

**Some *Coniophoraceae* (Basidiomycetes, Boletales)
from the Ethiopian highlands: *Coniophora
bimacrospora*, *sp. nov.* and a note on the phylogenetic
relationships of *Serpula similis* and *Gyrodontium***

François-Xavier CARLIER^a, Adane BITEW^b, Gabriel CASTILLO^c
and Cony DECOCK^{d1}

^aUnité de Phytopathologie (FYMY),
Faculté d'Ingénierie Biologique, Agronomique et Environnementale,
Croix du Sud 3, B-1348 Louvain-la-Neuve, Belgique.

^bSchool of Medical Laboratory Technology,
University of Addis Ababa, P.O. Box 1176, Addis Ababa, Ethiopia.

^cLaboratoire d'Algologie, de Mycologie et de Systématique Expérimentale,
Département de Biologie Végétale, (B22),
Université de Liège, 4000 Liège, Belgique.

^dMycothèque de l'Université catholique de Louvain (MUCL², MBLA),
Faculté d'Ingénierie Biologique, Agronomique et Environnementale,
Croix du Sud 3, B-1348 Louvain-la-Neuve, Belgique
(decock@mbla.ucl.ac.be).

Abstract – *Coniophora bimacrospora*, *sp. nov.* is described from the Ethiopian highlands. The taxon is mainly characterized by an olive green hymenial surface, bi-spored basidia, and large, averaging $20 \times 15 \mu\text{m}$, ellipsoid to broadly ovoid, brownish, cyanophilous, and dextrinoid basidiospores. It is compared to some other *Coniophora* reported from Africa. *Coniophora puteana*, *C. olivacea*, *Serpula similis*, and *Gyrodontium sacchari* are also reported from the Ethiopian highlands. The phylogenetic relationships between *S. similis*, *G. sacchari*, and other *Coniophoraceae* are briefly discussed.

Africa / *Coniophoraceae* / *Gyrodontium* / *Serpula* / taxonomy

Résumé – *Coniophora bimacrospora* *sp. nov.* est décrite à partir d'un spécimen collecté dans les hauts plateaux éthiopiens. L'espèce est caractérisée par un hyménium à teinte vert-olive prédominante (olive pale à foncé), des basides bisporées, et des basidiospores de grande taille, atteignant en moyenne $20.2 \times 14.8 \mu\text{m}$, ellipsoïdes à largement ovales, brunes, cyanophiles, et dextrinoïdes. Les espèces *Coniophora puteana*, *C. olivacea*, *Serpula similis*, et *Gyrodontium sacchari* sont également reportées pour les hauts plateaux éthiopiens.

Afrique / *Coniophoraceae* / *Gyrodontium* / *Serpula* / taxonomie

1. Corresponding author.

2. MUCL is a part of the Belgian Coordinated Collections of Microorganisms, BCCM.

INTRODUCTION

During a survey of wood-inhabiting fungi from the Ethiopian highlands, several species of *Coniophoraceae* Ulbr. *sensu* Donk (1964) were collected, among which a peculiar species of *Coniophora* DC. ex Mérat. The latter was characterized by the combination of a smooth, mainly olive green to dark olive green hymenial surface, bi-spored basidia, and remarkably large, averaging $20 \times 15 \mu\text{m}$, ellipsoid to broadly ovoid, rarely subglobose, and dextrinoid basidiospores. No other described *Coniophora* presents those peculiar features (Gilbertson & Hemmes 1997, Ginns 1982, Telleria 1984, 1991) and the species is described below as *Coniophora bimacrospora* Decock, Bitew et Castillo, *sp. nov.* It is compared with *C. puteana* (Schum.: Fr.) P. Karst., *C. olivacea* (Fr. : Fr.) P. Karst., both also collected in the Ethiopian highlands, and *C. fusispora* (Cke & Ell.) Sacc.

Other *Coniophoraceae sensu* Donk (1964) recorded for the area are *Serpula similis* (Berk. & Br.) Ginns (Ginns 1971) and *Gyrodontium sacchari* (Spreng.: Fr.) Hjortstam (Hjortstam 1995).

Preliminary phylogenetic relationships of *S. similis* and of *G. sacchari* with other *Coniophoraceae sensu* Donk (1964) were inferred from parsimony analysis of partial nuclear ribosomal large subunit DNA sequence data. The results are presented and briefly discussed.

MATERIALS AND METHODS

Morphology. Specimens are preserved at LG, MUCL, and O (herbarium acronym are from Holmgren *et al.*, 1990) and the herbarium of the University of Addis Ababa. Specimens were examined in Melzer's reagent, Lactic acid Cotton blue (Kirk *et al.* 2000), and KOH 4%. Colors are described according to Kornerup & Wanscher (1981). All microscopic measurements were done in Melzer's reagent. In presenting the size range of microscopic elements, 5 % of the measurements were excluded at each end and are given in parentheses, when relevant. \bar{x} = arithmetic mean, R = the ratio of length/width of basidiospores, and \bar{x}_R = arithmetic mean of the ratio R. Nuclear ribosomal large subunit is abbreviated in the text nrLSU.

Molecular. Cultures were grown in liquid malt (2%) or liquid cherry media (Untereiner *et al.* 1998) at 25°C, in the dark. DNA was extracted from freshly collected mycelium, following the protocol of Lee *et al.* (1988) and purified with GeneClean® III kit (Q-Biogene), following the manufacturer's recommendations. The primers pair LROR-LR6 (biology.duke.edu/fungi/mycology/primers) was used to amplify the 5' end of the nr LSU DNA regions. Successful PCR reactions resulted in a single band observed on a 0.8 % agarose gel, corresponding to approximately 1200 bps. PCR-products were cleaned using the QIAquick® PCR purification kit (250) (QUIAGEN Inc.), following the manufacturer's protocol. Sequencing reactions were performed using CEQ DTCS Quick Start Kit® (Beckman Coulter), according to the manufacturer's recommendations with the primers LROR, LR3, LR3R, LR5, LR6 (biology.duke.edu/fungi/mycology/primers). Nucleotide sequences were determined with a CEQ 2000 XL capillary automated sequencer (Beckman Coulter). Nucleotide sequences were initially automatically aligned with Clustal X for Macintosh (version 1.5b), then manually adjusted as necessary with the editor in PAUP* (version 4.0b10, Swofford 2002).

Table 1. Species used in the phylogeny analysis with their accession number in GenBank.

<i>Species</i>	<i>Genbank accession no.</i>	<i>MUCL no.</i>
<i>Serpula lacrymans</i> (Wulf. : Fr.) Schroet.	AF098402	
<i>Serpula lacrymans</i>	AY491667	30710
<i>Serpula lacrymans</i>	AY491668	34572
<i>Serpula similis</i> (Berk. & Br.) Ginns	AY491669	43394
<i>Serpula similis</i>	AY491670	43280
<i>Serpula similis</i>	AY491671	44771
<i>Serpula incrassata</i> (Berk. & M.A. Curtis) Donk	AY491672	30791
<i>Serpula incrassata</i>	AY491673	30792
<i>Serpula himantioides</i> (Fr.: Fr.) P. Karst.	AY491674	38575
<i>Serpula himantioides</i>	AY491675	38979
<i>Leucogyrophana mollusca</i> (Fr.) Pouz.	AF098381	
<i>Leucogyrophana mollusca</i>	AY491676	40638
<i>Leucogyrophana pinastri</i> (Fr.) Ginns & Weres.	AY491677	31050
<i>Serpula pulverulenta</i> (Fr.) Bond.	AF352045	
<i>Coniophora puteana</i> (Schum.: Fr.) P. Karst.	AF098337	
<i>Coniophora olivacea</i> (Fr.: Fr.) P. Karst.	AF098376	
<i>Coniophora arida</i> (Fr.) P. Karst.	AF098375	
<i>Coniophora marmorata</i> Desm.	AF352038	
<i>Gyrodontium sacchari</i> (Spreng.: Fr.) Hjortstam	AY491678	40589
<i>Gyrodontium sacchari</i>	AY491679	41573
<i>Gyrodontium sacchari</i>	AY491680	42726
<i>Paxillus involutus</i> (Batsch: Fr.) Fr.	AF167701	
<i>Paxillus filamentosus</i> Fr.	AF167681	
<i>Paxillus vernalis</i> Watling	AF167685	
<i>Austropaxillus infundibuliformis</i> (Clé.) Bresinsky & Jarosch	AF098393	
<i>Tapinella panuoides</i> (Fr.) Gilbert	AF098394	
<i>Tapinella atrotomentosa</i> (Batsch: Fr.) Šutara	AF098395	
<i>Suillus sinuspaulianus</i> (Pomerleau & A.H. Smith) Dick & Snell	AF071536	
<i>Suillus viscidus</i> (L.: Fr.) Imazeki	AF098396	
<i>Gyrodon lividus</i> (Bull.) Fr.	AF098378	
<i>Gymnopaxillus nudus</i> Claridge, Trappe & Castellano	AY177266	
<i>Pseudomerulius aureus</i> (Fr.: Fr.) Jülich	AY293207	
<i>Agaricus arvensis</i> Schaef.: Fr.	U11910	

Phylogenetic analysis of the aligned sequences was performed using the maximum parsimony method of PAUP* version 4.0b10 (Swofford 2002). Gaps were treated as fifth base. Optimal trees were identified using heuristic searches, and further evaluated by bootstrap analysis, retaining clades compatible with the 50% majority-rules in the bootstrap consensus tree.

Accession numbers for sequences obtained from and deposited in GenBank are included in Table 1.

RESULTS

To assess the phylogenetic relationships of *S. similis* with other species of the genus and of *Gyrodontium* Pat. within the *Coniophoraceae sensu* Donk (1964), a phylogenetic analysis based on partial ribosomal LSU (28S) DNA sequences

was undertaken. Our partial LSU data matrix originally contained 969 characters, including gaps, for 32 sequences (strains), (Table 1). However, the *S. similis* sequences contained a single insertion of 35 bps that was recoded as a single event. Furthermore, 39 ambiguously aligned positions were removed for the analysis, resulting in a final data matrix of 895 characters, gaps included.

A heuristic search with 20,000 random additions produced one single most parsimonious tree (MPT), 792 steps in length (CI = 0.553, RI = 0.745). The bootstrap consensus tree (500 replications) differed slightly from the single MPT in the position of several terminal clades including the relative position of *S. incrassata* (Berk. & M.A. Curtis) Donk and *Hydnomerulius pinastris* (Fr.) Jarosch & Besl (*Leucogyrophana pinastris* (Fr.) Ginns & Weres.).

TAXONOMY

Coniophora DC. ex Mérat, Nouv. Fl. Env. Paris 2nd ed., vol. I: 36, 1821.

Type species: *Coniophora puteana* (Schum.: Fr.) P. Karst., Not. Saell. Fauna Fl. Fenn. Førh. 9: 370, 1868.

For descriptions and discussions of the genus and species, See Ginns (1982) and Hallenberg & Eriksson (1985).

Coniophora is well characterized by resupinate basidiomes, mostly clamp generative hyphae with, however, scattered verticillate clamps connection, especially in the wide marginal hyphae (and also in other parts of the basidiome but are then much more difficult to observe), and brown, cyanophilous, variably dextrinoid, thick- and double-walled basidiospores with a small apical germ pore, the latter resulting from a local thinning of the wall (Ginns & Kokko 1976). The genus so far contains 18 species (and 2 varieties), all but three (Gilbertson & Hemmes 1997, Telleria 1984, 1991) being described in much details in Ginns (1982).

Three species have, so far, been encountered in the Ethiopian Highlands, viz. *C. puteana* (Schum.: Fr.) P. Karst. (Bitew 2002), *C. olivacea* (Fr.: Fr.) P. Karst., and *C. bimacrospora*, described below.

Coniophora bimacrospora Decock, Bitew et Castillo, *sp. nov.* Figs. 1-6.

Basidiomata effusa, resupinata, margine albida vel cremea, fimbriata; hymenii superficies laevis, (cremea), pallide olivacea ad atro-olivacea; systema hypharum monomiticum; hyphae hyalinae vel pallido brunneae, pro parte maxima simpliciter septatae, aliquot uni- vel multifibulatae; cystidia nulla; basidia 55-100 µm longa, 6.0-8.0(-10.0) µm lata, cum 2 sterigmatibus; basidiosporae ellipsoidae vel ovoidae, vel subgloboasae, crassitunicatae, brunneae, dextrinoideae, cyanophilae, poro germinativo apicale, (18.0-)18.0-22.5(-24.0) × (12.5-)13.0-16.0(-17.5) µm (\bar{x} = 20.2 × 14.8 µm), \bar{x}_R = (1.1-)1.2-1.5(-1.6).

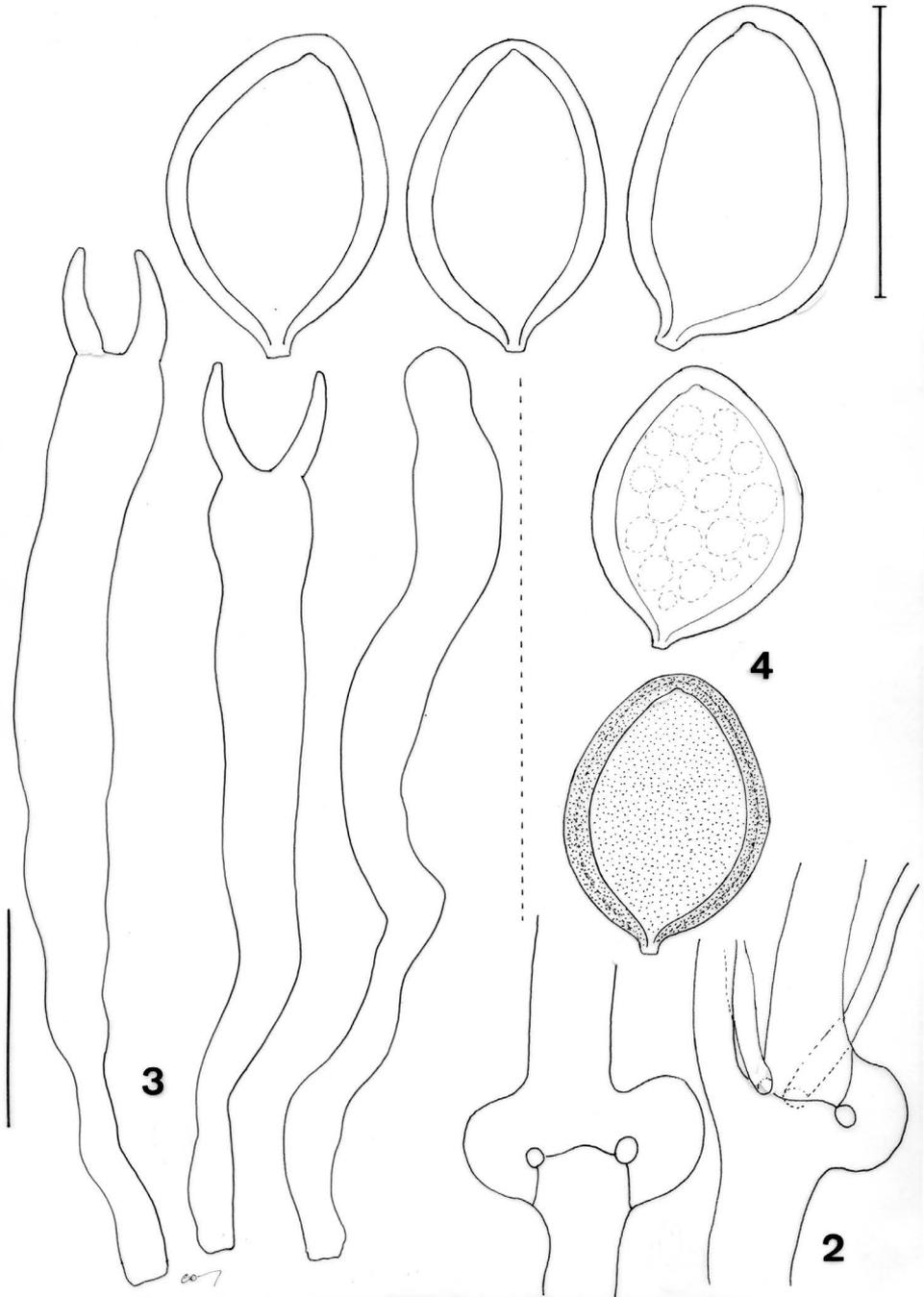
Basidiome resupinate, effused, adnate, reaching 160 × 40 mm, up to 200-400 µm thick in section; **margin** narrow and well delimited, 0.5-1 mm wide, or more effused, up to 3-4 mm wide, whitish to pale cream, with some patches of pale violet (18A2, violet white), contrasting with the darker hymenial surface, slightly fimbriate at the very margin, the hyphae then clearly separated under the stereomicroscope (40x); **hymenial surface** smooth, at first pallid, creamy, soon pale yellowish olive, olive to dark olive, (3-4)E(6-7) to 4F(5-7) (olive green to olive brown), to very dark olive where the basidiospore deposit is dense, up to dark yel-



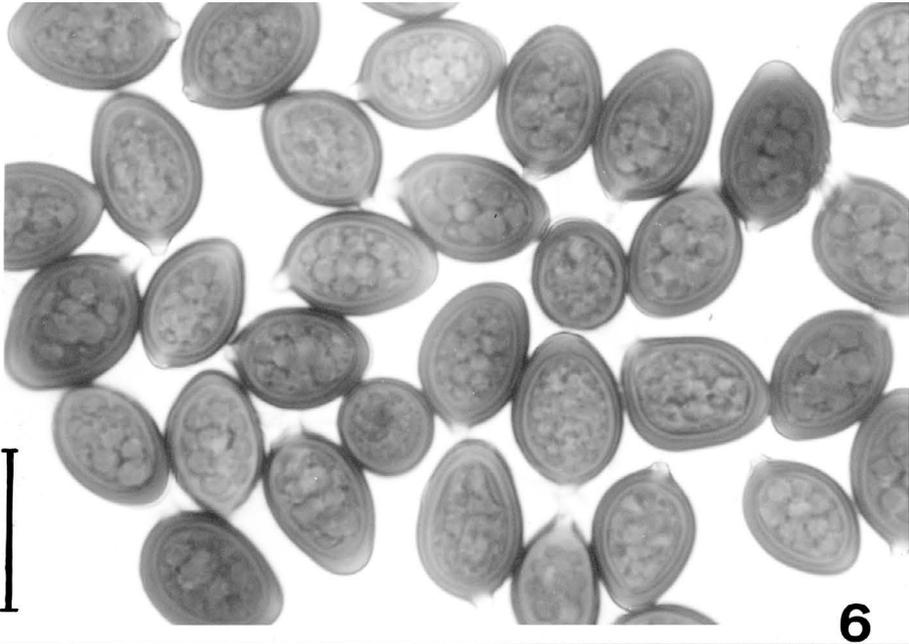
Fig. 1. *Coniophora bimacrospora* (type). Basidiome (scale bar = 25 mm).

lowish brown (5F6, snuff brown), when old; **hyphal system** monomitic; **marginal hyphae** hyaline, variable in size, from 2-4 μm up to 8-11 μm in diam., with simple septa or, although scattered and difficult to find, verticillate clamps on the larger ones (2-4 clamps / septum), thin- to slightly thick-walled, smooth or slightly incrustated; **in subiculum**, generative hyphae forming a dense *textura oblita*, simple-septate (verticillate clamps not observed in the subiculum), hyaline and thin- to (especially deep in the trama) slightly thick-walled, pale brown in the area close to the substrate, branched at variable degree, 2-5 μm diam.; **hyphal tufts** protruding through the hymenial surface, rare, scattered, up to 350 μm long, 50-60 μm wide, composed of thin-walled, simple-septate generative hyphae; **basidia** long, clavate-cylindrical, often with a narrower stipe-like base, and sometimes with a slight constriction in the upper third, without clamps at the basal septum, 55-100 μm long, 6.0-8.0(-10.0) μm wide, bi-spored, with two sterigmata, up to 8 μm long, with blunt apices; **basidiospores** ellipsoid to broadly ovoid, up to globose, or occasionally slightly pyriform with a broad basal apiculus, 2-2.5 μm long, 1.5-2 μm wide, thick-walled, the wall up to 3.5-4.0 μm thick, with a small apical dome-shaped depression at the inner wall surface outward (germ pore), yellowish to yellowish brown, not to usually strongly dextrinoid, cyanophilous, and with a vacuolar content, (18.0-)18.0-22.5(-24.0) \times (12.5-)13.0-16.0(-17.5) μm (\bar{x} = 20.2 \times 14.8 μm), \bar{x}_R = (1.1-)1.2-1.5(-1.6); **cystidia** absent; **cystidioles** absent or as narrow, sinuous hyphoid-like cystidioles, 30-60 \times 2-3 μm ; **chlamydospores** absent.

HOLOTYPE: **ETHIOPIA**, Oromia Region (former Shoa Province), forest above the village of Ginshi, 09°04'N - 038°09'E, ca. 2500 m. a.s.l, secondary dry afro-mountainous forest, dominated by *Juniperus procera* Hochst. Ex A. Rich and



Figs 2-4. *Coniophora bimacrospora* (type). 2. Marginal generative hyphae with multiple clamps (scale bar = 10 μ m); 3. Basidia (scale bar = 20 μ m); 4. Basidiospores (scale bar = 20 μ m).



Figs 5-6. *Coniophora bimacrospora*. Basidiospores (scale bars = 20 μ m).

Podocarpus falcatus (Thunb.) Mirb on wood beneath the bark of a dead stump of an unidentified gymnosperm³, 25 Jul. 2003, C. Decock (ET-03/72), A. Bitew, and G. Castillo, MUCL 45009 (ISOTYPE O).

Remarks. *Coniophora bimacrospora* is well characterized by its olive green (pale to dark olive green to olive brown) hymenial surface, two-spored basidia, and large, averaging $20 \times 15 \mu\text{m}$, ellipsoid to broadly ovoid, up to subglobose, yellowish to yellowish brown, dextrinoid basidiospores. There are no other *Coniophora* species with such a combination of characters. The exclusively bi-spored basidia are unique within the genus, all the species with the exception of *C. eremophila* Lindsay & Gilbn., in which Ginns (1982) reported the occurrence of both bi- and tetra-spored basidia, having, as a rule, four-spored basidia. Large basidiospores ($13\text{--}23 \mu\text{m}$ long, Ginns 1982) are present in *C. fusispora*. However, the basidiospores are fusiform and much narrower in the latter species ($5.4\text{--}7.8 \mu\text{m}$ wide, with a \bar{x}_R superior to 2, Ginns 1982). *Coniophora fusispora* is mainly known from the north temperate area but is also present in Africa (Cony Decock, pers. obs.⁴, Masuka & Ryvardeen 1992). *Coniophora arida* (Fr.: Fr.) P. Karst. has basidiospores somewhat similar in shape to those of *C. bimacrospora*, but much smaller ($10.4\text{--}13 \times 6.0\text{--}8.0\text{--}(9.6) \mu\text{m}$, Ginns 1982).

Coniophora puteana and *C. olivacea*, both taxa also found in the area, are easily differentiated from *C. bimacrospora* by their smaller, ellipsoid basidiospores, $9.5\text{--}14.5\text{--}(16) \times 6.0\text{--}7.5\text{--}(8) \mu\text{m}$ and $8\text{--}11 \times 4.5\text{--}5.5 \mu\text{m}$ ($8.5\text{--}10 \times 5.5\text{--}6.5 \mu\text{m}$ in our specimen (fig. 8)), respectively (Ginns 1982, Hallenberg and Eriksson 1985). Furthermore, *C. olivacea* has long, incrusting, and projecting cystidia, a feature unique within *Coniophora*.

Specimens examined:

***Coniophora puteana*:** ETHIOPIA, Oromia Region (former Shoa Province), Munessa forest, on decaying logs of *Podocarpus falcatus*, A. Bitew, Herbarium University Addis Ababa.

***Coniophora olivacea*:** ETHIOPIA, Oromia Region (former Shoa Province), Menagesha State Forest, $08^{\circ}58'N - 038^{\circ}32'E$, ca. 2500 m. a.s.l, in a *Juniperus procera* forest, on and beneath the bark of a dead tree, *Juniperus procera*, 24 Jul. 2003, C. Decock (ET-03/*Coniophora*), A. Bitew, and G. Castillo, MUCL 45052.

Serpula Pers. ex. S.F. Gray, Nat. Arr. Brit. Pl. I: 637, 1821.

Type species: *Serpula lacrymans* (Wulf.: Fr.) Schroet., Cohn F. Kryptogamen-Flora von Schleisien: 466, 1889.

For descriptions of the various species, see Hallenberg & Eriksson (1985), Gilbertson and Ryvardeen (1987), and Ginns (1971).

Serpula is mainly characterized by a resupinate to effused-reflexed, up to pileate basidiome, a meruloid to poroid, or tuberculate hymenium, yellowish brown to brown, a dimitic hyphal system with clamped generative hyphae and unbranched skeletal (skeletaloid) hyphae, and broadly ellipsoid to slightly ovoid, yellowish, thick-walled, and cyanophilous basidiospores. Four species were traditionally accepted in the genus, viz., in addition to the type, *S. himantioides* (Fr.: Fr.) P. Karst., *S. incrassata* (Berk. & M.A. Curtis) Donk, and *S. similis* (Berk. & Br.)

3. The tree could not be precisely identified but the species has spiraled thickening and cupressoid type of vascular punctuation.

4. CAMEROON, Dja Biosphere Reserve, near the Somalomo ECOFAC station, on dead wood on soil, Apr. 2001, C. Decock, Dja 54, Dja 55, MUCL 43282.

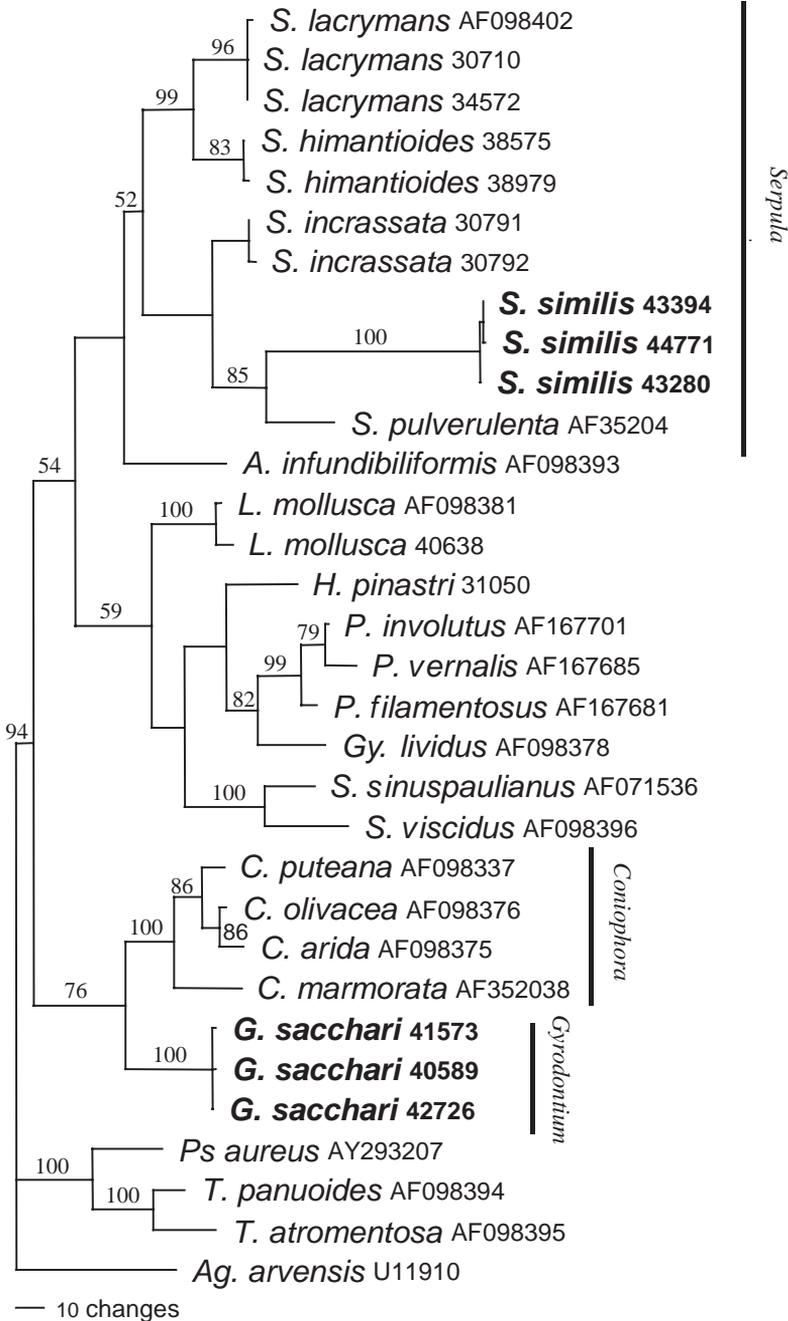


Fig 7. Single most parsimonious tree from a heuristic search (see text for explanation). Abbreviation: A = *Austropaxillus*; Ag = *Agaricus*; C. = *Coniophora*; G. = *Gyrodontium*; Gy. = *Gyrodon*; H. = *Hydromerulius*; L. = *Leucogyrophana*; P. = *Paxillus*; Ps. = *Pseudomerulius*; S. = *Serpula*; T. = *Tapinella*; Su. = *Suillus*.

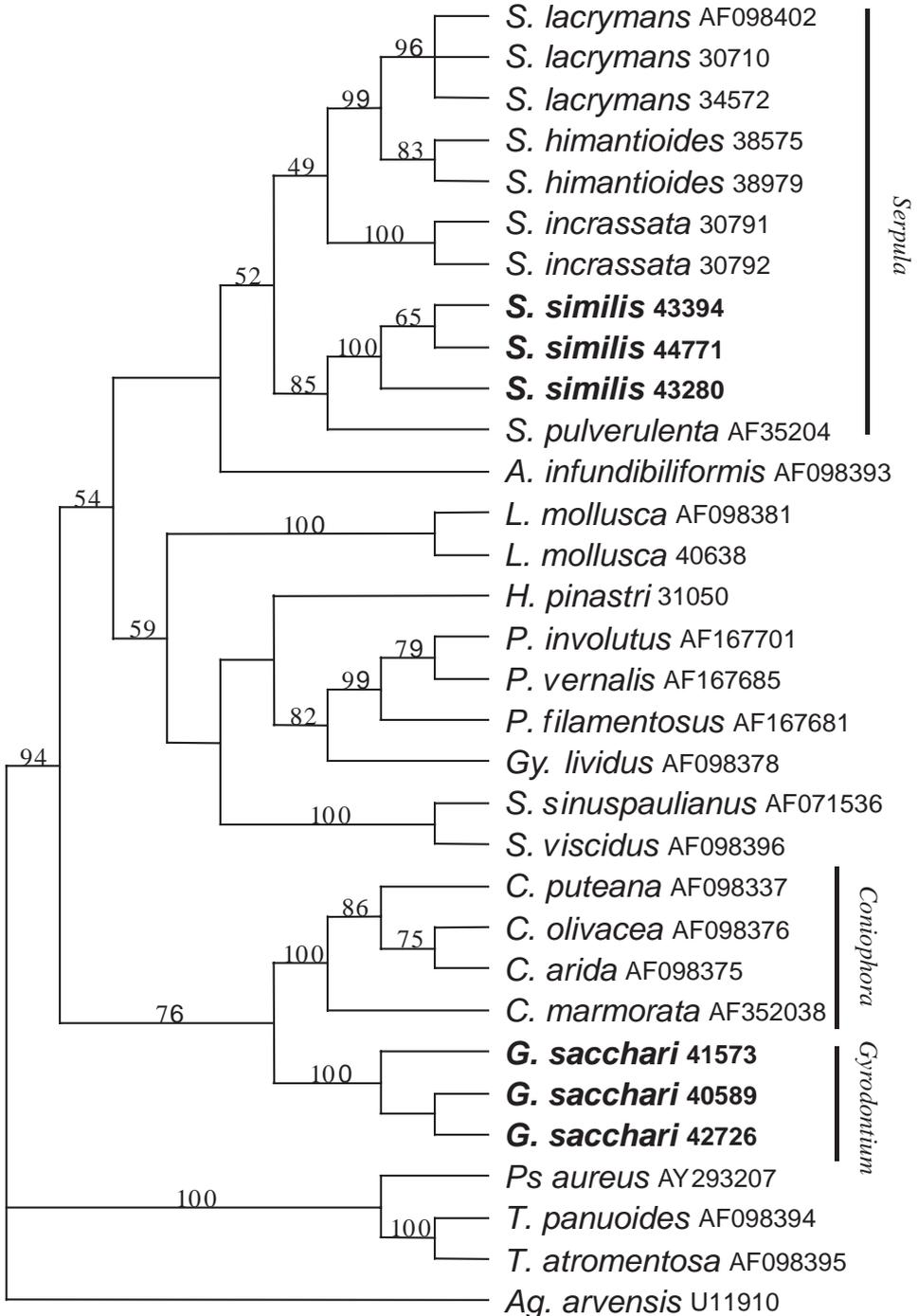


Fig 8. Bootstrap consensus tree (see text for explanation and fig. 7 for abbreviations used).

GINNS. The first three species have relatively large basidiospores, reaching on average 10-11 μm long, and occurs mainly in the northern temperate area⁵. *Serpula similis* has smaller basidiospores, on average up to 6 μm long, and is endemic in the inter-tropical zone, occurring for the most part in the paleotropical area (tropical Asia and Africa). Recent molecular data (Jarosch & Besl 2001) supported the common origin of the three "large-spored", temperate taxa (*S. lacrymans*, *S. himantioides*, and *S. incrassata*). The same data (Jarosch & Besl 2001) also supported the placement of *Leucogyrophana pulverulenta* Fr. in *Serpula* (as *S. pulverulenta* (Fr.) Bondartsev), the latter forming together with the three "large-spored" taxa a monophyletic clade. Hallenberg & Eriksson (1985) previously discussed the taxonomic placement of *L. pulverulenta* and its affinities with *Serpula*, and noted that both taxa shared the darker (yellowish brown) basidiospores (the other *Leucogyrophana* species having pale yellowish basidiospores) and the hyphal differentiation in the rhizomorphs, of which the thick-walled, unbranched skeletoid hyphae. Hallenberg & Eriksson (1985) then concluded that *S. pulverulenta* was "undoubtedly very close to *Serpula* and could have been treated there".

The phylogenetic relationships of *Serpula similis* with other *Serpula* species remained unknown.

Serpula similis (Berk. & Br.) Ginns, Mycologia 63: 231, 1971.

For a description of the species, see Ginns (1971).

Serpula similis was collected in the southwestern part of the country, in a mountainous evergreen forest (afro-mountainous ombrophilous forest, White 1983). The specimen was characterized by: an effused basidiome, reaching 150 \times 90 mm, separable, the abhymenial surface loosely attached to the substrate by a loose network of hyphae having a silky aspect; a white to pale creamy (when fresh) to pale yellow when dry, soft, cottony, smooth margin, turning into a fertile hymenial surface by development of low ridges changing progressively into a poroid surface; hymenial surface, pale yellow turning progressively pale orange, pale brown to olive brown when fresh, in dried state, pale yellow (4A(3-4), then pale orange (light orange, pale grayish orange, 5(A-B)5, carrot red to brownish orange (6(B-C)7, then brown (6D7, dead leaf) where the basidiospores deposit is dense, in the older parts of the basidiome; mycelial strands are present especially in the decayed wood, white to pale grayish yellow, up to 500 μm diam. The hyphal system is dimitic with sinuous, narrow skeletal hyphae. Basidiospores are ellipsoid to broadly ellipsoid, 4.5-5.5 \times 3.2-3.7 μm .

Contrary to the other *Serpula* species that grow very well on Malt Extract Agar, *S. similis* grows much better on Cherry Agar media. Isolations in the field from freshly collected specimens always failed on Malt Agar but were always successful on Cherry Agar media.

Specimen examined:

ETHIOPIA: Southern Nations Nationalities and Peoples Administrative Region (former Kefa Prov.), between the villages of Misan and Tepi, 06°59'N-035°35'E, ca. 1750 m. a.s.l., on a dead fallen trunk of an undetermined angiosperm, by the side of the road, 22 Jul. 2003, C. Decock (ET-03/21), A. Bitew, and G. Castillo, MUCL 44771 and LG-GC-3228 (culture ex- MUCL 44771, LG).

5. *Serpula himantioides* has also been recorded in old pine plantations in Eastern Zimbabwe (CD, pers. obs. (MUCL 38575, MUCL 38576, Masuka & Ryvarden 1994)) but is not native of the area. *Serpula incrassata* occurs mainly in eastern North America down to the gulf coast (Gilbertson & Ryvarden 1987) but it has also been recorded in Hawaii (Gilbertson & Hemmes 1997).

Additional specimens examined:

AFRICA: CAMEROON: Dja Biosphere Reserve, *ca.* Ekom village, 03°20'N, 13°02'E, *ca.* 650 m. alt., on a dead fallen trunk of an unidentified angiosperm, 12 Apr. 2001, C. Decock, G. Castillo, and F.-X. Carlier, Dja 75, MUCL 43280, (culture ex- MUCL 43280); Dja Biosphere Reserve, *ca.* Somalomo ECO-FAC station, 03°22'N, 13°43'E, *ca.* 660 m. a.s.l., on a dead fallen trunk of an unidentified angiosperm, 11 Apr. 2001, C. Decock, G. Castillo, and F.-X. Carlier, Dja 52, MUCL 43394, (culture ex- MUCL 43394).

ASIA: THAILAND: Nakhon Ratchasima Prov., Tup-Lan National Park, on a very decayed, fallen trunk of an unidentified angiosperm, 26 Jun. 2003, C. Decock, J.-M. Moncalvo, and S. Rodtong, Th-03/07, MUCL 44663, Suranaree University of Technology (culture ex- MUCL 44663, MIRCEN-Thailand).

Serpula similis differs from the other *Serpula* species by having smaller basidiospores and a tropical distribution, but its relationships with the other species are as yet unknown. Morphologically, *S. pulverulenta* would be the closest taxon, sharing with *S. similis* the smaller basidiospores ($5.5\text{--}7.0 \times 3.5\text{--}4.0 \mu\text{m}$ and $4.0\text{--}5.0\text{--}(7.0) \times 3.0\text{--}3.5 \mu\text{m}$, respectively). *Serpula pulverulenta* occurs, however, exclusively in the northern, temperate area.

The relationships of *S. similis* with other *Serpula* species were tentatively inferred from a phylogenetic analysis based on partial nrLSU sequences data. In these studies, *Serpula*, including *S. similis*, formed a monophyletic clade, although with poor support from the bootstrapping (bootstrap value 52%). Within this clade, *S. lacrymans* and *S. himantioides* on one side and *S. similis* and *S. pulverulenta* on the other side formed two very well supported sub-clades (bootstrap value 99% and 85%, respectively). The position of *S. incrassata* remained, however, unresolved in our analysis. In the MPT (fig. 7), the latter species clustered with the two small-spored taxa. However, in the bootstrap consensus tree (fig. 8), which slightly differed from the single MPT, it clustered with the large-spored taxa, although the branch received a weak support from the bootstrapping (bootstrap value 49%).

The close affinities between *S. lacrymans* and *S. himantioides* have been known for a long time, and both names were for a while considered to be synonyms. Morphologically, both species are very similar and share a similar basidiome, although thinner in *S. himantioides*, with a similar hymenial surface, basidiospores shape and size, and skeletal hyphae (Hallenberg & Eriksson 1985). Both occur in the north temperate area. *Serpula incrassata* was for a time considered in a separate genus, *Meruliporia* Murrill, which was distinguished from *Serpula* by having a poroid hymenial surface (Gilbertson & Ryvarden 1987). However, the latter feature should not be considered critical for distinguishing genera, when all other microscopic characteristics are in accordance, and the species is better placed in *Serpula*.

The phylogenetic relationships between the tropical *S. similis* and the temperate *S. pulverulenta* were more surprising, given their geographic distribution; a shared common origin of the four temperate *Serpula* would have been, perhaps, expected. However, *S. similis* and *S. pulverulenta* share, in comparison to the other *Serpula*, the relatively small basidiospores (see above), and could form a "small-spored" clade within the genus.

Although our current studies do not strictly support either the monophyletic origin of *Serpula* as the genus is circumscribed at present, or the common origin of the three northern temperate, large-spored taxa, perhaps because of insufficient resolution in the gene used, these hypotheses are worth testing in a



Fig. 9. *Gyrodontium sacchari*. Basidiome (MUCL 38596, Zimbabwe).

more detailed studies based on other genes, perhaps ITS or other protein-coding gene sequences, or multigenic analysis.

Gyrodontium Pat., Essai tax. Hym.: 117, 1900.

Monotypic⁶, type species: *Gyrodontium sacchari* (Spreng.: Fr.) Hjortstam, Mycotaxon 54: 186, 1995.

For a description of the species, see Hjortstam (1987, as *G. boveanum* (Mont.) Maas Geest.), Maas Geesteranus (1964, as *G. boveanum* and *G. versicolor* (Berk. & Br.) Maas Geest.)

Gyrodontium is mainly characterized by a resupinate to more commonly pileate basidiome, a toothed hymenium, the teeth being yellowish olive to olive brown to brown, several mm in length, cylindrical to angular in section, and a combination of a monomitic hyphal system with clampless generative hyphae, small (4.2-5.2 × 2.8-3.2 μm), ellipsoid, yellowish, thick-walled basidiospores, and presence of thick-walled, yellowish chlamydospores, especially in the context.

The species has been recorded on all continents and is considered as pantropical. It occurs mainly on dead wood in humid tropical forest but can also be found in man-made environments, wooden houses, mines, wooden bridges, etc. in tropical/subtropical regions, where it causes a brown rot. As far as we know the species is known in a single locality in Ethiopia.

6. Actually, preliminary results from a revision of *G. sacchari* have shown that the species might represent a complex of two taxa, one of which occurring preferably in wooden constructions in South America. This will be detailed in a other publication.

In our preliminary phylogenetic analysis, *Gyrodontium* formed a well-supported clade (bootstrap value 76%) with the various species of *Coniophora*. *Coniophora* and *Gyrodontium* are very different as regards their basidiomes and hymenial surface. *Gyrodontium* forms resupinate to commonly pileate basidiome with a toothed hymenial surface while *Coniophora* forms exclusively resupinate and smooth basidiomes. However, both genera share mostly simple septate vegetative hyphae⁷. Hjortstam (1987) also noted the presence of an apical germ pore in the basidiospores of *G. sacchari* (under *G. boveanum* (Mont.) Maas G.), a feature also described in some *Coniophora* species (Ginns & Kokko 1976). However, we have not been able to confirm this feature in our collections of *Gyrodontium*.

Specimen examined:

ETHIOPIA, Oromia Region (former Arussi Prov.), Wondo Genet forest, 12 km south-east of Shashemene, 7°5'N-38°45'E, ca. 1900 m. a.s.l., 08-09 Jan. 1973, L. Ryvarden # 8777, O.

Other specimens examined:

AFRICA: ZIMBABWE, Matabeleland North, Victoria Falls National Park, Victoria Falls area, inside a hollow dead trunk, *Acacia arioloba*, 12 Jan. 1996, C. Decock, V. Robert, & A. Masuka, ZW-V-11, MUCL 41573 (culture ex- MUCL 41573).

ASIA: THAILAND, Khao Yai National Park, trail to the waterfalls, on a dead standing trunk of unidentified angiosperm, 07 Aug. 1997, C. Decock Th-24, MUCL 40589 (culture ex- MUCL 40589, MIRCEN Thailand).

SOUTH AMERICA: FRENCH GUYANA, Cacao area, Plateau K, on a decayed, fallen trunk, undetermined angiosperm, 19 Jan. 2000, C. Decock, F.-X. Carlier, and G. Castillo, # Fx-01, MUCL 42726 (culture ex- MUCL 42726).

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7. The vegetative hyphae are simple septate in *Gyrodontium*, but with occasional, scattered verticillate clamps in most (but not all) *Coniophora* species (Ginns 1982).

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