--}27 \times 8\text{--}11 \mu\text{m}$	$20\text{--}22 \times 11\text{--}13 \mu\text{m}$	$31\text{--}38 \times 14\text{--}19 \mu\text{m}$
Anamorphic stage	Present	Absent	Absent

Asterina rubiacearum is associated with *Balladyna canthiigena* *sp. nov.*, *Meliola longiseta* Höhnelt and *M. plectroniae* Hansf., which are also growing on the leaves.

Balladyna canthiigena M.R. Bhise, C.R. Patil, C.B. Salunkhe & S.V. Kambhar *sp. nov.* (Fig. 2) MycoBank: MB 811800.

Colonies amphigenous, mostly hypophyllous, dark brown, effused, dense velvety at center, circular to spreading, confluent, up to 13 mm in diameter. Hyphae pale brown, straight to flexuous, branching opposite to alternate at acute to wide angles, closely reticulate, hyphal cells $13\text{--}36 \times 5\text{--}7 \mu\text{m}$. Appressoria alternate to unilateral, moderately placed, antrorse to recurved, unicellular, oblong, elongate to variously curved, $13\text{--}19 \times 5\text{--}7 \mu\text{m}$. Mycelial setae numerous,

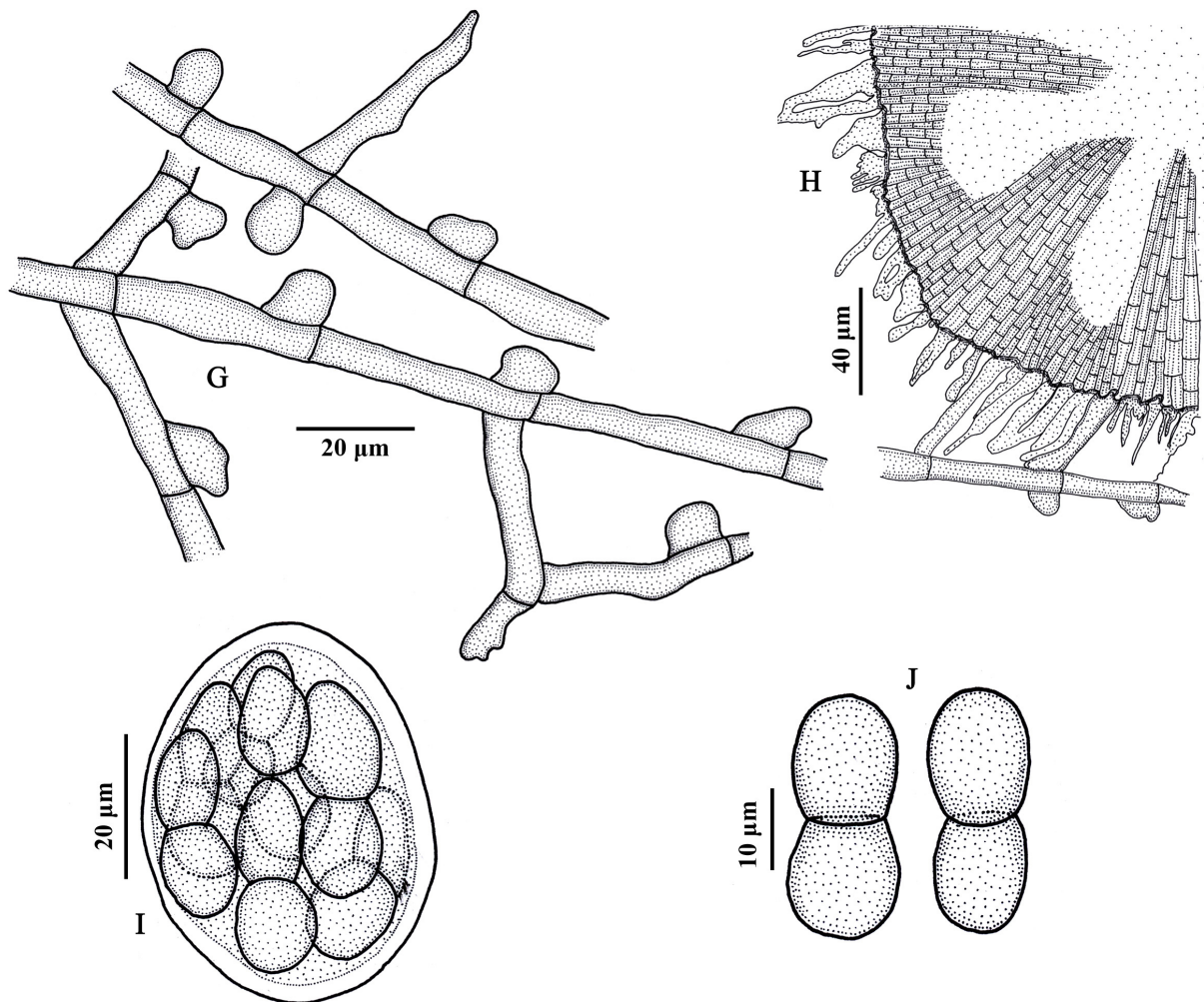
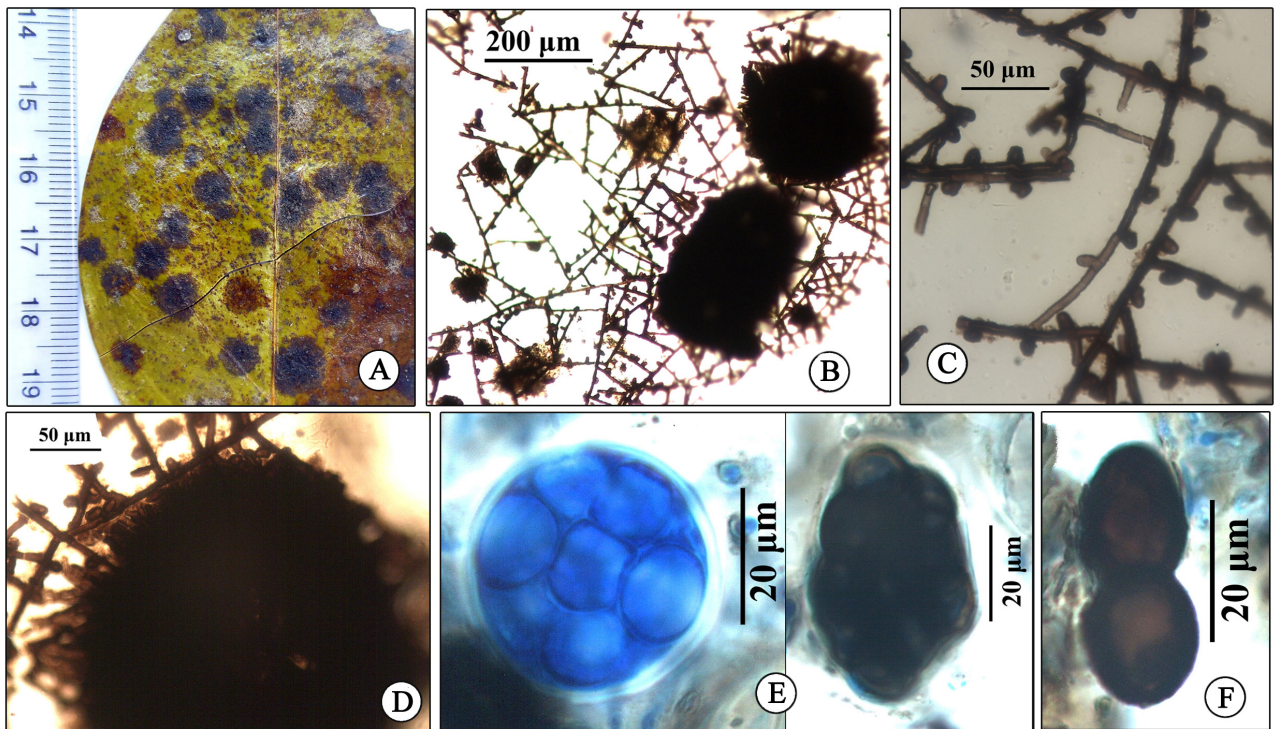


FIGURE 1. Illustration of *Asterina rubiacearum* M.R. Bhise, C.R. Patil, C.B. Salunkhe & S.V. Kambhar. (A) Infected Leaf, (B) Mycelial Colony with thyriothecia, (C) & (G) Appressoriate mycelium, (D) & (H) Part of thyriothecium, (E) & (I) Ascus, (F) & (J) Ascospores. Illustrated by Mahendra R. Bhise

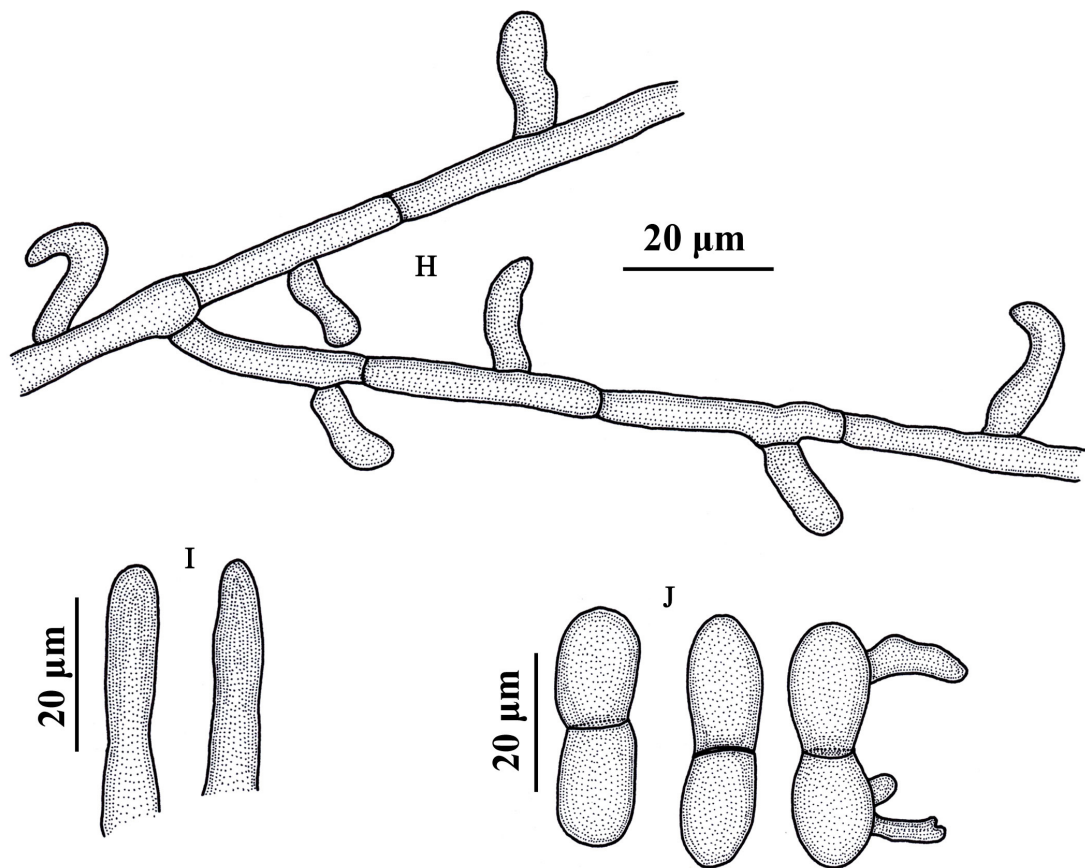
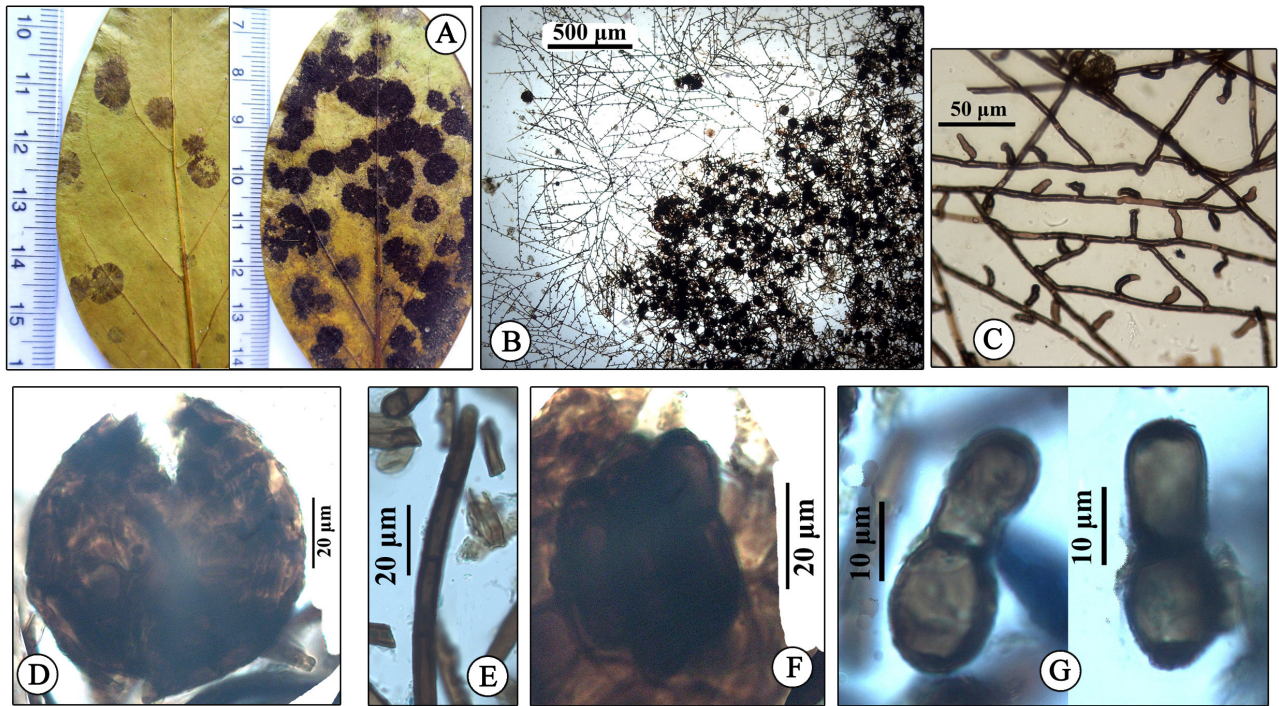


FIGURE 2. Illustration of *Balladyna canthiigena* M.R. Bhise, C.R. Patil, C.B. Salunkhe & S.V. Kambhar. *Balladyna canthiigena*. (A) Infected Leaves, (B) Mycelial Colony with perithecia, (C) & (H) Appressoriate mycelium, (D) Perithecium, (E) & (I) Mycelial setae, (F) Ascus, (G) & (J) Ascospores. Illustrated by Mahendra R. Bhise

distinctly at the center of colony and aggregated along perithecia, absent on peripheral hyphae, simple, straight, closely scattered, septate, apex obtuse, up to 130 µm long. Perithecia numerous, closely scattered at the center of colony, globose to orbicular, ostiolate, slightly verrucose at margin, up to 120 µm in diameter. Asci globose to obovoid, evanescent, rarely seen, octosporous, up to 66 µm in diameter. Ascospores cylindrical, oblong to capsulate, olivaceous brown, uniseptate, slightly constricted at septum, upper cell cylindrical, lower subglobose, rounded at both end, 30–33 × 9–11 µm, wall smooth.

Type:—INDIA. Maharashtra: Satara, Mahabaleshwar, Wilson point, on leaves of *Canthium dicoccum* var. *umbellatum* (Rubiaceae), 19 October 2013, Bhise M.R., MHB0344 (b), holotype (HCIO 51669).

Additional specimen examined:—INDIA. Maharashtra: Satara, Mahabaleshwar, Birmani-Bhairijogeshwari, on leaves of *Canthium dicoccum* var. *umbellatum*, 10 December 2013, Bhise M.R., MHB0376 (c), HCIO 51670.

Etymology:—the specific epithet refers to the host genus.

Notes:—*Balladyna magnifica* (Sydow) Hansf. and *B. tenuis* Hansf. are known on *Canthium globgensis* and *C. vulgare*, respectively, from Africa (Hosagoudar 2004), and *B. indica* Hosag. is known on unidentified Rubiaceae from India (Hosagoudar 2009). *Balladyna canthiigena* differs from these species and closely related species in having larger velvety colonies, mycelial setae and perithecia distinctly formed only at the center of colony and absent on peripheral hyphae; larger sized hyphal cells, perithecia and ascospores; and distinctly cylindrical to capsulate and slightly constricted ascospores (Table 2). Therefore, *Balladyna canthiigena* is treated as a new species.

Balladyna canthiigena is associated with *Asterina rubiacearum*, *Meliola longiseta* and *M. plectroniae*, which are also growing on the leaves.

TABLE 2. Comparison of *Balladyna canthiigena* with *B. magnifica*, *B. tenuis*, and *B. indica*.

Characters	<i>B. magnifica</i>	<i>B. tenuis</i>	<i>B. indica</i>	<i>B. canthiigena</i>
Host plant	<i>Canthium globgensis</i>	<i>C. vulgare</i>	Unidentified Rubiaceae	<i>C. dicoccum</i> var. <i>umbellatum</i>
Colonies	Amphigenous, velvety, up to 4 mm diam.	Amphigenous, up to 4 mm diam.	Hypophyllous, up to 10 mm diam.	Amphigenous, dense velvety at center, up to 13 mm diam.
Hyphae	Cells 4–5 µm wide	Straight to flexuous, cells 15–25 × 4–5 µm	Straight to substraight, cells 19–36 × 6–8 µm	Straight to flexuous, cells 13–36 × 5–7 µm
Appressoria	Entire to sinuately lobate, 4–7 × 8 µm	Entire to sublobate, 10–12 × 4–6 µm	Oblong to cylindrical, straight to curved, 11–20 × 6–8 µm	Oblong, elongate to cylindrical, straight to curved, 13–19 × 5–7 µm
Mycelial setae	Scattered, 90–140 µm long	Scattered, up to 120 µm long	Scattered on mycelium, up to 144 µm long	Numerous, closely scattered at center of colony and aggregated along perithecia, absent on peripheral hyphae, up to 129 µm long
Perithecia	Scattered on mycelium, 70–80 × 40–55 µm	Scattered on mycelium, 60–90 × 55–75 µm	Scattered on mycelium, up to 100 µm	Numerous, closely scattered at center of colony, up to 119 µm
Asci	Ovate to oblong, 40–60 × 25–30 µm	Elliptical, 50 × 20 µm	Not seen	Evanescent, up to 66 µm diam.
Ascospores	Oblong, clavate, slightly constricted, 19–22 × 7 µm	Ellipsoidal, constricted at septum, 20–22 × 6–8 µm	Oblong, strongly constricted, 30–32 × 15–17 µm	Cylindrical, oblong to capsulate, slightly constricted, 30–33 × 9–11 µm

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