
MYCOTAXON

ISSN (print) 0093-4666 (online) 2154-8889 Mycotaxon, Ltd. ©2020

July–September 2020—Volume 135, pp. 501–512

<https://doi.org/10.5248/135.501>

Guayaquilia* gen. nov., typified by *Idriella cubensis

FREDDY MAGDAMA¹, DAYNET SOSA^{1*}, FERNANDO ESPINOZA¹,
LIZETTE SERRANO¹, SIMÓN PÉREZ-MARTINEZ², ELAINE MALOSSO³,
MARGARITA HERNÁNDEZ-RESTREPO⁴, RAFAEL F. CASTAÑEDA-RUIZ⁵

¹ *Escuela Superior Politécnica del Litoral, ESPOL,*

*Centro de Investigaciones Biotecnológicas del Ecuador, Campus Gustavo Galindo,
Km. 30.5 Vía Perimetral, P.O. Box 09-01-5863, Guayaquil, Ecuador*

² *Universidad Estatal de Milagro (UNEMI), Facultad de Ingeniería,*

Cdla. Universitaria Km. 1.5 vía Milagro-Km26. Milagro 091706, Guayas, Ecuador

³ *Centro de Biociencias, Departamento de Micología, Universidade Federal de Pernambuco,*

Avenida da Engenharia, s/n Cidade Universitária, Recife, PE, 50.740-600, Brazil

⁴ *Westerdijk Fungal Biodiversity Institute, 3508 AD Utrecht, The Netherlands*

⁵ *Instituto de Investigaciones Fundamentales en Agricultura (INIFAT),*

Tropical Alejandro de Humboldt, OSDE, Grupo Agrícola,

Calle 1 Esq. 2, Santiago de Las Vegas, C. Habana, Cuba, C.P. 17200

* CORRESPONDENCE TO: dasosa@espol.edu.ec

ABSTRACT—A new genus *Guayaquilia* is established to accommodate *Idriella cubensis* based on morphology and phylogenetic analysis. DNA sequence data place these specimens as incertae sedis separate from *Microdochiaceae* (*Xylariales*), forming a monophyletic lineage separated from *Neoidriella desertorum* and phylogenetically distant from *Idriella*. The novel genus is characterized by macronematous, tree-like, fasciculate, profuse dichotomously, alternately, or irregularly branched, brown conidiophores with polyblastic, denticulate, sympodial extended, intercalary and terminal conidiogenous cells that produce solitary, sublunate, subnavicular, lunate, inequilateral, (0–)1-septate, hyaline conidia.

KEY WORDS—asexual fungi, hyphomycetes, *Microdochiaceae*, taxonomy, tropics

Introduction

Idriella, introduced by Nelson & Wilhelm (1956) with *I. lunata* as type species, is distinguished by macronematous, mononematous, unbranched, and basally

inflated and apically slightly geniculate brown conidiophores, mostly reduced to polyblastic, denticulate, sympodial extended conidiogenous cells. Conidia are typically lunate or falcate, unicellular, hyaline, and acuminate towards the apex (Nelson & Wilhelm 1956). Morgan-Jones (1979) updated and provided brief nomenclatural commentaries on *Idriella australiensis*, *I. couratarii*, *I. desertorum*, *I. lunata*, *I. mycogonoidea*, *I. ramosa*, *I. vandalurensis*, and *I. variabilis* and proposed two new species, *I. angustispora* and *I. bambusae*. Von Arx (1981), who presented a combined key for *Idriella* and *Microdochium* species, proposed the conidial shape and the habitat as the main characters to separate the genera; he included the *Idriella* species treated by Morgan-Jones (1979), excluded *I. tropicalis* as similar to *I. variabilis*, and added five new combinations (*I. bolleyi*, *I. caespitosa*, *I. falcata*, *I. grisea*, and *I. tainanensis*). Subsequently, 16 new species have been described: *I. acerosa*, *I. amazonica*, *I. angamosensis*, *I. asaicola*, *I. cagnizarii*, *I. camptospermae*, *I. cubensis*, *I. euterpes*, *I. jambosae*, *I. licualae*, *I. mycophila*, *I. rara*, *I. rhododendri*, *I. setiformis*, *I. stilboidea*, and *I. uncinospora* (Castañeda-Ruiz 1985, 1986; Castañeda-Ruiz & Arnold 1985; Castañeda-Ruiz & Kendrick 1991; Castañeda-Ruiz & al. 1997; Matsushima 1985, 1995; Rodrigues & Samuels 1990, 1992; Subramanian & Bhat 1987; Wu & al. 1997).

When the generic concept of *Idriella* was expanded, it became a heterogeneous genus (Seifert & al 2011). In the generic type, *I. lunata*, conidiophores are unbranched and mostly reduced to conidiogenous cells producing unicellular conidia on tiny denticles arranged along the apical and subapical surface of each conidiogenous cell after several sympodial holoblastic extensions (Nelson & Wilhelm 1956), but many other *Idriella* species produce conidiophores branched in various patterns, sympodial extensions of the conidiogenous cells confined to a small, nodose area at the apex, and conidiogenous loci as inconspicuous denticles that produce unicellular or septate conidia. DNA sequences of several *Idriella* species revealed the polyphyletic nature of this genus, showing phylogenetic separation between *I. lunata* (type species) and four other *Idriella* species, which consequently were transferred to four new genera: *Castanediella* Hern.-Restr. & al., *Idriellopsis* Hern.-Restr. & Crous, *Neoidriella* Hern.-Restr. & Crous, and *Paraidriella* Hern.-Restr. & Crous (Crous & al. 2015, Hernández-Restrepo & al. 2016).

During a workshop on fungal diversity conservation in Cacao forest areas, two surveys of microfungi were conducted in *Theobroma cacao* plantations in Guayaquil, Guayas Province, Ecuador, and several *Idriella*-like specimens were found. LSU and ITS sequence analyses place these specimens as *incertae sedis*

and separate from *Microdochiaceae* (*Xylariales*). They are not congeneric with *Idriella lunata* (the generic type), and we propose a new genus *Guayaquilina* to accommodate them.

Materials & methods

Sampling and fungal strains studied

Samples of decaying plants were placed in plastic bags, transported to the laboratory, placed in moist chambers, and treated according to Castañeda-Ruiz & al. (2016). Individual conidia were separated from the plant material under a stereoscope using an entomological needle and cultured in two different media: V8 (V8: 125 ml V8 juice, 18 g agar, 1000 ml distilled water, pH 6.3) and Cornmeal agar (CMA: 20 g cornmeal, 18 g agar, 1000 ml distilled water, pH 6.3). Morphological observations were made from cultures grown on CMA after five days, incubated at $25 \pm 1^\circ\text{C}$ under 12 h alternating near-UV light and darkness (using Vica, FLB-20W T10 near-UV lamp in an irradiation box). Colony colors were coded according to Rayner (1970). Mounts were prepared in lactic acid (90%) or in polyvinyl alcohol-glycerol (8 g PVA in 100 mL of water + 5 mL of glycerol) and lactofuchsin (0.1 g acid fuchsin, 100 mL 85% lactic acid) (Carmichael 1955). Microscopic characters were measured at $\times 1000$ using a Nikon Eclipse Ni-U microscope with DIC optics and a Nikon DS-Fi2 camera.

Pure cultures were deposited at the Microbial Culture Collection of the Biotechnology Research Center, Guayaquil, Ecuador (CCM-CIBE), and the voucher specimens and slide preparations were deposited in the Herbarium, Departamento de Micología, Universidade Federal de Pernambuco, Recife, Brazil (URM). Also examined were the holotype and another specimen deposited as *Idriella cubensis* in the INIFAT Fungus Collection.

DNA extraction, sequencing, and phylogenetic analysis

Genomic DNA was extracted from fresh mycelia grown on V8 Agar at 25°C using a modified rapid extraction method for filamentous fungi according to Cenis (1992). The primer pairs ITS1/ITS4 (White & al. 1990) and LROR/LR5 (Vilgalys & Hester 1990) were used for the amplification of the internal transcribed spacers (ITS), and part of the large subunit of the nuclear ribosomal RNA gene (LSU). PCR cycling conditions followed Korabecna (2007; ITS) and Yang & al. (2017; LSU). PCR products were sent to Macrogen Korea for purification and sequencing with the same primers.

Sequences were aligned and edited using MEGA v.6.0. Phylogenetic relationships among taxa were addressed through Maximum Likelihood (ML) analysis using MEGA v.6.0 and Bayesian analysis using Beast v1.10.4 (Drummond & al. 2012). Data for each gene or region was analyzed both individually and together as a combined data set. jModeltest v.2.1.10 (Darriba & al. 2012) was used to determine the best nucleotide substitution model for both studies. Congruence between individual gene data sets was tested using the partition homogeneity test (Farris & al. 1995) implemented in PAUP v4.0b10 (Swofford, 2001), using a heuristic search option with random taxon addition and TBR branch swapping with 1000 replicates. Tree topologies from ML

analysis of individual genes were also compared visually for congruence. For the combined ML study, GTR was specified as the evolutionary model with estimated proportion of invariables sites and gamma distribution as default parameters. Number of substitution rates was set to four and topology search changed to SPR for tree improvement. Nodal support was assessed by bootstrap analysis from 1000 replicates. Bootstrap values equal or higher than 70% were considered significant. Bayesian inference was run with four Monte Carlo Markov (MCM) chains over 1 million generations with a sampling frequency of 1000 trees using the GTR+I+G as the best model (Drummond & al. 2012). To detect if the sample distribution has reached stationarity, convergence and the effective sample size (ESS) were checked for each run. Posterior probabilities (PP) for the Bayesian analysis were determined by calculating 50% majority rule consensus tree and added onto congruent nodes of the ML tree topology. PP equal or above 0.95 were considered significant. Relevant sequences of ITS and LSU from Hernández-Restrepo & al. (2016) obtained from GenBank, were included in the phylogenetic inference for comparison purposes (TABLE 1).

TABLE I. Sequences of *Guayaquilina cubensis* and related species used in the phylogenetic analysis. New sequences are indicated in bold.

SPECIES	STRAIN #	ITS	LSU	REFERENCE
<i>Astrocystis concavispora</i>	IT1612	KP297404	KP340545	Daranagama & al. 2015
<i>Castanediella acaciae</i>	CBS 139896	KR476728	KR476763	Crous & al. 2015
<i>C. cagnizarii</i>	CBS 542.96	KP859054	KP858991	Hernández-Restrepo & al. 2016
	CBS 101043	KP859051	KP858988	Hernández-Restrepo & al. 2016
<i>C. couratarii</i>	CBS 579.71	KP859050	KP858987	Hernández-Restrepo & al. 2016
<i>Guayaquilina cubensis</i>	MUCL 39017	KC775733	KC775708	Becerra-Hernández & al. 2016
	CCMCIBE-H312	MH777025	MH777024	This Study
	CCMCIBE-H320	MH777026	MH777023	This Study
<i>Idriella lunata</i>	CBS 177.57	KP859043	KP858980	Hernández-Restrepo & al. 2016
	CBS 204.56	KP859044	KP858981	Hernández-Restrepo & al. 2016
	CBS 209.60	KP859045	KP858982	Hernández-Restrepo & al. 2016
	CBS 736.74	KP859046	KP858983	Hernández-Restrepo & al. 2016
<i>Idriellopsis uncinospora</i>	CBS 575.92	KP859052	KP858989	Hernández-Restrepo & al. 2016
<i>Kretzschmaria deusta</i>	CBS 163.93	KC477237	KY610458	Wendt & al. 2018

<i>Microdochium albescens</i>	CBS 243.83	KP858994	KP858930	Hernández-Restrepo & al. 2016
<i>M. citrinidiscum</i>	CBS 109067	KP859003	KP858939	Hernández-Restrepo & al. 2016
<i>M. lycopodium</i>	CBS 109398	KP859005	KP858941	Hernández-Restrepo & al. 2016
<i>M. majus</i>	CBS 741.79	KP859001	KP858937	Hernández-Restrepo & al. 2016
<i>M. neoqueenslandicum</i>	CBS 445.95	KP858997	KP858933	Hernández-Restrepo & al. 2016
<i>M. nivale</i>	CBS 116205	KP859008	KP858944	Hernández-Restrepo & al. 2016
<i>M. seminicola</i>	CBS 122707	KP859007	KP858943	Hernández-Restrepo & al. 2016
<i>Microdochium sorghi</i>	CBS 691.96	KP859000	KP858936	Hernández-Restrepo & al. 2016
<i>M. tainanense</i>	CBS 269.76	KP859009	KP858945	Hernández-Restrepo & al. 2016
<i>M. trichocladopsis</i>	CBS 623 77	KP858998	KP858934	Hernández-Restrepo & al. 2016
<i>Neoidriella desertorum</i>	CBS 985.72	KP859048	KP858985	Hernández-Restrepo & al. 2016
<i>Paraidriella jambosae</i>	CBS 374.90	KP859049	KP858986	Hernández-Restrepo & al. 2016
<i>Poronia punctata</i>	CBS:656.78	KT281904	KY610496	Wendt & al. 2018
<i>Rosellinia aquila</i>	MUCL 51703	KY610392	KY610460	Wendt & al. 2018
<i>R. corticium</i>	MUCL 51693	KY610393	KY610461	Wendt & al. 2018
<i>R. necatrix</i>	CBS 349.36	AY909001	KF719204	Peláez & al. 2008
<i>Sarcoxylon compunctum</i>	CBS 359.61	KT281903	KY610462	Wendt & al. 2018
<i>Selenodriella cubensis</i>	CBS 683.96	KP859053	KP858990	Hernández-Restrepo & al. 2016
<i>S. fertilis</i>	CBS 772.83	KP859055	KP858992	Hernández-Restrepo & al. 2016
<i>Xylaria arbuscula</i>	CBS:126415	KY610394	KY610463	Fournier & al. 2011; Wendt & al. 2018
<i>X. hypoxylon</i>	CBS 122620	KY610407	KY610495	Wendt & al. 2018
<i>X. polymorpha</i>	MUCL 49884	KY610408	KY610464	Wendt & al. 2018

Phylogeny

The LSU-ITS dataset comprised 36 aligned sequences with 1482 positions. FIG. 1 presents the ML tree including BS and PP values. The partition homogeneity test showed no significant incongruence between the combined data sets ($p > 0.05$). Trees obtained from ML and Bayesian analysis of the individual loci and the combined analysis produced congruent topologies.

Phylogenetic inferences grouped the three strains identified as *Idriella cubensis* (MUCL 39017, CCMCIBE-H312, CCMCIBE-H320) together in a

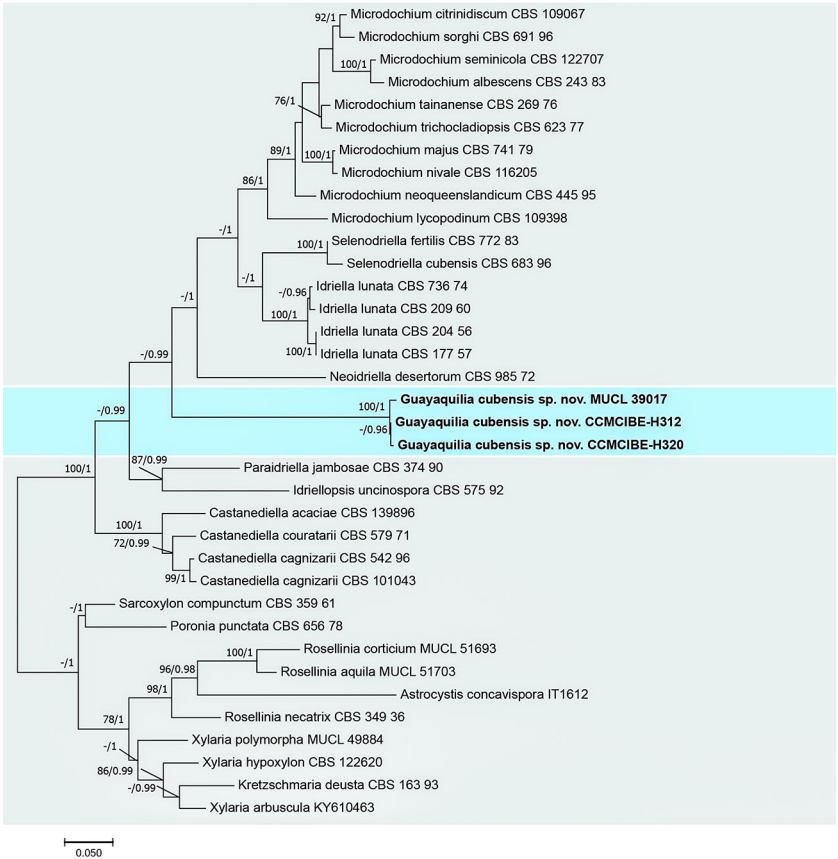


FIG. 1. Maximum Likelihood (ML) non-rooted tree inferred from the combined LSU and ITS sequences of *Guayaquilia cubensis* and related species. Numbers on the branches are support values >75% from BS and >0.95 from PP. The scale bar shows the expected changes per site.

supported clade and sister to *Neodriella desertorum*, both clades separate from, and basal to, the *Microdochiaceae* Hern.-Restr. & al. clade containing *Idriella lunata*, *Microdochium* spp., and *Selenodriella* spp. We therefore propose a new genus *Guayaquilia* typified by *Idriella cubensis*.

Taxonomy

Guayaquilia R.F. Castañeda, Magdama, D. Sosa & Hern.-Restr., gen. nov.

MB 831849

Differs from *Neodriella* and *Paraidriella* by its macronematous, tree-like, irregularly multibranching conidiophores and its intercalary, discrete conidiogenous cells.

TYPE SPECIES: *Idriella cubensis* R.F. Castañeda & G.R.W. Arnold [\equiv *Guayaquilia cubensis* (R.F. Castañeda & G.R.W. Arnold) R.F. Castañeda & al.].

ETYMOLOGY: *Guayaquilia* (Latin), referring to Guayaquil city, Ecuador.

ASEXUAL. COLONIES on natural substrate effuse, pulvinate-velutinous, golden brown to brown. **CONIDIOPHORES** macronematous, mononematous, fasciculate, erect, cylindrical, irregularly branched, septate, smooth, brown. **CONIDIOGENOUS CELLS** polyblastic, denticulate, sympodial extended, terminal or intercalary, cylindrical or slightly inflated, pale brown to brown. Conidial secession schizolytic. **CONIDIA** solitary, acropleurogenous, sublunate, subnavicular, inequilateral, unicellular or septate, hyaline, smooth. **CHLAMYDOSPORES** solitary, bicellular, brown and the apical cell globose, thick walled, smooth.

Guayaquilia cubensis (R.F. Castañeda & G.R.W. Arnold) R.F. Castañeda, Magdama, D. Sosa & Hern.-Restr., **comb. nov.** FIGS 2, 3

MB 831851

\equiv *Idriella cubensis* R. F. Castañeda & G.R.W. Arnold, Rev.
Jard. Bot. Nac., Univ. Habana 6(1): 50 (1985).

COLONIES on V8 agar at 25°C attaining 60 mm diam after five days, floccose, pale lavender grey to buff, sporulation poor, sparse. On CMA reaching 50 mm diam, felted, dark brick at the center, whitish toward the periphery. **CONIDIOPHORES** macronematous, mononematous, tree-like, fasciculate, profuse, dichotomously, alternately or irregularly branched toward the apex, slightly inflated or bulbous at the base, smooth, brown below, pale brown to subhyaline at the tip of branches, <500 μm long, 4–7.5 μm wide at the base, branches 2–3.5 μm wide. **CONIDIOGENOUS CELLS** polyblastic, denticulate, intercalary and terminal, in branches integrated, cylindrical, or slightly curved, brown to pale brown or subhyaline, 8–25 \times 2–3 μm . **CONIDIA** solitary, acropleurogenous, sublunate, subnavicular, lunate, inequilateral, (0–) 1-septate, 14–17 \times 2.5–3 μm . **CHLAMYDOSPORES** bicellular, the basal cells subcampanulate, subcuneiform to hemispherical, 5–8 μm wide, and the apical cells globose, 18–22 μm diam, brown, thick walled; both cells with lumina granulose, brown; terminal, smooth, arising from assimilative hyphae.

SPECIMENS EXAMINED: **ECUADOR, GUAYAS PROVINCE, Naranjal**, 2°48'S 79°40'W, on decaying leaves of *Theobroma cacao* L. (*Malvaceae*), 8 July 2017, F. Espinoza & S. Pérez-Martínez (URM 91815 = CCMCIBE-H312; GenBank MH777025, MH777024); 2°41'S 79°36'W, on decaying leaves of *Theobroma cacao*, 8 July 2017, F. Espinoza & S. Pérez-Martínez (URM 91815a = CCMCIBE-H320; GenBank MH777026, MH777023). **CUBA, LA HABANA PROVINCE, Santiago de Las Vegas**, 22°58'N 82°22'W, on decaying leaves of *Calophyllum calaba* L. (*Clusiaceae*), 29 Jun 1983, RF Castañeda Ruiz (holotype,

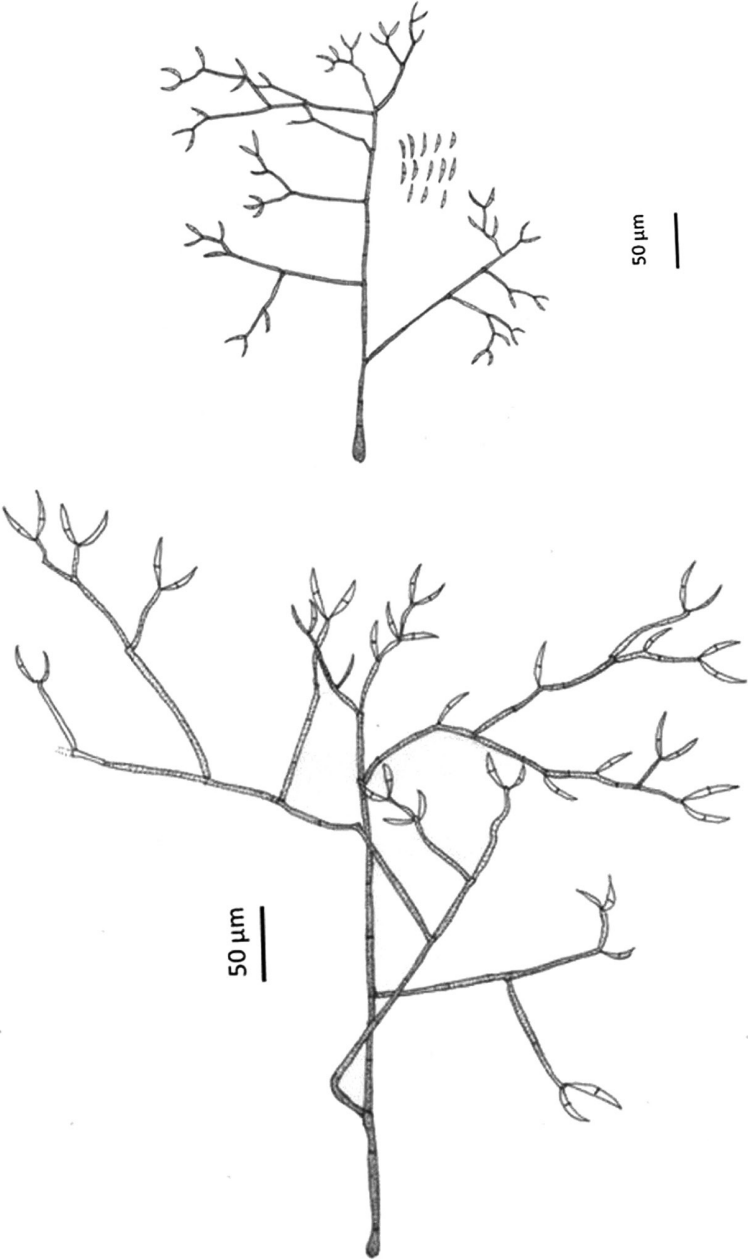


FIG. 2. *Guayaquilium cubensis* (holotype, INIFAT C83/57-1).
Conidiophores, conidiogenous cells, and conidia.

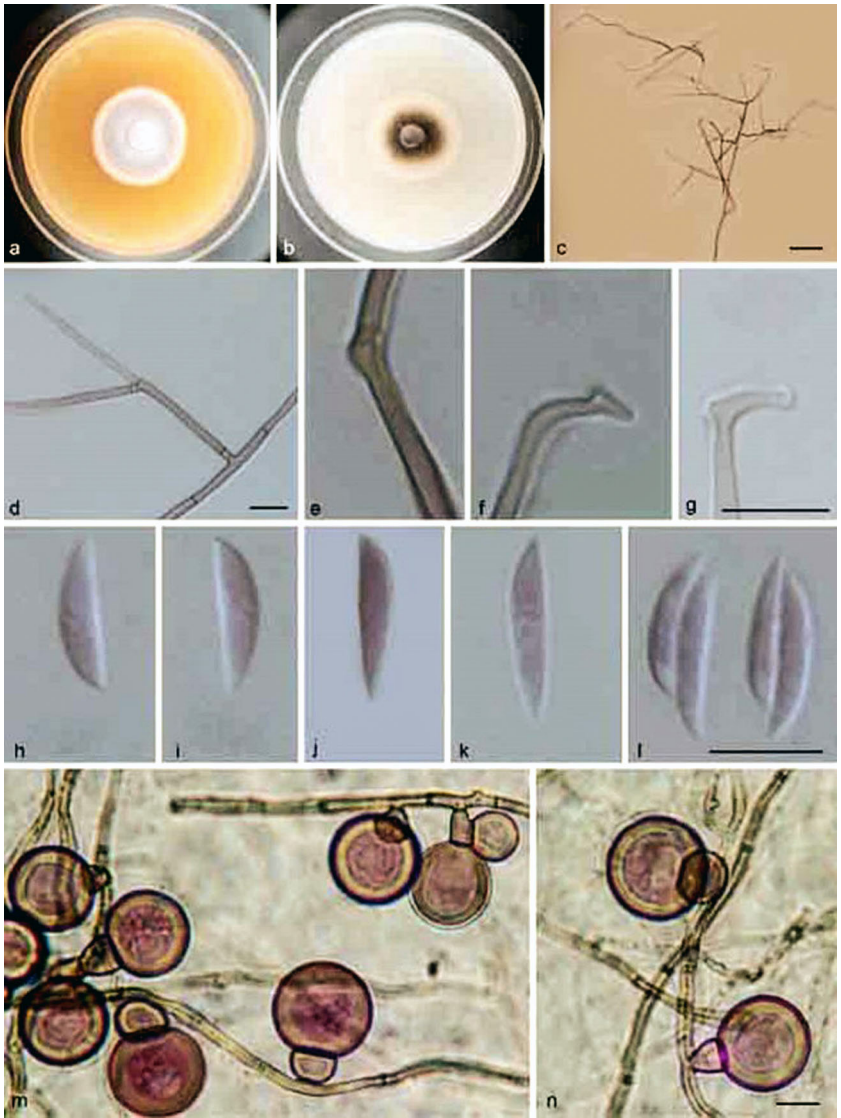


FIG. 3. *Guayaquilia cubensis* (CCMCIBE-H312). A. Colony on V8 agar; B. Colony on CMA; C, D. Conidiophores; E–G. Conidiogenous cells; H–L. Conidia; M, N. Chlamydozoospores. Scale bars = 10 μ m.

INIFAT C83/57-1); PINAR DEL RIO PROVINCE, LOS PORTALES, 22°40'N 83°28'W, on decaying leaves of *Cupania* sp. (*Sapindaceae*), 5 Feb. 1994, RF Castañeda Ruiz, (INIFAT C94/27 = MUCL 39017).

NOTE: *Guayaquilina* shares some morphological characters with the genera *Castanediella*, *Idriella*, *Idriellopsis*, *Neoidriella*, and *Paraidriella*, such as blastic conidial ontogeny and denticulate conidiogenous loci, but the tree-like, dichotomously, alternately or irregularly profuse branched conidiophores with intercalary and terminal conidiogenous cells are present only in *Guayaquilina*. Also, the bicellular, globose, brown chlamydospores that arise from assimilative hyphae in *Guayaquilina* are another distinctive character. The conidiophore morphology in *Guayaquilina* resembles that of some *Phaeodactyllum* species (*P. biseptatum*, *P. curvularioides*, and *P. stadleri*) described by Castañeda-Ruiz & al. (2009, 2013) and Matsushima (1980), but these taxa have clavate, ellipsoidal, to obovoid, brown to subhyaline conidia.

Acknowledgments

We are indebted to Dr. Flavia Rodrigues Barbosa (Instituto de Ciências Naturais, Humanas e Sociais, Universidade Federal de Mato Grosso, Brazil) and Dr. De-Wei Li (The Connecticut Agricultural Experiment Station Valley Laboratory, USA) for their critical reviews. The authors are grateful to Escuela Superior del Litoral (ESPOL), CIBE for financial support and the International Society for Fungal Conservation for facilities. RFCR is grateful to the Cuban Ministry of Agriculture. We acknowledge the websites provided by Dr. P.M. Kirk (Index Fungorum) and Dr. K. Bensch (Mycobank). Dr. Lorelei Norvell's editorial review and Dr. Shaun Pennycook's nomenclature review are greatly appreciated.

Literature cited

- Arx JA von. 1981. Notes on *Microdochium* and *Idriella*. *Sydowia* 34: 30–38.
- Becerra-Hernández CI, González D, Luna ED, Mena-Portales J. 2016. First report of pleoanamorphy in *Gyothrix verticiclada* with an *Idriella* like synanamorph. *Cryptogamie Mycologie* 37: 241–252 <https://doi.org/10.7872/crym/v37.iss2.2016.241>
- Carmichael JW. 1955. Lacto-fuschsin: a new medium for mounting fungi. *Mycologia* 47: 611.
- Castañeda-Ruiz RF. 1985. Deuteromycotina de Cuba. *Hyphomycetes*, II. La Habana, 23 p.
- Castañeda-Ruiz RF. 1986. *Fungi Cubenses*. La Habana, 20 p.
- Castañeda-Ruiz RF, Arnold GRW. 1985. Deuteromycotina de Cuba. I. *Hyphomycetes*. *Revista del Jardín Botánico Nacional* 6:47–67.
- Castañeda RF, Kendrick B. 1991. Ninety-nine conidial fungi from Cuba and three from Canada. *University of Waterloo Biology Series* 35: 1–132.
- Castañeda RF, Guarro J, Cano J. 1997. Notes on conidial fungi. XII. New or interesting hyphomycetes from Cuba. *Mycotaxon* 63: 169–181.
- Castañeda Ruiz RF, Iturriaga T, Minter DW Heredia Abarca G, Stadler M, Saikawa M.; Fernández R. 2009. Two new anamorphic fungi and some microfungi recorded from 'El Ávila', Venezuela. *Mycotaxon* 107: 225–237. <https://doi.org/10.5248/107.225>
- Castañeda-Ruiz RF, Hernández-Restrepo M, Gené J, Guarro J, Minter DW, Saikawa M. 2012. Two new microfungi from Portugal: *Magnohelicospora iberica* gen. & sp. nov. and *Phaeodactyllum stadleri* sp. nov. *Mycotaxon* 121: 171–179. <https://doi.org/10.5248/121.171>

- Castañeda-Ruiz RF, Heredia G, Gusmão LFP, Li DW. 2016. Fungal diversity of Central and South America. 197–217, in: DW Li (ed.). *Biology of Microfungi*. Springer International Publishing. https://doi.org/10.1007/978-3-319-29137-6_9
- Genis JL. 1992. Rapid extraction of fungal DNA for PCR amplification. *Nucleic Acids Research* 20: 2380. <https://doi.org/10.1093/nar/20.9.2380>
- Crous PW, Wingfield MJ, Guarro J & al. 2015. Fungal Planet description sheets: 320–370. *Persoonia* 34: 167–266. <https://doi.org/10.3767/003158515X688433>
- Daranagama DA, Camporesi E, Liu X, Chamyuang S, Stadler M, Hyde KD. 2015. *Anthostomella* is polyphyletic comprising several genera in *Xylariaceae*. *Fungal Diversity* 73: 203–238. <https://doi.org/10.1007/s13225-015-0329-6>
- Darriba D, Taboada GL, Doallo R, Posada D. 2012. jModelTest 2: more models, new heuristics and parallel computing. *Nature Methods* 9: 772.
- Drummond AJ, Suchard MA, Xie D, Rambaut A. 2012. Bayesian phylogenetics with BEAUti and the BEAST 1.7. *Molecular Biology and Evolution* 29: 1969–1973. <http://doi.org/10.1093/molbev/mss075>
- Farris JS, Källersjö M., Kluge AG, Bult C. 1995. Testing significance of incongruence. *Cladistics* 10: 315–319.
- Fournier J, Flessa F, Peršoh D, Stadler M. 2011. Three new *Xylaria* species from southwestern Europe. *Mycological Progress* 10:33–52. <https://doi.org/10.1007/s11557-010-0671-8>
- Hernández-Restrepo M, Groenewald JZ, Crous PW. 2016. Taxonomic and phylogenetic re-evaluation of *Microdochium*, *Monographella* and *Idriella*. *Persoonia* 36: 57–82. <http://doi.org/10.3767/003158516X688676>
- Korabecna M. 2007. The variability in the fungal ribosomal DNA (ITS1, ITS2, and 5.8 S RRNA Gene): Its biological meaning and application in medical mycology. *Communicating Current Research and Educational Topics and Trends in Applied Microbiology* 108: 783–787. <https://doi.org/10.1128/JCM.39.10.3617>
- Matsushima T 1980. Saprophytic microfungi from Taiwan, part 1. Hyphomycetes. *Matsushima Mycological Memoirs*.1. Matsushima Fungus Collection, Kobe
- Matsushima, T. 1985. *Matsushima Mycological Memoirs* No. 4. Matsushima Fungus Collection Kobe.
- Matsushima, T. 1995. *Matsushima Mycological Memoirs* No. 8. Matsushima Fungus Collection, Kobe.
- Morgan-Jones G. 1979. Notes on hyphomycetes XXX. On three species of *Idriella*. *Mycotaxon* 8(2): 402–410.
- Nelson PE, Wilhelm S. 1956. An undescribed fungus causing a root rot of strawberry. *Mycologia* 48: 547–551. <https://doi.org/10.1080/00275514.1956.12024564>
- Peláez F, González V, Platas G, Sánchez-Ballesteros J, Rubio V. 2008. Molecular phylogenetic studies within the family Xylariaceae based on ribosomal DNA sequences. *Fungal Diversity*, 31: 111–134.
- Rayner RW. 1970. A mycological colour chart. Kew, Surrey, UK.
- Rodrigues KF, Samuels GJ. 1990. Preliminary study of endophytic fungi in tropical palm. *Mycological Research* 94: 827–830. [https://doi.org/10.1016/S0953-7562\(09\)81386-5](https://doi.org/10.1016/S0953-7562(09)81386-5)
- Rodrigues KF, Samuels GJ. 1992. *Idriella* species endophytic in palms. *Mycotaxon* 43: 271–276
- Seifert K, Morgan-Jones G, Gams W, Kendrick B. 2011. The genera of hyphomycetes. *CBS Biodiversity Series* 9. 997 p.
- Subramanian CV, Bhat DJ. 1989 [1987]. Hyphomycetes from South India I. Some new taxa. *Kavaka* 15: 41–74.

- Swofford DL. 2001. PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4 Ed. Sinauer Associates, Sunderland, MA, USA.
- Vilgalys R, Hester M. 1990. Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. Journal of Bacteriology 172: 4238–4246. <https://doi.org/10.1128/jb.172.8.4238-4246.1990>
- Wendt L, Sir EB, Kuhnert E, Heitkämper S, & al. 2018. Resurrection and emendation of the *Hypoxylaceae*, recognized from a multigene phylogeny of the *Xylariales*. *Mycological Progress* 17: 115–154 [https://doi.org/ 10.1007/s11557-017-1311-3](https://doi.org/10.1007/s11557-017-1311-3)
- White TJ, Bruns T, Lee S, Taylor J. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In *PCR Protocols*, 315–322. <https://doi.org/10.1016/B978-0-12-372180-8.50042-1>
- Wu WP, Sutton BC, Gange AC. 1997. Notes on three fungicolous fungi: *Anastomyces microsporus* gen. et sp. nov., *Idriella rhododendri* sp. nov. and *Infundibura adhaerens*. Mycological Research 101: 1318–1322. <https://doi.org/10.1017/S0953756297004097>
- Yang J, Liu JK, Hyde KD, Jones EBG, Liu ZY. 2017. Two new species in *Fuscosporellaceae* from freshwater habitats in Thailand. *Mycosphere* 8: 1893–1903 [Doi 10.5943/mycosphere/8/10/12.](https://doi.org/10.5943/mycosphere/8/10/12)