Soil ascomycetes from Spain. XV. New and noteworthy fungi from Gran Canaria Island (Canary Islands archipelago)

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Abstract: Gran Canaria is the third island in surface area and altitude of the Canary Islands archipelago (Spain), located in the Atlantic Ocean. Its geomorphology provides a wide range of ecological niches that, together with its geographical isolation, have given rise to numerous endemic species of animals and plants. Despite extensive studies on their flora and fauna, research on microscopic fungi remains limited. Therefore, to assess the biodiversity of geophilic microscopic fungi of Gran Canaria, 12 samples were collected from the topsoil layer in different sites of *Finca de Osorio*, in *Parque Rural de Doramas*, at the North of the island. The samples were processed by direct sprinkling onto glycerol 18 % agar (G18) and ascospore agar (AA), by activation of dormant spores using 5 % acetic acid followed by plating onto potato-carrot extract agar (PCA), and by Toma-Karling-Vanbreuseghem (*ToKaVa*) hair baiting method. Incubation was carried out at 25 °C and 37 °C. The fungi were isolated in pure culture, and the strains were phenotypically characterized and preliminary identified using molecular data by comparing the nucleotide sequences of one or more phylogenetic informative markers using the BLAST search tool. Phylogenetic analysis was conducted when it was necessary. A total of 199 fungal strains were obtained, being assigned to 37 genera and 76 species, including four new genera, 17 new species and three new combinations distributed across the family *Chaetomiaceae* (12), and the genera *Penicillium* (2), *Spiromastigoides* (1), *Thermoascus* (1) and *Westerdykella* (1). In conclusion, the volcanic soils of Gran Canaria Island show a high fungal diversity, particularly within the family *Chaetomiaceae*, highlighting that the Macaronesia is an underexplored geographic region reservoir of micromycetes.

Key words: *Ascomycota*, *Chaetomiaceae*, phylogeny, soil-borne, taxonomy.

Taxonomic novelties: New genera: *Catenatispora* Sastoque, Cano & Stchigel, *Novoallocanariomyces* Sastoque, Stchigel & Cano, *Novochaetomium* Sastoque, Cano & Stchigel, *Paraarxotrichum* Sastoque, Cano & Stchigel. **New species:** *Allocanariomyces diversisporus* Sastoque, Stchigel & Cano, *Botryotrichum solisexuale* Sastoque, Cano & Stchigel, *Canariomyces similis* Sastoque, Stchigel & Cano, *Catenatispora terrestris* Sastoque, Cano & Stchigel, *Chaetomium annellidicum* Sastoque, Stchigel & Cano, *Humicola simplicissima* Sastoque, Cano & Stchigel, *Novoallocanariomyces verrucisporus* Sastoque, Stchigel & Cano, *Novochaetomium canariense* Sastoque, Cano & Stchigel, *Ovatospora phialospora* Sastoque, Stchigel & Cano, *Paraarxotrichum sterile* Sastoque, Cano & Stchigel, *Penicillium abortivum* Sastoque, Stchigel & Cano, *Penicillium doramasicum* Sastoque, Cano & Stchigel, *Pseudohumicola duospora* Sastoque, Stchigel & Cano, *Pseudohumicola fragilis* Sastoque, Cano & Stchigel, *Spiromastigoides globispora* Sastoque, Cano & Stchigel, *Thermoascus simplicissimus* Sastoque, Stchigel & Cano, *Westerdykella canariensis* Sastoque, Cano & Stchigel. **New combinations:** *Pseudohumicola nivea* (De Bert.) Sastoque, Stchigel & Cano, *Pseudohumicola repens* (De Bert.) Sastoque, Cano & Stchigel, *Pseudohumicola sardiniae* (De Bert.) Sastoque, Stchigel & Cano.

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INTRODUCTION

Gran Canaria is one of the main islands of the Canary Archipelago, located in the Atlantic Ocean about 150 km off the northwest coast of Africa and approximately 1350 km from mainland Europe (Salas-Pascual 2003). The island is nearly circular, with an approximate diameter of 45 km, making it the third-largest island in the archipelago. Its highest peak is *Morro de la Agujereada* (Salas-Pascual 2003, Rodriguez-Gonzalez *et al.* 2018). Gran Canaria's geological structure is primarily volcanic, with its landscapes shaped by both geological processes and local climatic factors (Salas-Pascual 2020).

The island's topography is characterized by deep ravines, mountainous regions, volcanic formations, and contrasting terrains. Two major geomorphological regions can be distinguished: the northeastern sector, known as Neotamaran, is a geologically recent area with moderate elevation, basaltic substrates, and a humid climate due to the influence of trade winds. This region supports more moisture-dependent plant communities. In contrast, the southwestern sector, referred to as Paleotamaran, consists of ancient, eroded landforms with altered acidic and basic materials. This region, which lacks significant wind-driven humidity, exhibits steep terrain marked by deep ravines and arid conditions (Salas-Pascual 2003, 2020, Salas-Pascual *et al.* 2015).

The climate of Gran Canaria is characterized by mild temperature variations, with annual averages ranging between 13 °C and 23.5 °C. However, altitude-dependent contrasts occur, while summer temperatures in lowland areas may exceed 40 °C due to warm Saharan winds, winter conditions at higher elevations can bring occasional snowfall when influenced by polar or Atlantic air masses. Annual precipitation varies between 200 and 400 mm, with most rainfall occurring in winter (Rodriguez-Gonzalez *et al.* 2018, Salas-Pascual 2020).

The island exhibits a high level of botanical diversity, with an estimated 1513 recorded species and subspecies (Salas-Pascual 2020). Its vegetation is remarkably heterogeneous, encompassing coastal shrublands predominantly composed of *Euphorbia balsamifera* and *E. canariensis*, as well as thermophilic woodlands and palm groves featuring *Phoenix canariensis*. Additionally, a few humid environments support laurel forests (*Lauraceae*), whereas higher elevations are characterized by extensive *Pinus canariensis* forests. Furthermore, secondary shrublands, primarily consisting of *Adenocarpus foliolosus*, *Chamaecytisus proliferus*, and *Teline microphylla*, contribute significantly to the island's overall vegetation structure (de Nascimento *et al.* 2015).

Despite the extensive research conducted on Gran Canaria's flora and fauna, studies focusing on soil-dwelling microscopic fungi remain limited. While previous research has examined fungal communities in association with plants and specific ecosystems, investigations on soil mycobiota remain scarce compared to other regions of the Canary Islands (Scholler & Rubner 1999, Castañeda-Ruíz *et al.* 2000, Zachow *et al.* 2009, Mena-Portales *et al.* 2015, Paris 2016, Hernández-Restrepo *et al.* 2017, Quijada *et al.* 2017, Sastoque *et al*. 2025), and even rarer on this particular island (Hernández-Restrepo *et al.* 2017). Consequently, there is still much to uncover regarding the diversity and ecological roles of soil fungi on the island.

This study aimed to explore and characterize the diversity of soil-dwelling microfungi in Gran Canaria. A combination of general and semi-selective culture techniques was employed, along with a polyphasic taxonomic approach, to isolate and identify fungal species from soil samples collected in one of the few places where laurel forests in a good state of conservation can still be found.

MATERIALS AND METHODS

Sampling sites

In 2009, 12 samples of volcanic soils were collected in *Finca de Osorio* (28.073597, -15.546387), in *Parque Rural de Doramas*, located in the North of Gran Canaria Island, with basaltic soils and a dense vegetation dominated by *Lauraceae* members.

Fungal isolation

Samples of approximately 100 g of the most superficial layer of soil free of formed organic matter were placed in sterile polyethylene bags and sealed with rubber bands. Once in the lab, the samples were stored at room temperature. Subsequently, they were cultured using different isolation techniques in duplicate. Cultural techniques included the sprinkling method onto G18 agar [5 g/L peptone (Oxoid, Madrid, Spain), 10 g/L glucose (Sigma, Madrid, Spain), 1 g/L monopotassium phosphate (Panreac, Madrid, Spain), 0.5 g/L magnesium sulfate (Panreac-AppliChem, Madrid, Spain), 220 g/L glycerol (Panreac-AppliChem, Madrid, Spain), 15 g/L bacteriological agar (Condalab, Madrid, Spain), 0.2 g/L chloramphenicol (Sigma, Madrid, Spain); Hocking & Pitt 1980, Atlas 2010] and ascospore agar [AA; 10 g/L potassium acetate (Merk, Madrid, Spain), 2.5 g/L yeast extract (Pronadisa, Madrid, Spain), 1 g/L glucose (Sigma, Madrid, Spain), 30 g/L bacteriological agar, 0.2 g/L chloramphenicol; Adams 1949, Atlas 2010]. On the other hand, to activate dormant spores, approx. 2 g of soil sample was mixed with 5 mL of 5 % acetic acid (Panreac-AppliChem, Madrid, Spain) into plastic disposable test tubes, stirred and left to stand for 10 min. Once the time had elapsed, the supernatant was removed by decantation, the sediment was re-suspended in 5 mL of sterile distilled water, and 2.5 mL of the same were transferred to two sterile 90-mm-diam. Petri dishes and mixed with approx. 20 mL of molten PCA (potatoes, 20 g/L, carrots, 20 g/L, bacteriological agar, 20 g/L; 0.2 g/L chloramphenicol; Onions & Pitt 1988) at approx. 55 °C (Stchigel 2000). Once gelled, they were incubated at 25 °C and 37 °C. The *ToKaVa* hair baiting (Vanbreuseghem 1952) was performed using horsehair as the keratin source, cut in 3–5 mm long fragments, sterilized by tyndallisation and sprinkled on an approx. 5 mm thick layer of soil sample into 90-mm-diam. Petri dishes were then moistened with sterile water and incubated at room temperature. Cultures were examined weekly under a dissecting microscope for up to 3 mo and fungal diversity was isolated on potato dextrose agar (PDA; Pronadisa, Madrid, Spain; Hawksworth *et al.* 1995) and oatmeal agar (OA; 30 g/L filtered oatmeal flakes after boiling for 1 h, 20 g/L bacteriologic agar, 0.2 g/L chloramphenicol; Samson *et al.* 2010) into 50-mm-diam. Petri dishes, incubated at the same temperatures as the primary isolation.

Phenotypic characterization of fungal strains

When the fungal strains grown on OA and PDA in the aforementioned conditions reached maturity, reproductive structures were taken using sterile hypodermic needles and syringes (tuberculin/insulin type) and deposited on a drop of mounting medium [lactic acid (Panreac-Applichem, Madrid, Spain)] between slide and coverslip. Then, these structures were observed and measured using an Olympus BH-2 brightfield microscope with an eye scale (Olympus Corporation, Tokyo, Japan). Also, when it was necessary, the micromorphology was studied in detail using the slide culture technique according to Cano & Guarro (1987). Micrographs of the fungal structures were acquired with a DeltaPix Infinity X coupled to the Zeiss Axio Imager M1 microscope (Oberkochen, Germany), using Nomarski (interference contrast) and phase contrast condensers. These images were edited with Adobe Photoshop CS6 v. 13.0 (Adobe Systems, San Jose, CA, USA).

Culture characteristics and micromorphology were reported growing at 25 °C the fungal strains on corn meal agar [CMA; 50 g/L corn meal, 20 g/L glucose (Sigma, Madrid, Spain), 15 g/L bacteriologic agar; Benham 1931], Czapek-Dox agar [CZA; 30 g/L sucrose (Panreac-AppliChem, Madrid, Spain), 3 g/L NaNO3 (Merk, Madrid, Spain), 1 g/L K2HPO4 (Panreac, Madrid, Spain), 0.5 g/L KC1 (Panreac, Madrid, Spain), 0.5 g/L MgSO4×7H2O (Panreac-AppliChem, Madrid, Spain), 0.01 g/L FeSO4×7H2O (Panreac, Madrid, Spain), 15 g/L bacteriologic agar; Thom & Church 1926], malt extract agar (MEA; 30 g/L malt extract, 5 g/L peptone, 15 g/L bacteriologic agar; Reiss 1972, Samson *et al.* 2010), OA, PCA, PDA, Sabouraud dextrose agar (SDA; Pronadisa, Madrid, Spain; Sabouraud 1892), and yeast extract sucrose agar (YES; 150 g/L sucrose, 20 g/L yeast extract, 20 g/L bacteriologic agar; Frisvad 1981) from 1–4 wk, following the methods described by Wang *et al.* (2022). The optimum, minimum and maximum temperatures of growth were obtained by inoculation of the fungal strains on PDA in 90-mm-diam. Petri dishes at 5, 12, 15, 20, 25, 30, 35, 37, 40 and 45 °C for 1 wk.

DNA extraction, amplification and sequencing

Fungal strains were inoculated on PDA and incubated for 1–2 wk at 25 °C. After that, the aerial mycelium was removed by scraping using a sterile scalpel to extract the DNA, according to FastDNA kit protocol (Bio; Vista, CA, USA) plus 50 mg of 425–600 µm size-fractionated glass beads, acid-washed (Sigma) with a FastPrep-24™ instrument (Thermo Savant, Holbrook, NY, USA). DNA was

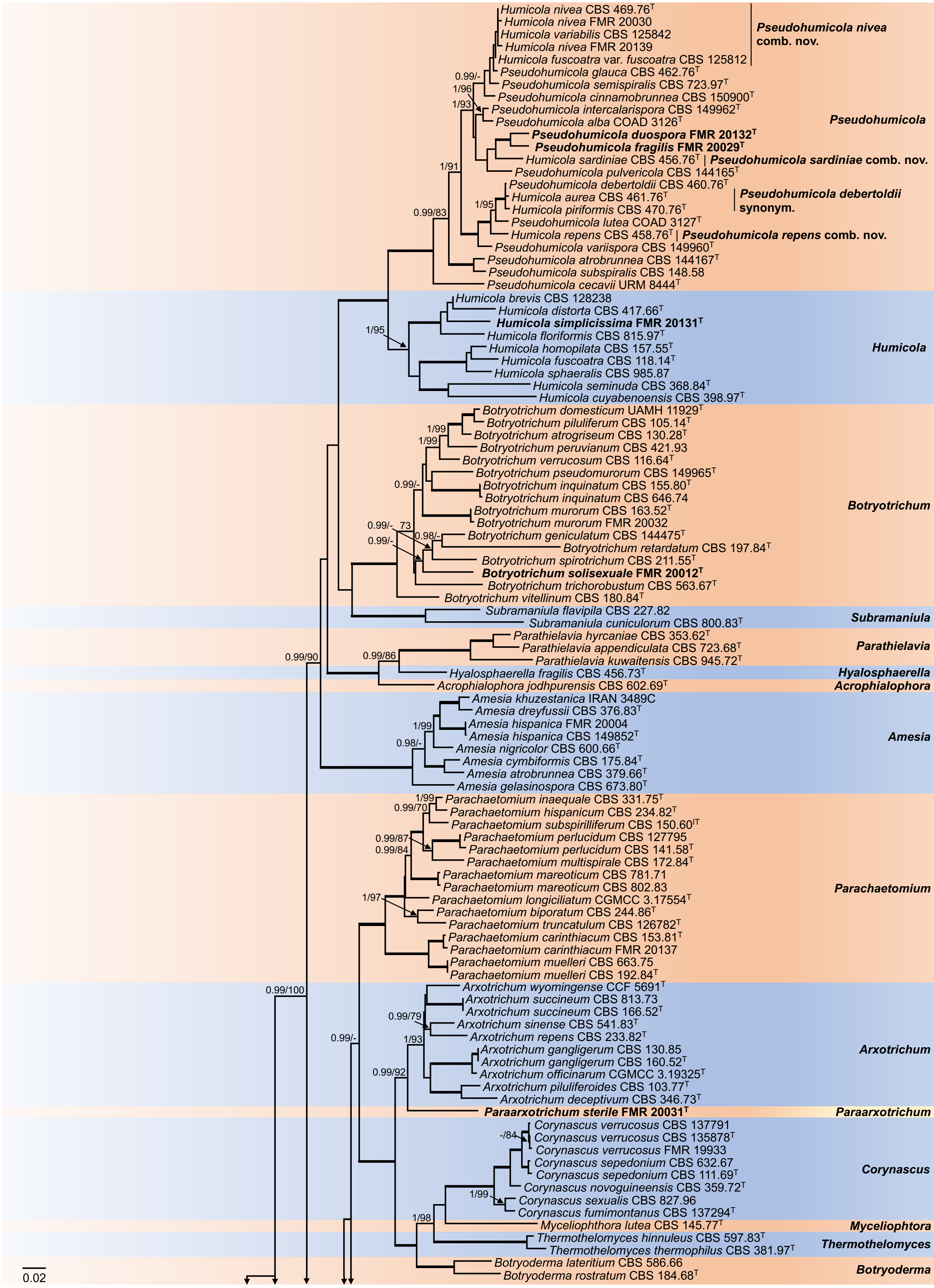

Fig. 1. Maximum likelihood tree obtained from the concatenated ITS-LSU-*rpb2*-*tub2* (3277 bp) alignment of the nucleotide sequences from our strains and those retrieved from the GenBank representing species in the *Chaetomiaceae*. Bayesian posterior probabilities (PP) ≥ 0.95 and the RAxML bootstrap support values (BS) ≥ 70 % are presented at the nodes (PP/BS). Thickened branches indicate full support (PP = 1 and BS = 100 %). The new species and combinations are noted in **bold**. ^{IT} Ex-isotype strain. ^{NT} Ex-neotype strain. ^{T} Ex-type strain. The tree was rooted with *Neurospora tetraspora* (CBS 178.33^{T}) and *Sordaria equicola* (CBS 524.50^{T}).

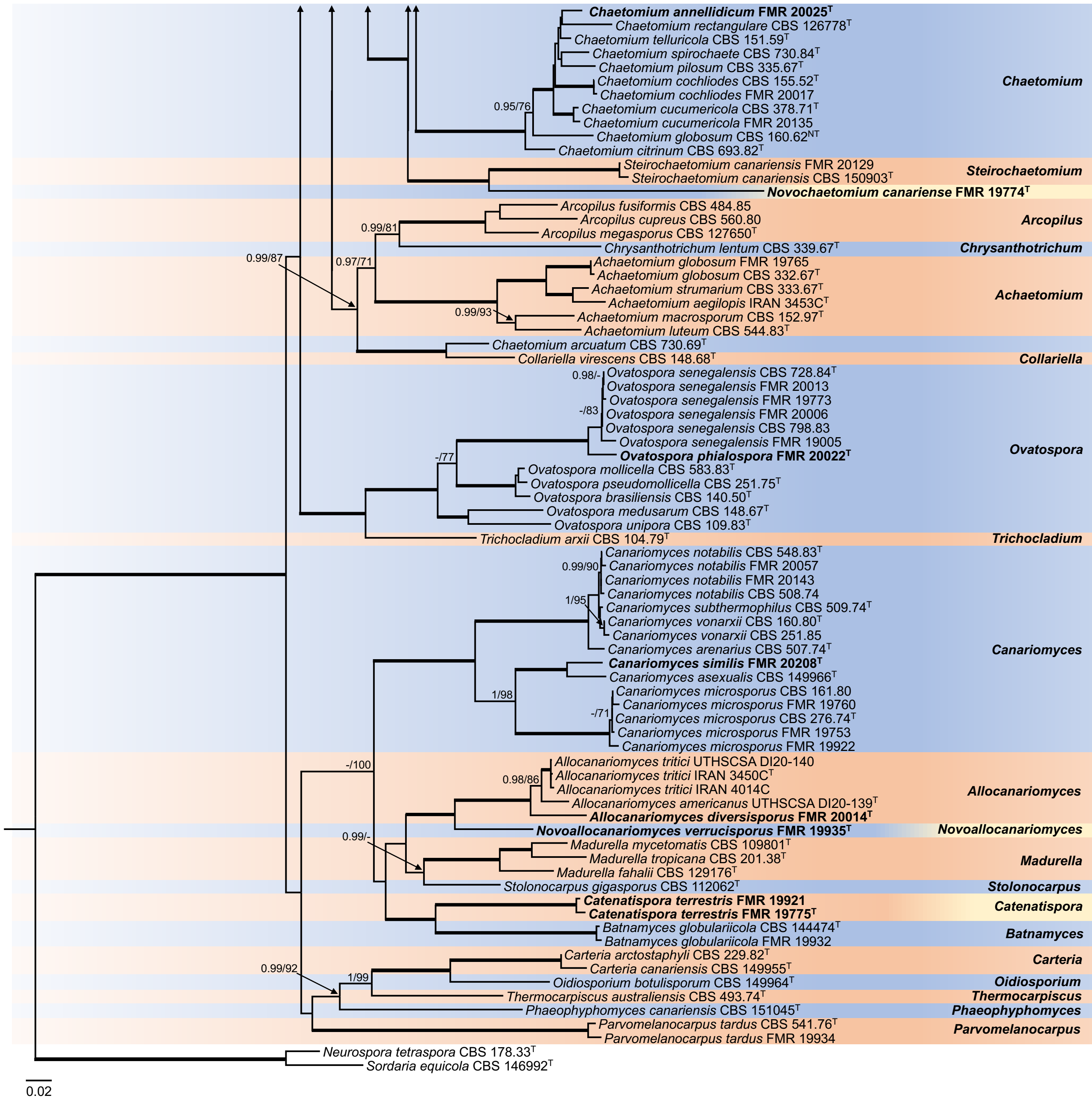

Fig. 1. (Continued).

quantified using a NanoDrop 2000 instrument (Thermo Scientific, Madrid, Spain). To facilitate the identification of the fungal strains and their phylogenetic analysis, partial sequences of five nuclear structural gene loci were amplified: the second largest subunit of the RNA polymerase II (*rpb2*), β-tubulin (*tub2*), translation elongation factor-1α (*tef1-α*), actin (*act1*), and calmodulin (*CaM*). Additionally, rRNA gene sequences were analysed, including a fragment of the 28S nrRNA gene (LSU) and the complete rDNA internal transcribed spacer region (ITS). The primers used are listed in Table S1.

The PCR reactions were performed using EmeraldAmp® GT PCR Master Mix (Takara Bio Inc., Saint-Germain-en-Laye, France) according to the manufacturer's manual for 25 µL of reaction. In each 25 µL reaction tube, 5 pmol of each primer and 50 ng of template DNA were added. The amplification was carried out using MyCycler™Thermal Cycler (Bio-Rad, Feldkirchen, Germany). The initial denaturation step was 95 °C for 5 min, followed by 35 cycles of denaturation at 95 °C for 30 s, annealing (Table S1) for 30 s and extension at 72 °C for 30 s, and a final extension at 72 °C for 7 min. The amplicons were sequenced in both directions with the same primer pair used for amplification at Macrogen Spain (Macrogen Inc., Madrid, Spain). The consensus sequences were obtained using the SeqMan software v. 7.0.0 (DNAStar Lasergene, Madison, WI, USA) and then deposited in GenBank.

Phylogenetic inference

Preliminary molecular identification of the isolates was performed by comparing the nucleotide sequence of each gene with those in the National Center for Biotechnology Information (NCBI) database (Altschul *et al.* 1990) using the BLAST search tool (https://blast.ncbi.nlm.nih.gov/Blast.cgi). Species-level identification was confirmed when the nucleotide sequences showed ≥ 98 % identity with the ex-type and/or reference strains in the database. The DNA sequences generated in this study were deposited in GenBank, with accession numbers provided in Table 1.

Table 1. Origin, source, loci amplified and sequenced and their accession numbers of the fungal strains in this study.

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
Achaetomium aegilopsis	IRAN 3453C[T]	Iran	Seed of *Aegilops triuncialis*	NR_172742	MT568844	—	MT568852	—	—
Achaetomium globosum	CBS 332.67[T]	India	*Tamarindus indica*, rhizosphere	NR_157458	MH870682	KM655441	KX976911	—	—
	FMR 19765	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182479**	**OZ182480**	**OZ182517**	**OZ182516**	—	—
Achaetomium luteum	CBS 544.83	Pakistan	*Rosa* sp., stem	KX976572	KX976697	KX976795	KX976913	—	—
Achaetomium macrosporum	CBS 152.97	India	Leaf litter	KX976573	KX976698	KX976796	KX976914	—	—
Achaetomium strumarium	CBS 333.67[T]	India	Soil	NR_144811	NG_056954	KC503254	AY681238	—	—
Acrophialophora jodhpurensis	CBS 602.69[T]	Pakistan	Unknown	NR_165583	NG_069743	MK876752	MK926890	—	—
Allocanariomyces americanus	UTHSCSA DI20-139[T]	USA	Human right hip subcutaneous tissue	NR_186952	MT902391	MT904877	MT904876	—	—
Allocanariomyces diversisporus	CBS 151777[T] (= FMR 20014)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199747**	**OZ199748**	**OZ199779**	**OZ199778**	—	—
Allocanariomyces tritici	IRAN 3450C[T]	Iran	*Triticum monococcum*, seed	NR_172184	NG_074461	MT568845	MT568850	—	—
	IRAN 4014C	Iran	*Triticum monococcum*, seed	MT568840	MT568843	MT568846	MT568851	—	—
	UTHSCSA DI20-140	USA	Human ear	MW194291	MW192768	MW244625	MW244626	—	—
Amesia atrobrunnea	CBS 379.66[T]	Solomon Islands	Moldy mattress	NR_145161	NG_057017	KX976798	KX976916	—	—
Amesia cymbiformis	CBS 175.84[T]	Solomon Islands	Tent rope	MH861721	KX976701	KX976800	KX976918	—	—
Amesia dreyfusii	CBS 376.83[T]	Israel	Dung of hare	NR_159783	NG_069794	MZ342985	MZ343023	—	—
Amesia gelasinospora	CBS 673.80[T]	Egypt	Soil	MH861306	MH873069	KX976804	KX976922	—	—
Amesia hispanica	CBS 149852[T]	Spain	Soil	NR_187092	OQ100832	OQ108867	OQ108868	—	—
	FMR 20004	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182493**	**OZ182494**	**OZ182531**	**OZ182530**	—	—
Amesia khuzestanica	IRAN 3489C	Iran	*Albizia* sp.	MT551117	—	MN275706	MN275701	—	—
Amesia nigricolor	CBS 600.66[T]	India	Vegetable detritus	NR_165999	KX976703	KX976802	KX976920	—	—
Arachnomyces bostrychodes	CBS 146926[T]	USA	Human scalp	LR701765	NG_088056	—	—	—	—
Arachnomyces graciliformis	CBS 146927[T]	USA	Bone of an animal	LR743667	LR743668	—	—	—	—
Arcopilus cupreus	CBS 560.80	Canada	Dung of moose	KX976584	KX976709	KX976808	KX976926	—	—
Arcopilus fusiformis	CBS 484.85	USA	Dung of rodent	KX976585	KX976710	KX976809	KX976927	—	—
Arcopilus megasporus	CBS 127650[T]	USA	Unknown	—	MH876091	MZ342971	MZ343010	—	—
Arxotrichum deceptivum	CBS 346.73[T]	USA	Dung of pack rat	MK919276	MK919276	MK919332	MK919390	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
Arxotrichum gangligerum	CBS 130.85	Canada	Dung of rabbit	MK919278	MK919278	MK919334	MK919392	—	—
	CBS 160.52^T	USA	Wood sample	MH856977	MH868498	MK919333	MK919391	—	—
Arxotrichum officinarum	CGMCC 3.19325^T	China	*Saccharum officinarum*	NR_165925	NG_070094	MN255448	MN337032	—	—
Arxotrichum piluliferoides	CBS 103.77^T	Japan	Grassland soil	NR_176706	MK919280	MK919336	MK919394	—	—
Arxotrichum repens	CBS 233.82^T	Spain	Dung	NR_176707	MK919282	MK919338	MK919396	—	—
Arxotrichum sinense	CBS 541.83^T	China	Soil	NR_176708	MH873359	MK919339	MK919397	—	—
Arxotrichum succineum	CBS 166.52^T	USA	*Abies magnifica* var. *shastensis*	NR_159768	NG_070436	MK919340	MK919398	—	—
	CBS 813.73	USA	*Abies magnifica* var. *shastensis*	MH860808	JX280736	MK919341	MK919399	—	—
Arxotrichum wyomingense	CCF 5691^T	USA	Soil	NR_159562	LT968154	—	LT971393	—	—
Batnamyces globulariicola	CBS 144474^T	Algeria	*Globularia Alypum*, roots	NR_169712	MT075917	MT075918	MT075919	—	—
	FMR 19932	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182487**	**OZ182488**	**OZ182525**	**OZ182524**	—	—
Botryoderma lateritium	CBS 586.66	South Africa	*Acacia karroo*, leaf litter	MH858889	MK919287	MK919343	MK919401	—	—
Botryoderma rostratum	CBS 184.68^T	Brazil	Sandy soil	MH859104	MK919288	MK919344	MK919402	—	—
Botryotrichum atrogriseum	CBS 130.28^T	The Netherlands	Dung of rabbit	NR_147666	KX976714	KX976813	KX976931	—	—
Botryotrichum domesticum	UAMH 11929^T	USA	Dust from swab sample	MH899168	NG_068583	MH899171	MH899172	—	—
Botryotrichum geniculatum	CBS 144475^T	China	Soil under herb	NR_177165	MZ351422	MZ342972	MZ343011	—	—
Botryotrichum inquinatum	CBS 155.80	Japan	Sewage sludge	MH861250	MK919289	MK919345	MK919403	—	—
	CBS 646.74	Egypt	Desert soil	MK919290	MK919290	MK919346	MK919404	—	—
Botryotrichum murorum	CBS 163.52	USA	Unknown	KX976591	KX976716	KX976815	KX976933	—	—
	FMR 20032	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182497**	**OZ182498**	**OZ182535**	**OZ182534**	—	—
Botryotrichum peruvianum	CBS 421.93	Cuba	Air	KX976596	KX976721	KX976820	KX976938	—	—
Botryotrichum piluliferum	CBS 105.14	Unknown	Unknown	KX976598	KX976723	KX976822	KX976940	—	—
Botryotrichum pseudomurorum	CBS 149965^T	Spain, La Palma, *Fuencaliente*	Soil	OZ001674	OZ001675	OZ001714	OZ00171	—	—
Botryotrichum retardatum	CBS 197.84^T	Kenya	Herbivore dung	MH861728	—	MZ342980	MZ343019	—	—
Botryotrichum sineconidiatum	CBS 151778^T (= FMR 20012)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199745**	**OZ199746**	**OZ199777**	**OZ199776**	—	—
Botryotrichum spirotrichum	CBS 211.55^T	USA	Dung of deer	NR_147667	NG_067362	KX976825	KX976943	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
Botryotrichum trichorobustum	CBS 563.67^T	Germany	Dung of rabbit	—	NG_067381	MZ342988	MZ343027	—	—
Botryotrichum verrucosum	CBS 116.64^T	UK	Salt-marsh soil, mature dunes	NR_168165	LT993567	LT993486	LT993648	—	—
Botryotrichum vitelinum	CBS 180.84^T	Turkey	Field soil	NR_177166	MZ351421	MZ342979	MZ343018	—	—
Canariomyces arenarius	CBS 507.74^T	Egypt	Desert soil	NR_103575	KM655383	KM655438	MK926898	MN078433	—
Canariomyces asexualis	CBS 149966^T	Spain, La Palma, *Teneguía* volcano	Soil	OZ001676	OZ001677	OZ001716	OZ001717	OZ001718	—
Canariomyces microsporus	CBS 276.74^T	Egypt	Desert soil	NR_165201	NG_067407	MK876760	JN709484	MN078437	—
	CBS 161.80	Japan	*Thymus* sp., leaf	MK926800	MK926800	MK876761	MK926900	—	—
	FMR 19753	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182473**	**OZ182474**	**OZ182510**	**OZ182509**	—	—
	FMR 19760	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182475**	**OZ182476**	**OZ182512**	**OZ182511**	—	—
	FMR 19922	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182477**	**OZ182478**	**OZ182514**	**OZ182513**	**OZ182515**	—
Canariomyces notabilis	CBS 548.83^T	Spain	*Phoenix canariensis* litter	NR_165232	NG_069797	MK876763	MK926902	MN078432	—
	CBS 508.74	Egypt	Desert soil	MK926803	KM655384	KM655439	MK926903	MN078431	—
	FMR 20057	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182499**	**OZ182500**	—	**OZ182536**	**OZ182537**	—
	FMR 20143	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182501**	**OZ182502**	—	**OZ182538**	**OZ182539**	—
Canariomyces similis	CBS 152078^T (= FMR 20208)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199805**	**OZ199806**	**OZ199803**	**OZ199802**	**OZ199804**	—
Canariomyces subthermophilus	CBS 509.74^T	Egypt	Desert soil	NR_145164	NG_069765	MK876764	MK926904	MN078436	—
Canariomyces vonarxii	CBS 160.80^T	Sudan	*Hibiscus* sp., dried flower	MK926805	MK926805	MK876765	MK926905	MN078435	—
	CBS 251.85	Nigeria	Unknown	MK926806	MK926806	MK876766	MK926906	MN078434	—
Carteria arctostaphyli	CBS 229.82^T	Switzerland	*Arctostaphylos uva-ursi*	MF952433	MK926807	MK876767	MK926907	—	—
Carteria canariensis	CBS 149955^T	Spain, La Palma, *Teneguía* volcano	Soil	OZ001678	OZ001679	OZ001719	OZ001720	—	—
Catenatispora terrestris	CBS 151779^T (= FMR 19775)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199739**	**OZ199740**	**OZ199769**	**OZ199768**	—	—
	FMR 19921	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199807**	**OZ199808**	**OZ199812**	**OZ199811**	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	rpb2	tub2	tef1 -α	CaM
Chaetomium annellidicum	CBS 151789^T (= FMR 20025)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ207014**	**OZ207015**	**OZ207013**	**OZ207012**	—	—
Chaetomium arcuatum	CBS 730.69^T	Turkey	*Lycopersicon esculentum*, root	KM655320	KM655359	KM655430	—	—	—
Chaetomium citrinum	CBS 693.82^T	Japan	Rice-field soil	NR_144863	NG_069789	KT214691	KT214764	—	—
Chaetomium cochliodes	CBS 155.52^T	Unknown	Dung of animal	NR_151835	NG_069672	KF001811	KC109772	—	—
	FMR 20017	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182495**	**OZ182496**	**OZ182533**	**OZ182532**	—	—
Chaetomium cucumericola	CBS 378.71^T	Turkey	Unknown	NR_144858	KT214610	KT214680	KT214756	—	—
	FMR 20135	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182505**	**OZ182506**	**OZ182543**	**OZ182542**	—	—
Chaetomium globosum	CBS 160.62^{NT}	Germany	Compost	NR_144851	NG_069699	KT214666	KT214742	—	—
Chaetomium pilosum	CBS 335.67^T	Australia	Grain of *Triticum aestivum*	NR_144862	NG_069734	FJ666387	KT214763	—	—
Chaetomium rectangulare	CBS 126778^T	Iran	Leaf of *Hordeum vulgare*	MH864225	HM365239	KT214688	HM365285	—	—
Chaetomium spirochaete	CBS 730.84^T	USA	Unknown	NR_144823	NG_069804	KF001819	JN256191	—	—
Chaetomium telluricola	CBS 151.59^T	UK	Soil	NR_144859	KT214613	KT214685	KT214759	—	—
Chrysanthotrichum lentum	CBS 339.67^T	South Africa	Soil	MK926809	MK926809	—	MK926909	—	—
Collariella virescens	CBS 148.68^T	Pakistan	Agricultural soil	NR_147671	KX976749	KX976848	KX976996	—	—
Corynascus fumimontanus	CBS 137294^T	USA	Forest soil	LK932694	LK932706	MK919347	MK919405	—	—
Corynascus novoguineensis	CBS 359.72^T	Papua-New Guinea	Soil	MH860498	MH872213	MK919348	MK919406	—	—
Corynascus sepedonium	CBS 111.69^T	India	Soil	MH859271	KX976777	KX976892	KX977027	—	—
Corynascus sepedonium	CBS 632.67	USSR	Unknown	MH859064	MH870784	HQ871830	MK919407	—	—
Corynascus sexualis	CBS 827.96	India	Soil	MK919295	MK919295	MK919352	MK919409	—	—
Corynascus verrucosus	CBS 137791	USA	Soil	LK932699	LK932704	LK932732	—	—	—
	CBS 135878	USA	Soil	LK932695	LK932705	MK919354	MK919411	—	—
	FMR 19933	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182489**	**OZ182490**	**OZ182527**	**OZ182526**	—	—
Humicola brevis	CBS 128238 (= FMR 20620)	USA	Soil	MH864861	MH876304	**OZ199817**	**OZ199816**	—	—
Humicola cuyabenoensis	CBS 398.97^T	Ecuador	Unknown	NR_160060	NG_058727	LT993492	LT993654	—	—
Humicola distorta	CBS 417.66^T	USA	*Populus tremuloides*, dead leaf	NR_172959	MH878558	LT993496	LT993658	—	—
Humicola floriformis	CBS 815.97^T	Thailand	Unknown	NR_172533	NG_075152	LT993497	LT993659	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1-α*	*CaM*
Humicola fuscoatra	CBS 118.14[T]	Norway	Soil	NR_163527	MH866152	KX976882	KX977017	—	—
Humicola homopilata	CBS 157.55[T]	Norway	Filter paper in soil	MH857425	KM655364	KM655399	LT993663	—	—
Humicola seminuda	CBS 368.84	Canada	Soil	LT993594	MH877836	LT993513	LT993675	—	—
Humicola simplisissima	CBS 151780[T] (= FMR 20131)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199755**	**OZ199756**	**OZ199788**	**OZ199787**	—	—
Humicola sphaeralis	CBS 985.87	France	Soil	LT993598	LT993598	LT993517	LT993679	—	—
Hyalosphaerella fragilis	CBS 456.73[T]	India	Rhizosphere of *Pennisetum typhoideum* in garden soil	NR_145140	NG_067404	KX976907	KX977042	—	—
Leiothecium ellipsoideum	CBS 607.74[T]	Greece	Soil, between rocks	KF732839	—	JN121541	KY709178	—	KY611939
Madurella fahalii	CBS 129176[T]	Sudan	Man, foot mycetoma	NR_165587	NG_067278	MK876780	MK926919	—	—
Madurella mycetomatis	CBS 109801[T]	Sudan	Man, foot mycetoma	NR_189379	JX280743	MK876781	MK926920	—	—
Madurella tropicana	CBS 201.38[T]	Indonesia	Man, foot	NR_137791	NG_067277	JN573212	MK926924	—	—
Myceliophthora lutea	CBS 145.77[T]	UK	Hay	NR_145149	KM655351	KX976891	KX977026	—	—
Neurospora tetraspora	CBS 178.33[T]	Canada	*Lagopus* sp., dung	NR_077163	NG_068996	DQ470932	AY681212	—	—
Novoallocanariomyces verrucisporus	CBS 151781[T] (=FMR 19935)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199743**	**OZ199744**	**OZ199775**	**OZ199774**	—	—
Novochaetomium canariense	CBS 151782[T] (=FMR 19774)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199737**	**OZ199738**	**OZ199767**	**OZ199766**	—	—
Oidiosporium botulisporum	CBS 149964[T]	Spain, La Palma, *Teneguía* volcano	Soil	OZ014599	OZ014600	OZ016228	OZ016229	—	—
Ovatospora brasiliensis	CBS 140.50	India	Moist jute cloth	KX976683	KX976781	KX976896	KX977031	—	—
Ovatospora medusarum	CBS 148.67[T]	Zaire	Soil	KX976684	KX976782	KX976897	KX977032	—	—
Ovatospora mollicella	CBS 583.83[T]	USA	Dung of spotted skunk	KX976685	KX976783	KX976898	KX977033	—	—
Ovatospora phialospora	CBS 151783[T] (= FMR 20022)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199749**	**OZ199750**	**OZ199781**	**OZ199780**	—	—
Ovatospora pseudomollicella	CBS 251.75[T]	India	Air	NR_147680	KX976784	KX976899	KX977034	—	—
Ovatospora senegalensis	CBS 798.83	Israel	Dung of gazelle	KX976688	KX976786	KX976901	KX977036	—	—
	CBS 728.84[T]	Senegal	Plant remains	NR_147681	KX976785	KX976900	KX977035	—	—
	FMR 19005	Spain, La Palma, *Teneguía* volcano	Soil	OZ001680	OZ001681	OZ001721	OZ001722	—	—
	FMR 19773	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182481**	**OZ182482**	**OZ182519**	**OZ182518**	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
	FMR 20006	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182483**	**OZ182484**	**OZ182521**	**OZ182520**	—	—
	FMR 20013	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182485**	**OZ182486**	**OZ182523**	**OZ182522**	—	—
Ovatospora unipora	CBS 109.83ᵀ	Egypt	Soil	NR_147682	NG_069274	KX976902	KX977037	—	—
Paecilomyces divaricatus	CBS 284.48ᵀ	USA	Mucilage bottle with library paste	FJ389931	—	—	FJ389992	—	FJ389953
Paecilomyces saturatus	CBS 323.34ᵀ	Japan	Unknown	FJ389947	—	—	FJ390005	—	FJ389962
Paraarxotrichum sterile	CBS 152420ᵀ (= FMR 20031)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199762**	**OZ199763**	**OZ199799**	**OZ199798**	—	—
Parachaetomium biporatum	CBS 244.86ᵀ	Spain	Soil	MK919303	MK919303	MK919360	MK919417	—	—
Parachaetomium carinthiacum	CBS 665.82	Japan	*Thymus* sp.	MH861536	MK919299	MK919356	MK919413	—	—
	FMR 20137	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182507**	**OZ182508**	**OZ182545**	**OZ182544**	—	—
Parachaetomium hispanicum	CBS 234.82ᵀ	Spain	Dung	NR_176709	MK919304	MK919361	MK919418	—	—
Parachaetomium inequale	CBS 331.75ᵀ	Ukraine	Soil	NR_178150	MK919306	MK919363	MK919420	—	—
Parachaetomium longiciliatum	CGMCC 3.17554ᵀ	China	Soil	NR_157442	KP336823	KT149497	KP336872	—	—
Parachaetomium mareoticum	CBS 781.71	Israel	Dung of gazelle	MH860352	—	MZ342993	MZ343032	—	—
	CBS 802.83	Israel	Dung	MZ334723	JX280715	MZ342997	MZ343036	—	—
Parachaetomium muelleri	CBS 663.75	Turkey	Unknown	MK919301	MK919301	MK919358	MK919415	—	—
	CBS 192.84ᵀ	Pakistan	Decayed twig	MK919300	MK919300	MK919357	MK919414	—	—
Parachaetomium perlucidum	CBS 141.58ᵀ	Ukraine	Dead herbaceous stem	MH857726	JX280728	MK919365	MK919422	—	—
	CBS 127795	USA	Unknown	MH864710	MH876143	MK919368	MK919425	—	—
Parachaetomium subspirilliferum	CBS 150.60ᵀ	Russia	Soil	NR_156254	NG_067367	MK919369	MK919426	—	—
Parachaetomium truncatulum	CBS 126782ᵀ	Iran	Cyst of *Heterodera schachtii*	NR_151831.	HM365263	MT568849	HM365298	—	—
Parathielavia appendiculata	CBS 723.68ᵀ	India	Leaf of *Punica granatum*	NR_165588	MK926827	MK876788	MK926927	—	—
Parathielavia hyrcaniae	CBS 353.62ᵀ	Iran	Sand dune soil	NR_145189	MH869771	KX976908	KX977043	—	—
Parathielavia kuwaitensis	CBS 945.72ᵀ	Kuwait	Desert soil	NR_166001	NG_067400	KX976909	KX977044	—	—
Parvomelanocarpus tardus	CBS 541.76ᵀ	Switzerland	Cotton jacket	NR_147678	KX976775	KX976888	KX977023	—	—
	FMR 19934	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182491**	**OZ182492**	**OZ182529**	**OZ182528**	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1* -*α*	*CaM*
Penicillium abortivum	CBS 151784[T] (= FMR 19752)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199761**	—	**OZ199796**	**OZ199795**	—	**OZ199797**
Penicillium alutaceum	CBS 317.67[T]	South Africa	Soil	AF033454	—	JN121489	KJ834430	—	KP016768
Penicillium arizonense	CBS 141311[T]	USA	Soil	MH492021	—	MH492022	MH492019	—	MH492020
Penicillium atramentosum	CBS 291.48[T]	USA	French Camembert cheese	AF033483	—	JN406584	AY674402	—	KU896821
Penicillium atrovenetum	CBS 241.56[T]	England	Soil	AF033492	—	JN121467	JX140944	—	KJ867004
Penicillium canis	NRRL 62798[T]	USA	Ilial bone lesion in a Rhodesian ridgeback dog	KJ511291	—	KF900196	KF900167	—	KF900177
Penicillium catenatum	CBS 352.67[T]	South Africa	Desert soil	KC411754	—	JN121504	KJ834438	—	KP016774
Penicillium chrysogenum	CBS 306.48[T]	USA	Unknown	AF033465	—	JN121487	JF909955	—	JX996273
Penicillium cinerascens	NRRL 748[T]	Unknown	Unknown	AF033455	—	MN969112	JX141041	—	JX157405
Penicillium citreonigrum	CBS 258.29[T]	Belgium	Rotting stem	AF033456	—	JN121474	EF198621	—	EF198628
Penicillium concentricum	CBS 477.75[T]	Germany	Colon of deer	KC411763	—	KT900575	AY674413	—	DQ911131
Penicillium coralligerum	CBS 123.65[T]	France	*Hordeum vulgare*, seed	JN617667	—	JN406632	MN969378	—	MN969248
Penicillium corylophilum	CBS 312.48[T]	Unknown	Unknown	AF033450	—	KP064631	JX141042	—	KP016780
Penicillium crystallinum	CBS 479.65[T]	Costa Rica	Forest soil	AF033486	—	EF669669	EF669682	—	FJ530973
Penicillium doramasicum	CBS 151785[T] (= FMR 20207)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199757**	**OZ199758**	**OZ199790**	**OZ199789**	—	**OZ199791**
Penicillium dimorphosporum	CBS 456.70[T]	Australia	Mangrove swamp soil	AF081804	—	JN121517	KJ834448	—	KP016783
Penicillium erubescens	CBS 318.67[T]	South Africa	Nursery soil	AF033464	—	JN121490	HQ646566	—	EU427281
Penicillium griseofulvum	CBS 185.27[T]	Belgium	Unknown	AF033468	—	JN121449	JF909942	—	KT900574
Penicillium guttulosum	NRRL 907[T]	USA	Soil	HQ646592	—	MG386247	HQ646576	—	HQ646587
Penicillium hermansii	CBS 124296[T]	Netherlands	Mushroom compost with smoky mould	MG333472	—	MG386242	MG386214	—	MG386229
Penicillium jensenii	CBS 327.59[T]	Japan	Forest soil	AY443470	—	JN406614	JX140954	—	AY443490
Penicillium labradorum	CBS 145775[T]	USA	Lymph node aspirates from a dog	MK881918	—	MK887900	MK887898	—	MK887899
Penicillium laeve	CBS 136665[T]	Thailand	Soil	KF667369	—	KF667371	KF667365	—	KF667367
Penicillium lanosum	CBS 106.11[T]	Germany	*Lecanora* sp.	DQ304540	—	KU904356	DQ285627	—	FJ530974
Penicillium lapidosum	CBS 343.48[T]	USA	Canned blueberry	MN431392	—	JN121500	KJ834465	—	FJ530984

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
Penicillium madriti	CBS 347.61^{T}	Spain	Garden soil	AF033482	—	JN406561	KJ834470	—	EU644076
Penicillium magnielliptisporum	CBS 138225^{T}	New Zealand	House dust	KJ775686	—	MN969124	KJ775179	—	KJ775413
Penicillium malodoratum	CBS 490.65^{T}	Costa Rica	Forest soil	AF033485	—	EF669672	EF669681	—	FJ530972
Penicillium menonorum	NRRL 50410^{T}	USA	Garden soil	HQ646591	—	KF900194	HQ646573	—	HQ646584
Penicillium meridianum	CBS 314.67^{T}	South Africa	Grassland soil	AF033451	—	JN406576	KJ834472	—	KP016794
Penicillium mexicanum	CBS 138227^{T}	Mexico	House dust	KJ775685	—	MN969127	KJ775178	—	KJ775412
Penicillium mononematosum	CBS 172.87^{T}	USA	*Amaranthus* sp., heavily moulded seed	JX997082	—	JX996709	AY495997	—	JX996964
Penicillium nalgiovense	CBS 352.48^{T}	Czechoslovakia	Ellischauer cheese	AY371617	—	JX996719	KU896811	—	JX996974
Penicillium nepalense	CBS 203.84^{T}	Nepal	Rice soil	KC411692	—	JN121453	KJ834474	—	KP016796
Penicillium ovatum	CBS 136664^{T}	Malaysia	Soil under leaf litter of *Pinus caribaea*	KF667370	—	KF667372	KF667366	—	KF667368
Penicillium parvum	CBS 359.48^{T}	Nicaragua	Soil	AF033460	—	JN406559	KF900173	—	KF900173
Penicillium parvofructum	CBS 141690^{T}	Spain	Forest soil	LT559091	—	MN969197	LT627645	—	LT627646
Penicillium pimiteouiense	NRRL 25542^{T}	USA	Kidney epithelial cell culture flask	AF037431	—	JN406650	HQ646569	—	HQ646580
Penicillium restrictum	CBS 367.48^{T}	Honduras	Soil	AF033457	—	JN121506	KJ834486	—	KP016803
Penicillium rubefaciens	CBS 145.83^{T}	Spain	Sandy soil under pine tree	KC411677	—	JN406627	KJ834487	—	KP016804
Penicillium rubidurum	NRRL 6033^{T}	Papua-New Guinea	Soil	AF033462	—	JN406545	HQ646574	—	HQ646585
Penicillium sacculum	CBS 231.61^{T}	Spain	Soil	KC411707	—	JN121462	KJ834488	—	KU896849
Penicillium senticosum	CBS 316.67^{T}	South Africa	Soil in subtropical forest	KC411733	—	MN969136	KJ834490	—	MN969296
Penicillium striatisporum	CBS 705.68^{T}	South Africa	*Acacia karroo*, leaf litter	AF038938	—	JN406538	MN969401	—	KP016807
Penicillium terrenum	CBS 313.67^{T}	South Africa	Soil in subtropical forest	AM992111	—	JN406577	KJ834496	—	KP016808
Penicillium vallebormidaense	CBS 147064^{T}	Italy	Compost in maturation	MT316359	MW092765	MW115864	MW115862	—	MW115863
Penicillium vinaceum	CBS 389.48^{T}	USA	Soil	AF033461	—	JN406555	HQ646575	—	HQ646586
Phaeohyphomyces canariensis	CBS 151045^{T}	Spain, La Palma, *Fuencaliente*	Soil	OZ026876	OZ026877	OZ026880	OZ026881	—	—
Phialomyces macrosporus	CBS 430.64^{T}	New Zealand	Soil	MN431404	—	JN121515	MN969422	—	MN969343
Preussia fleischhakii	CBS 565.63	Germany	Wheat field soil	GQ203761	MH869980	—	—	—	—
Preussia typharum	CBS 107.69	Japan	Dung of deer	GQ203766	GQ203726	—	—	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
Pseudohumicola alba	COAD 3126^T	Brazil	Air from a cave	ON989662	ON979681	ON995382	ON988189	—	—
Pseudohumicola atrobrunnea	CBS 114167^T	China	Garden soil	LT993570	LT993570	LT993489	LT993651	—	—
Pseudohumicola aurea	CBS 461.76^T (= FMR 20617)	Italy	Nematode-infested soil	MH444277	**OZ207011**	**OZ199819**	**OZ199818**	—	—
Pseudohumicola cecavii	URM 8444^T	Brazil	Cave sediment	OP672391	—	OP722570	OP672392	—	—
Pseudohumicola cinnamobrunnea	CBS 150900^T	Spain, La Palma, *Teneguía* volcano	Soil	OZ016267	OZ016268	OZ016230	OZ016231	—	—
Pseudohumicola debertoldii	CBS 460.76^T	Italy	*Quercus* forest soil	MH860994	MH872765	OZ016246	MH444288	—	—
Pseudohumicola duospora	CBS 152421^T (= FMR 20132)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199764**	**OZ199765**	**OZ199801**	**OZ199800**	—	—
Pseudohumicola fragilis	CBS 151786^T (= FMR 20029)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199751**	**OZ199752**	**OZ199783**	**OZ199782**	—	—
Pseudohumicola glauca	CBS 462.76^T	Italy	Soil nematode-infested	MH444273	OZ016244	OZ016245	MH444286	—	—
Pseudohumicola intercalispora	CBS 149962^T	Spain, La Palma, *Teneguía* volcano	Soil	OZ001682	OZ001683	OZ001723	OZ001724	—	—
Pseudohumicola lutea	COAD 3127^T	Brazil	Air from a cave	ON989663	ON979682	ON995383	ON988190	—	—
Pseudohumicola nivea	CBS 469.76^T (= FMR 6578)	Italy	*Talitrus saltator*, gastroenteric cavity	MH444274	MH872767	**OZ199821**	**OZ199820**	—	—
	CBS 125812	Italy	Soil	MH863738	MH875201	—	—	—	—
	CBS 125842 (= FMR 20619)	The Netherlands	Rabbit dung	MH863772	MH875234	**OZ199823**	**OZ199822**	—	—
	FMR 20030	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199834**	**OZ199835**	**OZ199831**	**OZ199830**	—	—
	FMR 20139	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199836**	**OZ199837**	**OZ199833**	**OZ199832**	—	—
Pseudohumicola piriformis	CBS 470.76^T (= FMR 20618)	Italy	Uncultivated soil	MH444278	MH872768	**OZ199825**	**OZ199824**	—	—
Pseudohumicola pulvericola	CBS 144165^T	Mexico	Dust	LT993592	LT993592	LT993511	LT993673	—	—
Pseudohumicola repens	CBS 458.76^T (= FMR 20099)	Italy	Wheat field soil	MH444275	**OZ207009**	**OZ199827**	MH444287	—	—
Pseudohumicola sardiniae	CBS 456.76^T (= FMR 20614)	Italy	Soil of vineyard	MH444272	**OZ207010**	**OZ199829**	MH444285	—	—
Pseudohumicola semispiralis	CBS 723.97^T	Unknown	Filter paper	LT993597	MH874274	LT993516	LT993678	—	—
Pseudohumicola subspiralis	CBS 148.58	China	Leaf fragments in soil	LT993599	LT993599	LT993518	LT993680	—	—
Pseudohumicola variispora	CBS 149960^T	Spain, La Palma, *Teneguía* volcano	Soil	**OZ001684**	**OZ001685**	**OZ001725**	**OZ001726**	—	—
Pseudospiromastix tentaculata	CBS 184.92^T	Somalia	Soil	NR_111162	NG_042397	—	—	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1 -α*	*CaM*
Sordaria equicola	CBS 146992[T]	Namibia	*Equus zebra hartmannae*, dung	NR_173047	MZ064492	MZ078202	MZ078267	—	—
Spiromastigoides alatospora	CBS 457.73[T]	India	*Vigna sinensis*, rhizosphere, grown in paddy-field soil	NR_178110	NG_088078	—	—	—	—
Spiromastigoides albida	CBS 139510[T]	USA	Human lung	LN867606	LN867602	—	—	—	—
Spiromastigoides asexualis	CBS 136728	USA	Discospondylitis in a German shepherd dog	LN867607	LN867603	—	—	—	—
Spiromastigoides curvata	CBS 140477[T]	Mexico	Contaminant of a strain of *Histoplasma capsulatum* from a bat intestine	NR_182323	NG_088027	—	—	—	—
Spiromastigoides frutex	CBS 138266[T]	Mexico	House dust	NR_178101	NG_088028	—	—	—	—
Spiromastigoides geomycoides	CBS 146934[T]	USA	Human, foot skin	NR_178134	NG_088057	—	—	—	—
Spiromastigoides globispora	CBS 151787[T] (=FMR 19927)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199741**	**OZ199742**	**OZ199773**	**OZ199770**	**OZ199771**	—
Spiromastigoides gypsea	CBS 134.77[T]	USA	Soil	NR_157448	NG_063935	—	—	—	—
Spiromastigoides kosraensis	CBS 138267[T]	Micronesia	House dust	NR_178102	NG_088029	—	—	—	—
Spiromastigoides minima	CBS 138268[T]	New Zealand	House dust	NR_178103	KP119647	—	—	—	—
Spiromastigoides pyramidalis	CBS 138269[T]	Australia	House dust	NR_178104	NG_088030	—	—	—	—
Spiromastigoides sugiyamae	CBS 140478[T]	USA	Soil	NR_178120	NG_088002	—	—	—	—
Spiromastigoides warcupii	CBS 576.63[T]	Australia	Soil	NR_144929	NG_057617	—	—	—	—
Steirochaetomium canariensis	CBS 150903[T]	Spain, La Palma, *Teneguía* volcano	Soil	OZ016269	OZ016270	OZ016232	OZ016233	—	—
	FMR 20129	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ182503**	**OZ182504**	**OZ182541**	**OZ182540**	—	—
Stolonocarpus gigasporus	CBS 112062[T]	Egypt	*Camelus dromedarius*, dung	NR_165592	MH874464	MK876798	MK926936	—	—
Subramaniula cuniculorum	CBS 800.83	Spain	Soil	KX976692	KX976790	KX976905	KX977040	—	—
Subramaniula flavipila	CBS 227.82	Spain	Dung	KP862599	KP970646	KP980691	KP900705	—	—
Thermoascus aurantiacus	CBS 257.34	Unknown	Unknown	MH855501	—	—	—	—	—
Thermoascus aegyptiacus	CBS 146342[T]	Egypt		MT068197	—	—	MN969411	—	MN969318
Thermoascus crustaceus	CBS 181.67[T]	USA	*Parthenium argentatum*, decaying plant	MN431405	—	MN969205	MN969423	—	MN969344
	CBS 374.62	USA	Culture contaminant	MH858182	—	—	—	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1* -α	*CaM*
Thermoascus simplicissimus	CBS 151788[T] (=FMR 20242)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199759**	**OZ199760**	**OZ199793**	**OZ199792**	—	**OZ199794**
Thermoascus thermophilus	CBS 528.71[T]	Sweden	*Pinus sp.*, wood and bark	MH860254	—	JF417442	MN969424	—	MN969345
Thermoascus verrucosus	CBS 605.74[T]	Australia	Nesting material of *Leipoa ocellata*	DQ073329	—	JN121540	MN969425	—	MN969346
Thermoascus yaguchii	CBS 146343	China	Soil	MT068196	—	—	MT070995	—	MN969362
Thermocarpiscus australiensis	CBS 493.74[T]	Australia	*Leipoa ocellata*, nesting material	AJ271590	KM655378	KM655419	MZ343024	—	—
Thermomyces dupontii	CBS 236.58[T]	USA	*Parthenium argentatum*, decaying plant	MN431410	-	JF417420	MN969432	—	MT066185
Thermomyces lanuginosus	CBS 632.91[T]	USA	Rotting guayule shrub	MN431411	-	MN969209	MN969433	—	MN969353
Thermothelomyces hinnuleus	CBS 597.83[T]	Japan	Cultivated soil	NR_155892	MK919327	MK919384	MK919441	—	—
Thermothelomyces thermophilus	CBS 381.97	Unknown	Man, biopsy of nasal cavity	HQ871766	KX976779	KX976894	KX977029	—	—
Trichocladium arxii	CBS 104.79[T]	USA	Dung of kangaroo-rat	MH861178	MH872947	KM655420	LT993712	—	—
Westerdykella angulata	CBS 610.74[T]	India	Rice-field soil	GQ203758	GQ203720	—	—	—	—
Westerdykella aquatica	JAUCC1788[T]	China	Mud	MH411093	MH411090	—	—	—	—
Westerdykella aurantiaca	IMI 086825	India	Mud	AY943057	—	—	—	—	—
Westerdykella canariensis	CBS 151789[T] (=FMR 20026)	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199753**	**OZ199754**	**OZ199785**	**OZ199784**	**OZ199786**	—
	FMR 20007	Spain, Gran Canaria, *Finca de Osorio*	Soil	**OZ199809**	**OZ199810**	**OZ199814**	**OZ199813**	**OZ199813**	—
Westerdykella capitulum	CBS 337.65[T]	India	Saline soil	MH858595	MH870234	—	—	—	—
Westerdykella centenaria	CBS 142400[T]	France	Laboratory bench in sterile preparation 'clean room'	NR_156002	NG_058468	—	—	—	—
	IHEM 27106	France	Hospital environment	OW988155	—	—	—	—	—
Westerdykella cylindrica	CBS 454.72[T]	Kenya	Dung of cow	DQ491519	NG_027595	—	—	—	—
Westerdykella dispersa	CBS 297.56[T]	USA	*Phlox drummondii*, seedling	NR_111187	NG_057827	—	—	—	—
	CBS 156.67	Nigeria	Soil	DQ468016	—	—	—	—	—
Westerdykella globosa	IFO 32588[T]	India	Soil	AY943046	—	—	—	—	—
Westerdykella minutispora	CBS 338.65[T]	India	*Oryza sativa*	MH858596	MH870235	—	—	—	—
	CBS 391.51[T]	Japan	Unknown	AY943048	—	—	—	—	—
Westerdykella multispora	CBS 309.72	Italy	*Unknown*	MH872199	—	—	—	—	—
	CBS 383.69	France	Saline soil	GQ203799	GQ203754	—	—	—	—

Table 1. (Continued).

Species	Strain	Origin	Source	ITS	LSU	*rpb2*	*tub2*	*tef1-α*	*CaM*
Westerdykella nigra	CBS 192.57	Unknown	Unknown	MH857693	MH869232	–	–	–	–
	CBS 416.72	Pakistan	Soil	GQ203800	GQ203755	–	–	–	–
Westerdykella ornata	CBS 379.55^{T}	Mozambique	Mangrove mud	MH857522	MH869059	–	–	–	–
Westerdykella purpurea	CBS 297.75	Togo	Sandy soil	AY943050	–	–	–	–	–
	MFLUCC 20-0140	Thailand	Decaying wood	MT465323	MT447879	–	–	–	–
Westerdykella reniformis	DAOM 242243^{T}	Canada	Red algae	NR_137090	JX235704	–	–	–	–

The nucleotide sequences generated during the development of this work are indicated in **bold**. New species and combinations are in **bold**. BCCM/IHEM, Mycology and Aerobiology section fungal culture collection, Sciensano (Brussels, Belgium). CBS, Westerdijk Fungal Biodiversity Institute, fungal and yeast collection (Utrecht, The Netherlands). CCF, Culture collection of fungi, Faculty of Science, Charles University (Prague, Czech Republic). CGMCC, China General Microbiological Culture Collection Center (Beijing, China). COAD, Coleção Octávio Almeida Drummond, Universidade Federal de Viçosa (Viçosa, Brazil). DAOM, Canadian National Mycological Herbarium (Ottawa, Canada). IFO, Institute for Fermentation (Osaka, Japan). IMI, Centre for Agricultural Bioscience International culture collection (Wallingford, United Kingdom). IRAN…C, Iranian Fungal Culture Collection, Iranian Research Institute of Plant Protection (Tehran, Iran). FMR, Faculty of Medicine-Reus culture collection (Reus, Spain). JAUCC, Jiangxi Agricultural University culture collection (Nanchang, China). MFLUCC, Mae Fah Luang Culture Collection (Chiang Rai, Thailand). NRRL, Agricultural Research Service (ARS) culture collection, United States Department of Agriculture (USDA) (Peoria, United States of America). UAMH, University of Alberta Mold Herbarium and Culture Collection (Edmonton, Canada). URM, Culture Collection, Universidade Federal de Pernambuco (Recife, Brazil). UTHSCSA, University of Texas Health Science Center at San Antonio culture collection (San Antonio, United States of America). ^{T} Ex-type strain. ^{NT} Ex-neotype strain.

For the phylogenetic study, ITS, LSU, *rpb2*, *tub2*, *tef1-α* and *CaM* sequences were employed to confirm the strain assignment to the families and genera according to phylogenetical studies for the *Aspergillaceae* (Houbraken *et al.* 2020), *Chaetomiaceae* (Wang *et al.* 2016a, b, 2019a, b, 2022, Alves *et al.* 2022, Oliveira Condé *et al.* 2023) *Sporormiaceae* (Song *et al.* 2020), *Spiromastigoidaceae* (Rodríguez-Andrade *et al.* 2021, Kandemir *et al.* 2022) and *Thermoascaceae* (Houbraken & Samson 2011, Houbraken *et al.* 2020). The sequences were aligned using the ClustalW (Thompson *et al.* 1994) within the MEGA software package (Kumar *et al.* 2016), with manual adjustments using the same platform. Phylogenetic reconstructions were carried out using maximum likelihood (ML) and Bayesian inference (BI). The ML analyses were conducted with RAxML (Stamatakis 2014) on the CIPRES web platform (https://www.phylo.org/) (Miller *et al.* 2012), while the BI analysis was performed with MrBayes v. 3.2.6 (Ronquist *et al.* 2012). The best substitution model for each gene matrix was estimated using MrModelTest v. 2.3.25 (Nylander 2004). In the ML analysis, the nearest-neighbour interchange was applied as the heuristic method for tree inference, with support for internal branches evaluated through 1000 ML bootstrap pseudoreplicates. A bootstrap support (BS) value of ≥ 70 % was considered statistically significant. For BI analyses, a Markov chain Monte Carlo (MCMC) (Metropolis & Ulam 1949) sampling was run for four million generations, with sampling every 1000 generations. The 50 % majority rule consensus trees and posterior probability (PP) values were calculated after discarding the first 25 % of trees as burn–in. A PP value of ≥ 0.95 was considered to indicate strong support.

RESULTS

Phylogenetic inference

The preliminary identification, based on morphological characters and the results of the BLAST search of the strains obtained in this study, suggests the finding of 17 potential new species of ascomycetes belonging in order of incidence to the families *Chaetomiaceae* (12), *Aspergillaceae* (2), *Spiromastigoidaceae* (1), *Sporormiaceae* (1) and *Thermoascaceae* (1). Therefore, the respective phylogenetic analyses were made to confirm this assumption. The selection of sequences from the NCBI databases was based on percentage similarity (using the BLAST search tool), with a minimum cutoff of between 80 % to 85 %, compared to the sequences generated in this study. Strains obtained in this study as well as those retrieved from the GenBank database are listed in Table 1.

Chaetomiaceae

Bayesian inference and ML analysis yielded similar tree topologies, with congruent results for each gene. However, LSU and ITS provided limited support for members of this family, consistent with previous reports (Wang *et al.* 2019a, 2022). The multilocus phylogenetic tree constructed using ITS-LSU-*rpb2*-*tub2* (Fig. 1) nucleotide sequences was based on 3277 positions, including gaps (663 bp for ITS, 858 bp for LSU, 855 bp for *rpb2*, and 901 bp for *tub2*). It comprised 168 ingroup taxa and two outgroups (*Neurospora tetraspora* CBS 178.33 and *Sordaria equicola* CBS 146992). The concatenated alignment is available in Zenodo: 10.5281/zenodo.14031809.

The phylogenetic tree (Fig. 1) resolved 37 well-supported main clades. The fully supported clade corresponding to the genus *Pseudohumicola* (*Ps.*) included FMR 20030 and FMR 20139 in a terminal clade along with the ex-type strains of *Ps. glauca* CBS 462.76, *Humicola* (*H.*) *nivea* CBS 469.76, *H. variabilis* CBS 125842 and *H. fuscoatra* var. *fuscoatra* CBS 125812. The strain FMR 20132 was placed in a fully supported terminal branch with FMR 20029, but as two different species (BLAST *rpb2* ID = 96.13 %), in the same terminal clade as the ex-type strain of *H. sardianiae* CBS 456.76 (BLAST *rpb2* ID = 93.31 % and94.01 %, respectively) and *Ps. pulvericola* CBS 144165 (BLAST *rpb2* ID = 93.99 % and 95.98 %, respectively). *Humicola aurea* CBS 461.76 and *H. piriformis* CBS 470.76 were in the same terminal branch as *Ps. debertoldii* CBS 460.76, in a terminal clade that also included the ex-type strains of *H. repens* CBS 458.76, *Ps. lutea* COAD 3127 and *Ps. variispora* CBS 149960. The strain FMR 20131 was placed in the *Humicola* spp. clade (1 PP/95 % BS) as a distinct species, close to *H. brevis* CBS 28238 and *H. distorta* (BLAST *rpb2* ID = 97.54 % and 92.81 %, respectively). On the other hand, FMR 20032 was conspecific with *Botryotrichum* (*B.*) *murorum* CBS 163.52, while FMR 20012 was placed in a subclade (0.99/- %) but separated from *B. spirotrichum* CBS 211.55 and *B. geniculatum* CBS 144475. The strain FMR 20004 was conspecific with *Amesia* (*Am.*) *hispanica* CBS 149852 in the *Amesia* spp. clade (1/100 %), while FMR 20137 was in the *Parachaetomium* (*Parach.*) spp. clade (1/100 %), conspecific with *Parach. carinthiacum* CBS 153.81. On the other hand, the strain FMR 20031 was placed in a well-supported independent clade

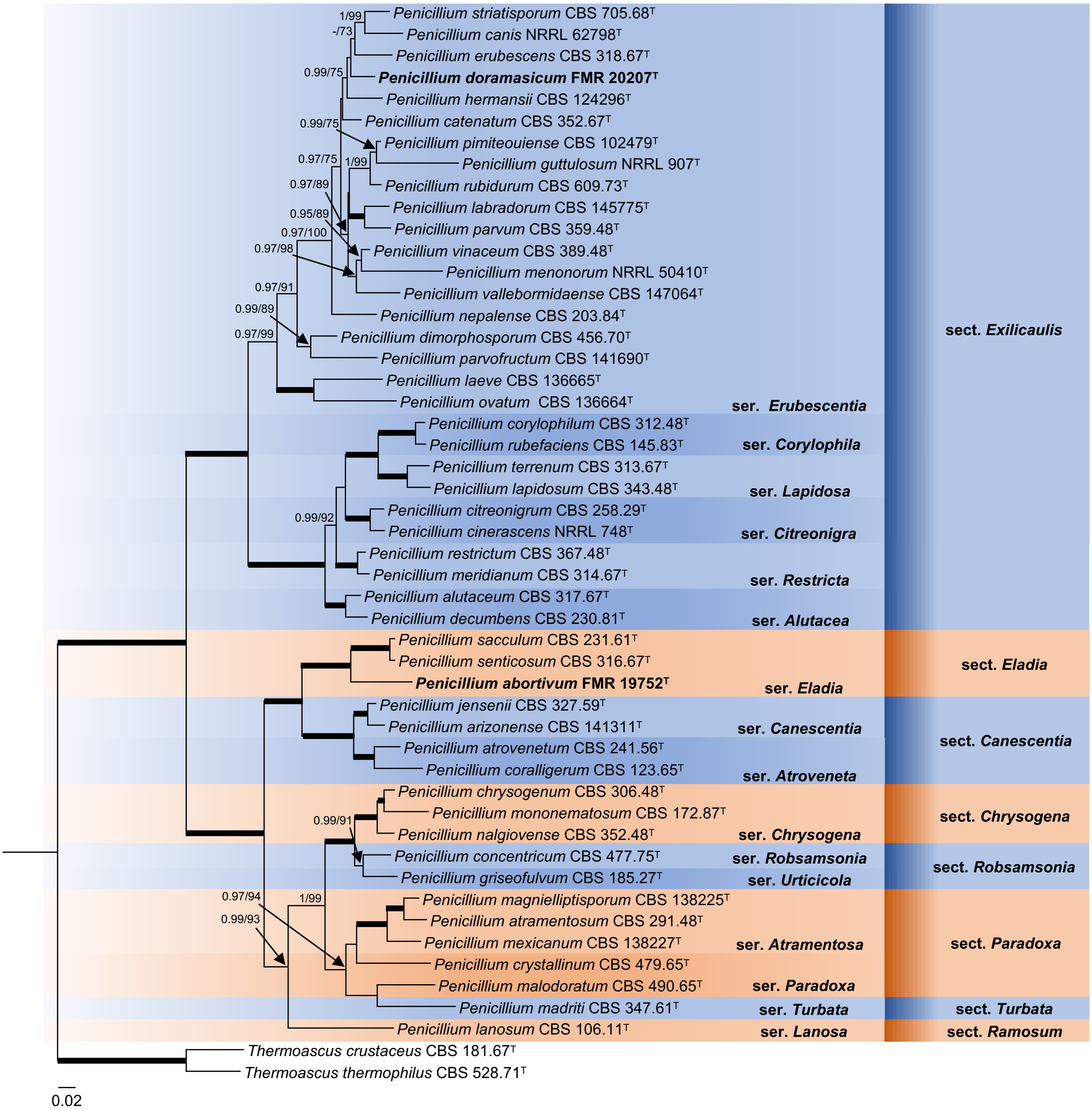

Fig. 2. Maximum likelihood tree obtained from the concatenated ITS-*tub2*-*rpb2*-*CaM* (2717 bp) alignment of the nucleotide sequences from our strains and those retrieved from the GenBank representing species in the genus *Penicillium*. Bayesian posterior probabilities (PP) ≥ 0.95 and the RAxML bootstrap support values (BS) ≥ 70 % are presented at the nodes (PP/BS). Thickened branches indicate full support (PP = 1 and BS = 100 %). The new species and combinations are noted in **bold**. ^{T} Ex-type strain. The tree was rooted with *Thermoascus crustaceus* (CBS 181.67^{T}) and *Thermoascus thermophilus* (CBS 528.71^{T})

(0.99/92 %) from the nearest ones *Arxotrichum* spp., while FMR 19933 was conspecific with *Corynascus verrucosus* CBS 137791 and CBS 135878. Within the *Chaetomium* (*C.*) spp. clade (1/100 %), FMR 20025 was identified as a new species, placed close to *C. telluricola* CBS 151.59 (BLAST *rpb2* ID = 95.77 %), and FMR 20017 and FMR 20135 were conspecific with *C. cochliodes* CBS 155.52 and *C. cucumericola* CBS 693.82, respectively. Regarding FMR 20129, it was identified as conspecific with *Steirochaetomium canariensis* CBS 150903. Our strain FMR 19774 was in a fully supported independent terminal clade related to the genus *Steirochaetomium* (*St.*), but representing a new genus. In the *Achaetomium* (*Ach.*) spp. clade (1/100 %), FMR 19765 was conspecific with *Ach. globosum* CBS 332.67. In the fully-supported *Ovatospora* (*O.*) spp. clade, FMR 20022 was placed in a fully supported terminal branch closely related but different than *O. senegalensis* strains CBS 798.83, CBS 728.84 and FMR 19005 (BLAST *rpb2* ID = 95.98 %, ID = 95.79 % and ID = 95.79 %, respectively); while FMR 20013, FMR19773 and FMR 20006 were conspecific with the type species of this genus (*O. senegalensis*). In the fully supported *Canariomyces* (*Can.*) spp. clade, the strains FMR 20057 and FMR 20143 were conspecific with *Can. notabilis* CBS 548.74 and CBS 508.74, while FMR 19760, FMR 19753 and FMR 19922 were with *Can. microsporus* CBS 161.80 and CBS 276.74. Regarding FMR 20208, it was in a fully supported terminal branch together with *Can. asexualis*, but as a distinct species (BLAST *rpb2* ID = 95.94 %). On the other hand, FMR 20014 was placed within the fully supported *Allocanariomyces* (*Alloc.*) spp. clade in a fully supported basal branch as a different species (BLAST *rpb2* ID = 95.37 %), while FMR 19935 was placed in a fully supported branch closely related to the *Allocanariomyces* spp. clade but representing a different new genus. Finally, FMR 19932 and FMR 19934 were conspecific with *Batnamyces* (*Bat.*) *globulariicola* CBS 149964 and *Parvomelanocarpus tardus* CBS 541.76, respectively; while FMR 19921 and FMR 19775 formed a monospecific fully supported lineage related to but distinct from *Bat. globulariicola*.

Aspergillaceae (*Penicillium* spp.)

The multilocus phylogenetic tree for *Penicillium* (*P.*) spp., constructed using ITS-*tub2*-*rpb2*-*CaM* (Fig. 2) as phylogenetic markers, included 49 ingroups and two outgroups (*Thermoascus crustaceus* CBS 181.67 and *Thermoascus thermophilus* CBS 528.71), with a total of 2717 positions including gaps (595 bp for ITS, 506 bp for *tub2*, 978 bp for *rpb2*, and 638 bp for *CaM*). Bayesian inference and ML analysis showed similar tree topology, with congruent results for each gene. In the phylogenetic tree (Fig. 2), FMR 20207 was placed in the series *Erubescentia* of the section *Exilicaulis*, in a terminal branch between the ex-type strains of *Penicillium erubescens* (CBS 318.67) and *Penicillium hermansii* (CBS 124296), but as a different species (BLAST *tub2* ID = 94.18 % and 93.15 %, respectively). Meanwhile, the strain FMR 19752 was in the series *Eladia* of the section *Eladia,* within a fully supported (1 PP/100 % BS) terminal clade including the ex-type strains of *Penicillium sacculum* (CBS 231.61) and *Penicillium senticosum* (CBS 316.67), but as a distinct species (BLAST *tub2* ID = 77.90 % and 77.18 %, respectively). The concatenated alignment is available on Zenodo: 10.5281/zenodo.14031860.

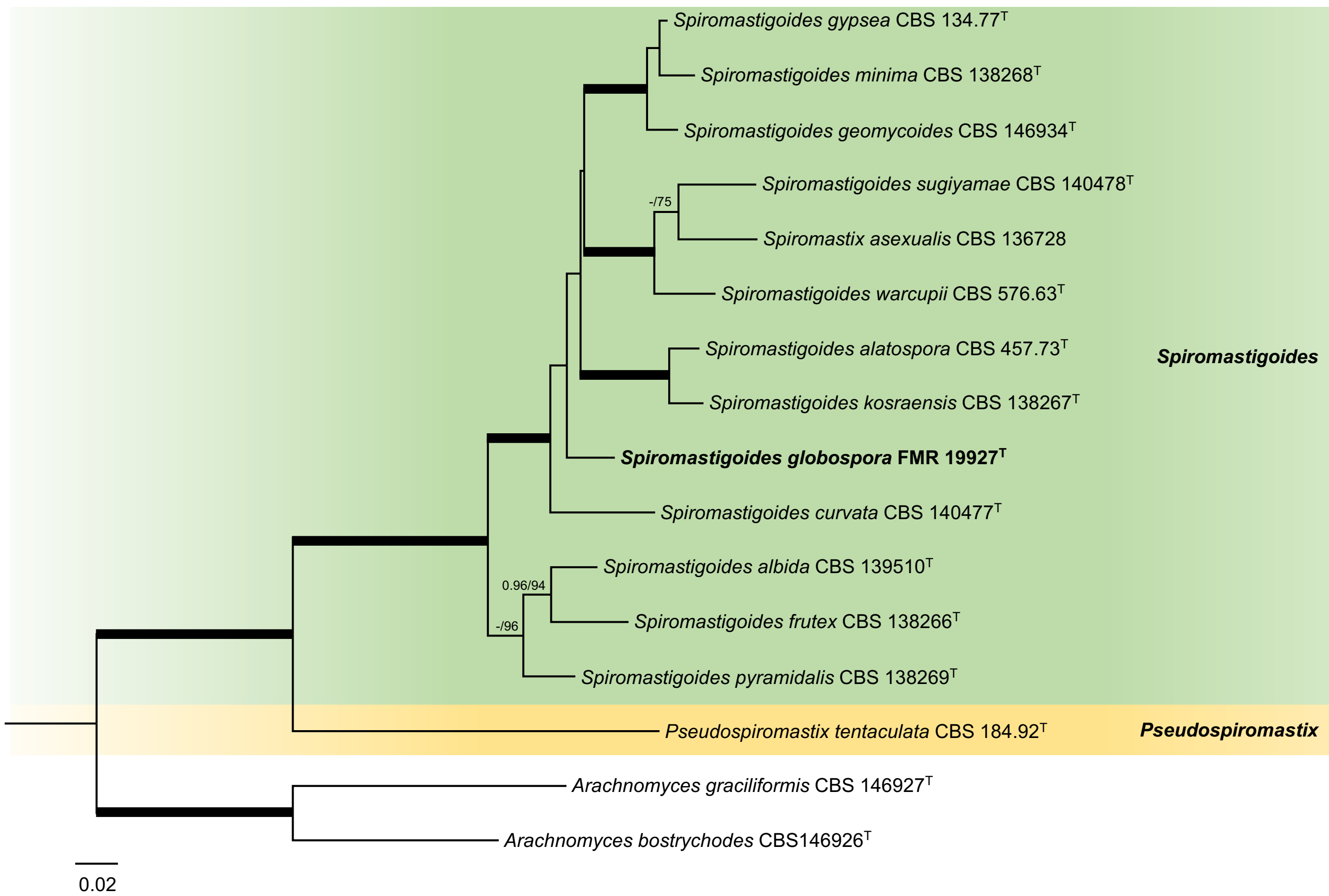

Fig. 3. Maximum likelihood tree obtained from the concatenated ITS-LSU (1522 bp) alignment of the nucleotide sequences from our strain and those retrieved from the GenBank representing species in the genera *Spiromastigoides* and *Pseudospiromastix*. Bayesian posterior probabilities (PP) ≥ 0.95 and the RAxML bootstrap support values (BS) ≥ 70 % are presented at the nodes (PP/BS). Thickened branches indicate full support (PP = 1 and BS = 100 %). The new species and combinations are noted in **bold**. ^{T} Ex-type strain. The tree was rooted with *Arachnomyces graciliformis* (CBS 146927^{T}) and *Arachnomyces bostrychodes* (CBS 146926^{T}).

Spiromastigoidaceae (*Spiromastigoides* spp.)

Regarding the species of *Spiromastigoides* (*S.*), a concatenated phylogenetic analysis was conducted using ITS and LSU (Fig. 3). The analysis included 14 ingroups species and two outgroups (*Arachnomyces graciliformis* CBS 146927 and *Arachnomyces bostrychodes* CBS 146927), totalling 1522 positions including gaps (679 bp for ITS, and 843 bp for LSU). Bayesian inference and ML analysis showed similar tree topology, with congruent results for each gene. In the phylogenetic tree, the strain FMR 19927 was positioned on a terminal branch between the clade including the ex-type strains of *S. alatospora* (CBS 457.73) and *S. kosraensis* (CBS 138267) and the terminal branch where the ex-type strain of *S. curvata* (CBS 140477) was placed, but as a distinct species (BLAST ITS ID = 93.52 %, 91.76 % and 92.19 %, respectively). The concatenated alignment is available on Zenodo: 10.5281/zenodo.14031892.

Fig. 4. Maximum likelihood tree obtained from the concatenated ITS-LSU (1405 bp) alignment of the nucleotide sequences from our strains and those retrieved from the GenBank representing species in the genus *Westerdykella*. Bayesian posterior probabilities (PP) ≥ 0.95 and the RAxML bootstrap support values (BS) ≥ 70 % are presented at the nodes (PP/BS). Thickened branches indicate full support (PP = 1 and BS = 100 %). The new species and combinations are noted in **bold**. ^{T}Ex-type strain. The tree was rooted with *Preussia typharum* (CBS 107.69) and *Preussia fleischhakii* (CBS 565.63).

Sporormiaceae (*Westerdykella* spp.)

Regarding the species of *Westerdykella* (*W.*), a concatenated phylogenetic tree was built using ITS and LSU nucleotide sequences (Fig. 4), comprising 22 ingroup species and two outgroups (*Preussia typharum* CBS 107.69 and *Preussia fleischhakii* CBS 565.63), with a total of 1405 positions including gaps (521 bp for ITS and 884 bp for LSU). Bayesian inference and ML analyses showed similar tree topology, with congruent results for each gene. The phylogenetic tree shows the strains FMR 20026 and FMR 20007 placed together in a terminal branch within a clade that also includes *W. reniformis* (DAOM 242243) but as a different species (BLAST ITS ID = 96.93 % and 96.54 %, respectively). The concatenated alignment is available on Zenodo: 10.5281/zenodo.14031924.

Thermoascaceae (*Thermoascus* spp.)

For the genus *Thermoascus* (*T.*), a multilocus phylogenetic tree was constructed using ITS and *tub2* nucleotide sequences (Fig. 5), comprising 13 ingroups and two outgroups (*Thermomyces lanuginosus* CBS 632.91.67 and *Thermomyces dupontii* CBS 236.58). The alignment included a total of 1200 positions including gaps (635 bp for ITS and 565 bp for *tub2*). Bayesian inference and ML analyses resulted in similar tree topology, with congruent results for each gene. In the phylogenetic tree the strain FMR 20242 was placed on a terminal branch, between the strains of *T. aurantiacus* (CBS 257.34) and the ex-type strain of *T. verrucosus* (CBS 605.74), but as a distinct species (BLAST ITS ID = 92.81 % and 96.10 %, respectively). The concatenated alignment is available on Zenodo: 10.5281/zenodo.14031915.

Taxonomy

Chaetomiaceae

Allocanariomyces diversisporus Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853754. Fig. 6.

Etymology: From Latin *diversus*-, diverse, -*sporae*, spores, due to the variation in the shape of its conidia.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25378, culture ex-type FMR 20014 = CBS 151777).

On OA after 2 wk at 25 °C: *Mycelium* mostly aerial, composed of septate, branched, smooth- and thin-walled, hyaline to brown, 1–4 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated in the vegetative hyphae, monoblastic. *Conidia* holoblastic, 1–2-celled, solitary, arising laterally or terminally on the hyphae, sessile, on short conical denticles or on short side branches, hyaline to subhyaline, smooth- and thin-walled, ellipsoidal, obovoid, pyriform, clavate, fusiform or irregularly-shaped (3.5–)4.5–17(–20) × 1.5–3 µm, round or pointed at the end, truncate at the base (Fig. 6E, F). *Sexual morph* not observed.

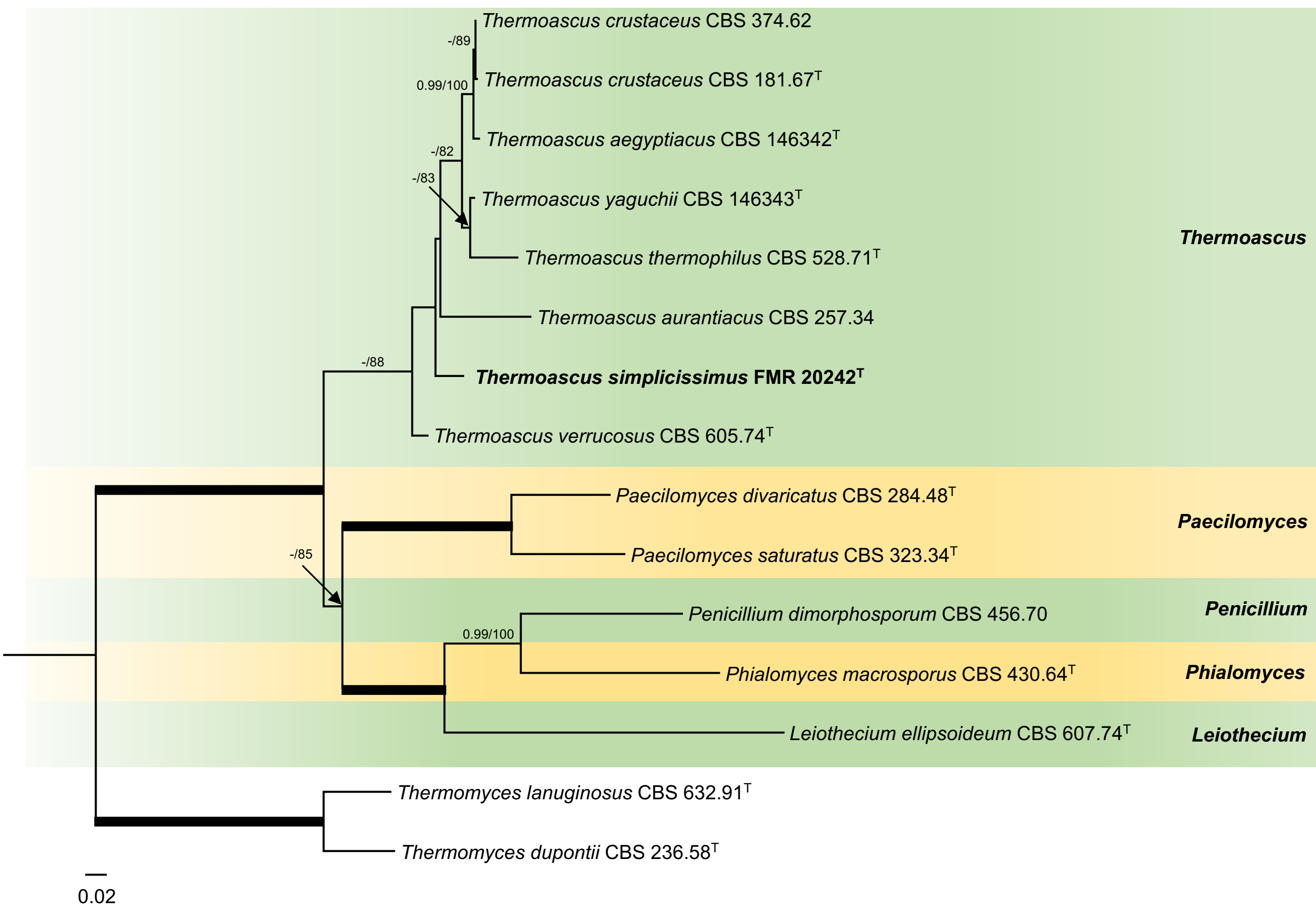

Fig. 5. Maximum likelihood tree obtained from the concatenated ITS-*tub2* (1200 bp) alignment of the nucleotide sequences from our strain and those retrieved from the GenBank representing species in the genus *Thermoascus* and related. Bayesian posterior probabilities (PP) ≥ 0.95 and the RAxML bootstrap support values (BS) ≥ 70 % are presented at the nodes (PP/BS). Thickened branches indicate full support (PP = 1 and BS = 100 %). The new species and combinations are noted in **bold**. [T] Ex-type strain. The tree was rooted with *Thermomyces lanuginosus* (CBS 632.91[T]) and *Thermomyces dupontii* (CBS 236.58[T]).

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 16–19 mm diam., flat, circular, restricted, margins filamentous and regular, surface uncoloured, without aerial mycelium; soluble pigment absent; reverse uncoloured. Colonies on MEA 25–26 mm diam., flat, circular, margins entire and regular, surface cream (4B3), grey (30D1) and velvety at the centre, margins uncoloured, with a white aerial mycelium; soluble pigment absent; reverse radiate, cream (4B3) and yellowish white (4A2) at the margins. Colonies on OA 40–43 mm diam., flat, circular, expansive, margins filamentous and regular, surface radiate, dark green (30F3), with grey (30C1) sparse and floccose aerial mycelium, margins uncoloured; soluble pigment absent; reverse dark green (30F4 to 30F3), margins uncoloured. Colonies on PCA 30–32 mm diam., flat, circular; margins entire and regular, surface radiate, velvety, greenish grey (1F3) with pastel grey (1C1) aerial hyphae, margins uncoloured; soluble pigment absent; reverse radiate, pale grey (1F3) to grey (1F1), margins uncoloured. Minimum, optimum and maximum temperature of growth: 15 °C, 37 °C and 45 °C, respectively.

Notes: *Allocanariomyces diversisporus* can be distinguished from *Alloc. tritici* and *Alloc. americanus* by the absence of a sexual morph and the production of larger conidia, which are more morphologically variable. In *Alloc. diversisporus*, the conidia have a variable shape, from ellipsoid, obovoid to pyriform, clavate, fusiform, and cylindrical, and measure (3.5–)4.5–17(–20) × 1.5–3 µm. In contrast, *Alloc. tritici* produces globose to pyriform conidia that are hyaline to brown, with dimensions of 3–9 × 3–4.5 µm, while *A. americanus* has obovoid to pyriform conidia measuring 5–7.75 × 2.5–5 µm (Mehrabi *et al.* 2020, Ryan *et al.* 2021, Wang *et al.* 2022).

Botryotrichum solisexuale Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853755. Fig. 7.

Etymology: From Latin *solum*-, only, and -*sexus*-, sex, because the fungus only reproduces sexually.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25379, culture ex-type FMR 20012 = CBS 151778).

On OA after 4 wk at 25 °C: *Mycelium* scarce, mostly submerged or superficial, composed of septate, branching, smooth- and thin-walled, subhyaline to brown, 1–4 µm wide hyphae. *Ascomata* superficial, solitary, olivaceous brown to olivaceous grey under reflected light, setose, ostiolate, globose, subglobose, ovoid or barrel-shaped, 80–160 × 50–140 µm (Fig. 7E). *Peridial wall* translucent, greenish-brown to olivaceous grey, 5–6-layered, 5–11 µm broad, outer layer of *textura epidermoidea* to *angularis* (Fig. 7F, G); *terminal hairs* abundant around the ostiole, greenish brown to olivaceous grey, septate, straight to the base and helical to the top, with a verrucous wall, pointed or geniculate at the apex, mostly over three times longer than the ascomata, 4–6 µm wide at the base (Fig. 7E); *lateral hairs* setae-like, straight, septate, greenish brown to olivaceous grey, up to 38 µm long, slightly verrucose (Fig. 7F, G). *Asci* unitunicate, fasciculate, broadly clavate to fusiform, spore-bearing part 23–42 × 10–19 µm, stalks 8–9 × 3–3.5 µm, with 8 irregularly-arranged or biseriate ascospores, soon evanescent (Fig. 7H). *Ascospores* unicellular, hyaline to pale pinkish brown when young, brown to dark brown when mature, smooth-walled, broadly fusiform, (12–)13–14(–15) × (7–)7.5–8(–8.5) × 7–8 µm, attenuated at one end, with an apical germ pore (Fig. 7I). *Asexual morph* not seen.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 23–24 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured, with scarce white (3A1) aerial mycelium and mucous at the centre; soluble pigment absent; reverse uncoloured. Colonies on MEA 22–23 mm diam., flat, circular, expansive, margins filamentous and regular, surface greyish cream (4B3) with a scarce white (5A1) aerial mycelium; soluble pigment absent; reverse pale

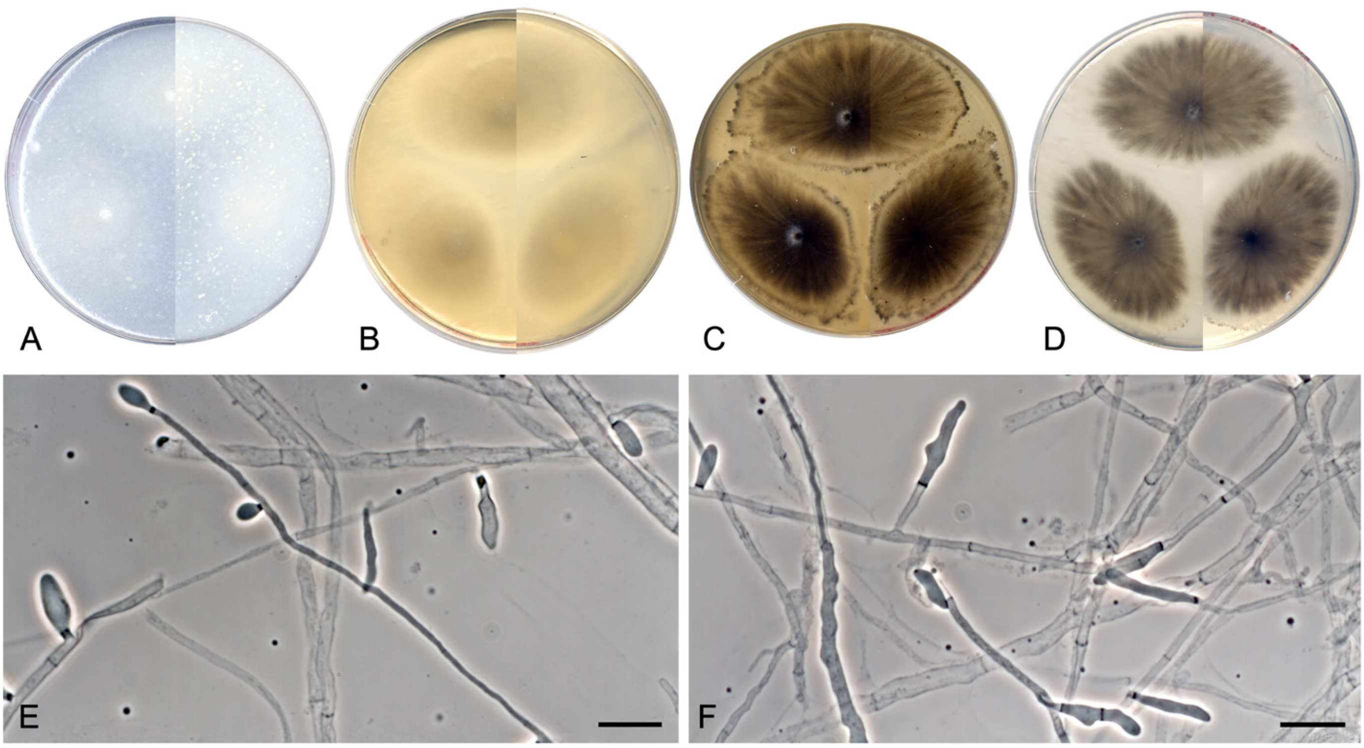

Fig. 6. *Allocanariomyces diversisporus* CBS 151777[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Sessile conidia and on side short branches. PC. Scale bars = 10 µm.

yellow (4A3) and yellowish white (4A2) at the margins. Colonies on OA 40–41 mm diam., flat, circular expansive, margins filamentous and regular, surface uncoloured with a scarce white (3A1) aerial mycelium and greyish brown (5D3) ascomata surrounding by mucus, and champagne (4B4) at the centre; soluble pigment absent; reverse uncoloured with greyish brown (5D3) dots. Colonies on PCA 22–23 mm diam., flat, circular, expansive, margins entire and regular, surface greyish white (1B1) with sparse greyish brown (5D3) ascomata and a scarce floccose white (1A1) aerial mycelium; soluble pigment absent; reverse white (1A2) and dark green (30F4) at the centre. Minimum, optimum and maximum temperature of growth: 5 °C, 30 °C and 40 °C, respectively.

Notes: *Botryotrichum solisexuale* differs from *B. spirotrichum* (one of the phylogenetic closest species) by having ascomata whose ostioles are surrounded by spirally coiled hairs, instead the non-ostiolate ascomata ornamented with two (or three) tufts of spirally coiled hairs at both extremes in *B. spirotrichum* (Benjamin 1955). Regarding to *B. geniculatum*, their non-ostiolate ascomata, asci and ascospores measure 150–310 µm diam., 48–72 × 20–22 µm, and (16.5–)17–20(–30) × (11–)11.5–13(–14) µm, respectively, whereas in *B. solisexuale* their dimensions are 80–160 × 50–140 µm, 23–42 × 10–19 µm, and (12–)13–14(–15) × (7–)7.5–8(–8.5) µm, respectively (Wang *et al.* 2022). *Botryotrichum solisexuale* was isolated via the *ToKaVa* technique; consequently, it's suspected to be a keratinophilic species.

Canariomyces similis Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853757. Fig. 8.

Etymology: From Latin *similis*-, similar, because the main morphological features are like *C. asexualis*.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25380, culture ex-type FMR 20208 = CBS 152078).

On OA after 2 wk of incubation at 25 °C: *Mycelium* mostly aerial, composed of septate, branched, anastomosing, smooth- and thin-walled (when hyaline) to subhyaline and granulose (when pigmented), 1–4 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated in the hyphae, monoblastic. *Conidia* holoblastic, unicellular, solitary, arising laterally on the hyphae, sessile or rarely on a short cylindric protrusion, subhyaline to olivaceous brown, smooth- and thin-walled, globose, subglobose,

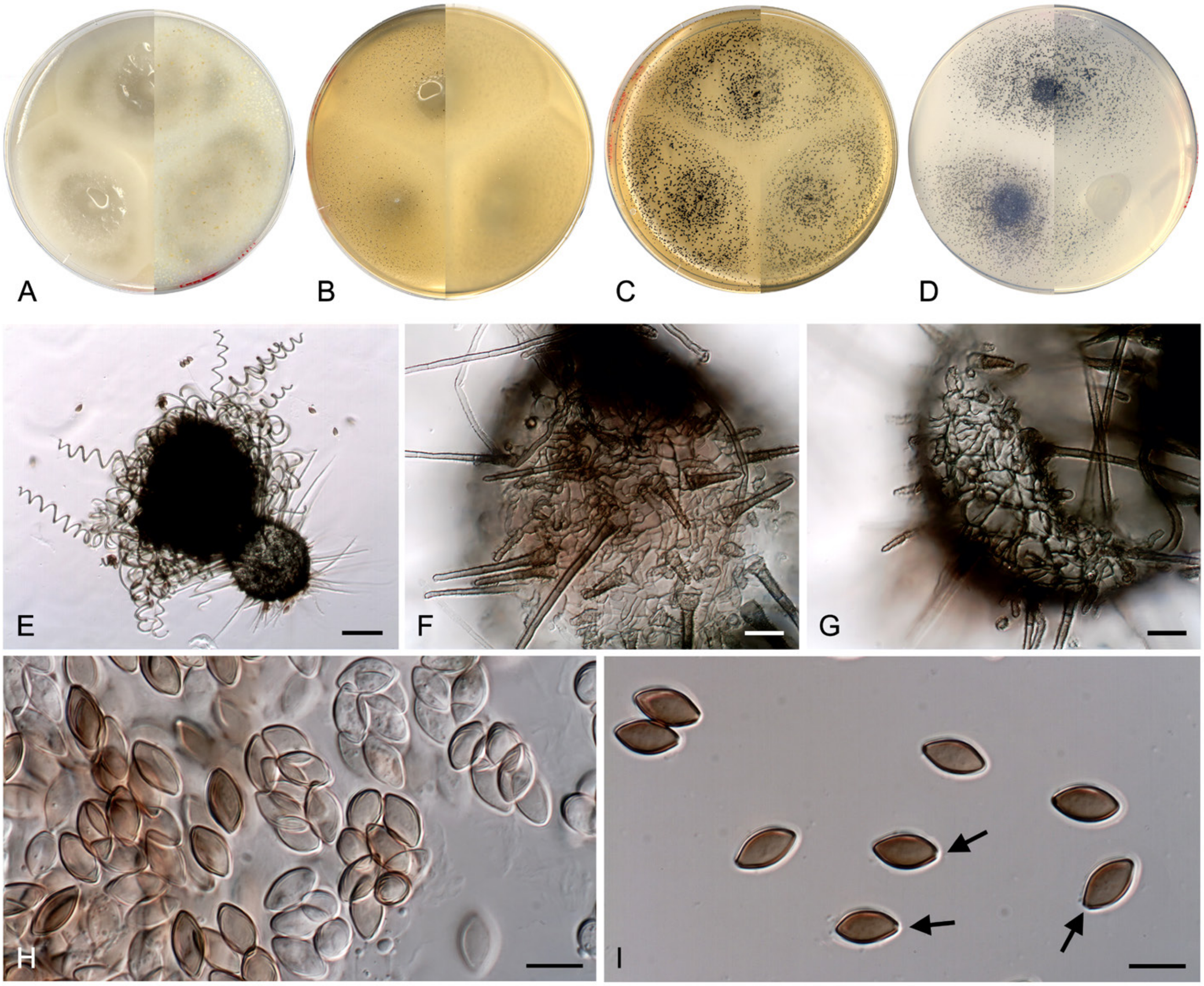

Fig. 7. *Botryotrichum solisexuale* CBS 151778[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Mature ascoma. **F, G.** Detail of the peridium. **H.** Asci within ascospores. **I.** Mature ascospores showing a terminal germ pore (black arrows). DIC Nomarski. Scale bars: E = 50 µm; F–I = 10 µm.

obovoid, ovoid or pyriform, (2.5–)3–6(–8) × (2–)2.5–4(–4.5) µm, often with a wide base (Fig. 8E, F). *Sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 22–23 mm diam., flat, circular, margins entire and regular, surface dark green (30F5) with a floccose grey (30D1) aerial mycelium; soluble pigment absent; reverse greenish grey (30F2). Colonies on MEA 34–35 mm diam., flat, circular, margins entire and regular, surface greyish green (1F4), darker at the centre, with a grey (1D2) and floccose aerial mycelium; soluble pigment absent; reverse radiated, greyish green (1F3), dark green (1F2) at the centre and uncoloured at the margins. Colonies on OA 39–40 mm diam., flat, circular, expansive, margins filamentous and regular, surface greyish green (1F4) with a sparse pastel grey (1C1) aerial mycelium; soluble pigment absent; reverse light grey (1F3). Colonies on PCA 35–36 mm diam., flat, circular, expansive, margins entire and regular, surface olive (1F4) with olive grey (1D2) aerial mycelium and yellowish white (4A2) margins; soluble pigment absent; reverse radiated, greenish grey (1F3) and yellowish white (4A2) margins. Minimum, optimum and maximum temperature of growth: 12 °C, 35 °C and 40 °C, respectively.

Note: *Canariomyces similis* produces globose to pyriform sessile conidia, which are mostly fusiform or heart-shaped in *Can. asexualis*, its phylogenetic closest species.

Catenatispora Sastoque, Cano & Stchigel, ***gen. nov.*** MB 853758.

Etymology: From Latin *catenatus*-, in chains, -*sporae*, spores, because the fungus produces long chains of holothallic conidia.

Mycelium composed of septate, hyaline to brown, branched, smooth- and thin- to thick-walled hyphae. *Conidiophores* absent. *Conidia* holothallic, formed by a deep remodelling of pre-existent hyphae sections, 0–1-septate, hyaline to dark brown, smooth- and thin- to thick-walled, globose, subglobose, barrel-shaped, cylindrical, rarely obovate, often flattened at both ends but without visible scars, disposed in simple or ramified chains of up to 30 conidia, getting old from the centre to the ends, forming secondary conidia by meristematic proliferation, detached from the conidiogenous hyphae by schizolysis. *Endoconidia* rare, hyaline, globose to ellipsoid, disposed in long chains. *Sexual morph* not seen.

Type species: Catenatispora terrestris Sastoque, Cano & Stchigel

Catenatispora terrestris Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853759. Fig. 9.

Etymology: From Latin *terrestris*, terrestrial, because the fungus inhabits the soil.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25394, culture ex-type FMR 19775 = CBS 151779).

Additional material examined: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, isolated from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (culture FMR 19921).

On PCA after 6 wk at 25 °C: *Mycelium* abundant, composed of septate, hyaline to brown, branched, smooth- and thin-walled hyphae (moderately thick-walled when pigmented), 1–9 µm wide. *Conidiophores* absent. *Conidia* holothallic, formed by remodelling of pre-existent hyphae sections, 0–1-septate, hyaline to dark brown pigmented, smooth- and thin- to thick-walled, globose, subglobose, barrel-shaped, cylindrical, rarely obovate, 5–15.5 × 4–20 µm, often flattened at both ends but without visible scars, in simple or ramified chains of up to 30 conidia (Fig. 9E), getting old from the centre to the ends, forming secondary conidia by meristematic proliferation (Fig. 9F), detached from the conidiogenous hyphae by schizolysis (Fig.

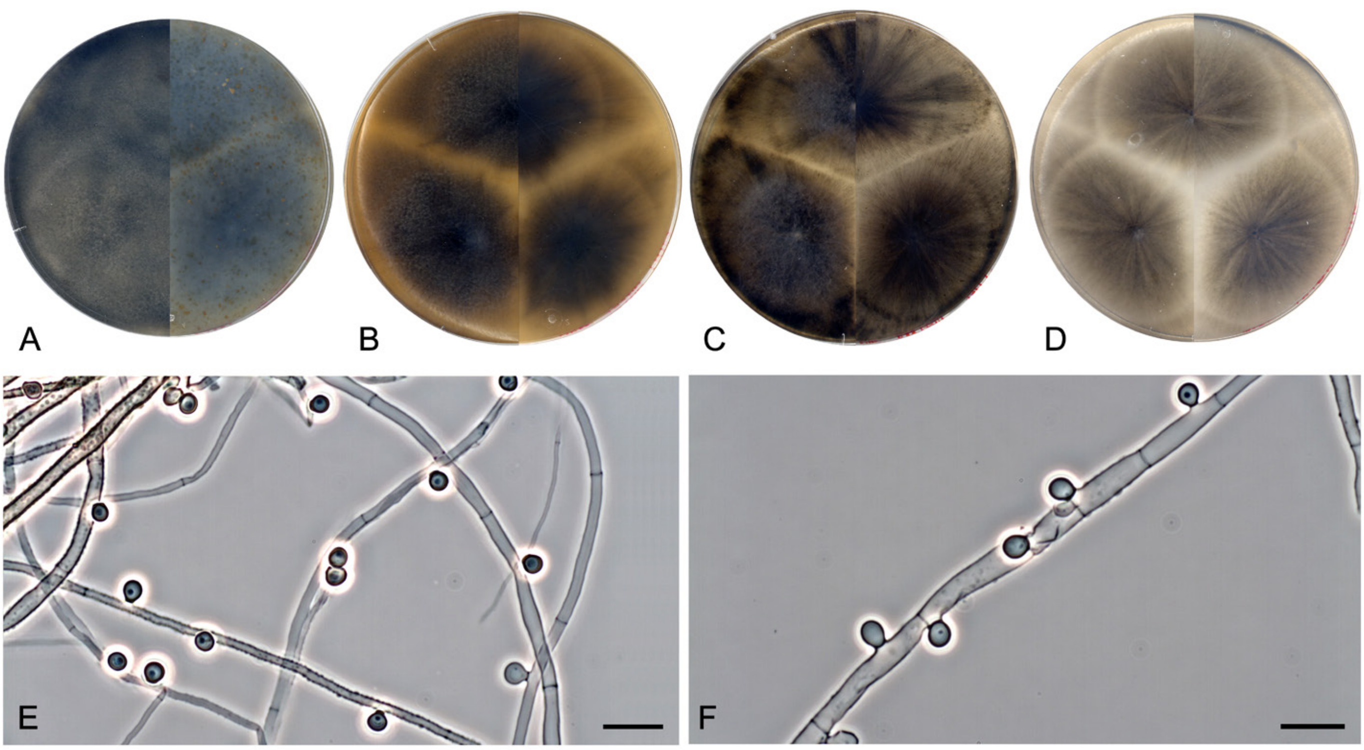

Fig. 8. *Canariomyces similis* CBS 152078. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Sessile conidia. PC. Scale bars = 10 µm.

9E–G). *Endoconidia* rare, hyaline, globose to ellipsoid, disposed in long chains, 0–1-septate, 4–16 × 5–9 µm (matching with the maximum wideness of the hyphae) (Fig. 9H). *Sexual morph* not seen.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 60–65 mm diam., circular, flat, expansive, margins filamentous and regular, surface radiated, black (6F3) because of submerged mycelium, with sparse, scarce, and grey (6E2) aerial hyphae; soluble pigment absent; reverse black (6F3). Colonies on MEA 65–70 mm diam., circular, flat, expansive, margins filamentous and slightly irregular, surface dark green (30F4) due to its filamentous and submerged mycelium, with scarce and sparse greenish grey (30E2) aerial hyphae; soluble pigment absent; reverse dark green (30F4). Colonies on OA 65–70 mm diam., circular, flat, expansive, margins filamentous and regular, surface radiated, ivy green (1F3) with sparse and scarce greyish white (1B1) aerial mycelium; soluble pigment absent; reverse similar in colour than the surface. Colonies on PCA 64–66 mm diam., circular, flat, expansive, margins filamentous and regular, surface radiated, ivy green (1F3) due to the submerged mycelium, with scarce, sparse, floccose, white (1A1) aerial hyphae; soluble pigment absent; reverse similar in colour to the surface. Minimum, optimum and maximum growth temperature: 15 °C, 30 °C and 45 °C, respectively.

Notes: Catenatispora (Cat.) terrestris differs from Bat. globulariicola, the phylogenetic closest taxon, by the production of 0–1-septate, hyaline to dark brown, globose, subglobose, barrel-shaped, cylindrical, rarely obovate holothallic conidia, measuring 5–15.5 × 4–20 µm and disposed in long chains, as well as by the formation of globose to ellipsoidal hyaline endoconidia in long chains, whereas *Bat. globulariicola* only produces ellipsoidal and smaller (5–12 × 8 µm) holothallic conidia in short chains. Also, both taxa differ in the maximum temperature of growth, being 28–30 °C for *Bat. globulariicola* and 45 °C for *Cat. terrestris* (Noumeur *et al.* 2020).

Chaetomium annellidicum Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853761. Fig. 10.

Etymology: Because the only mechanism of multiplication is through the production of annellidic conidia.

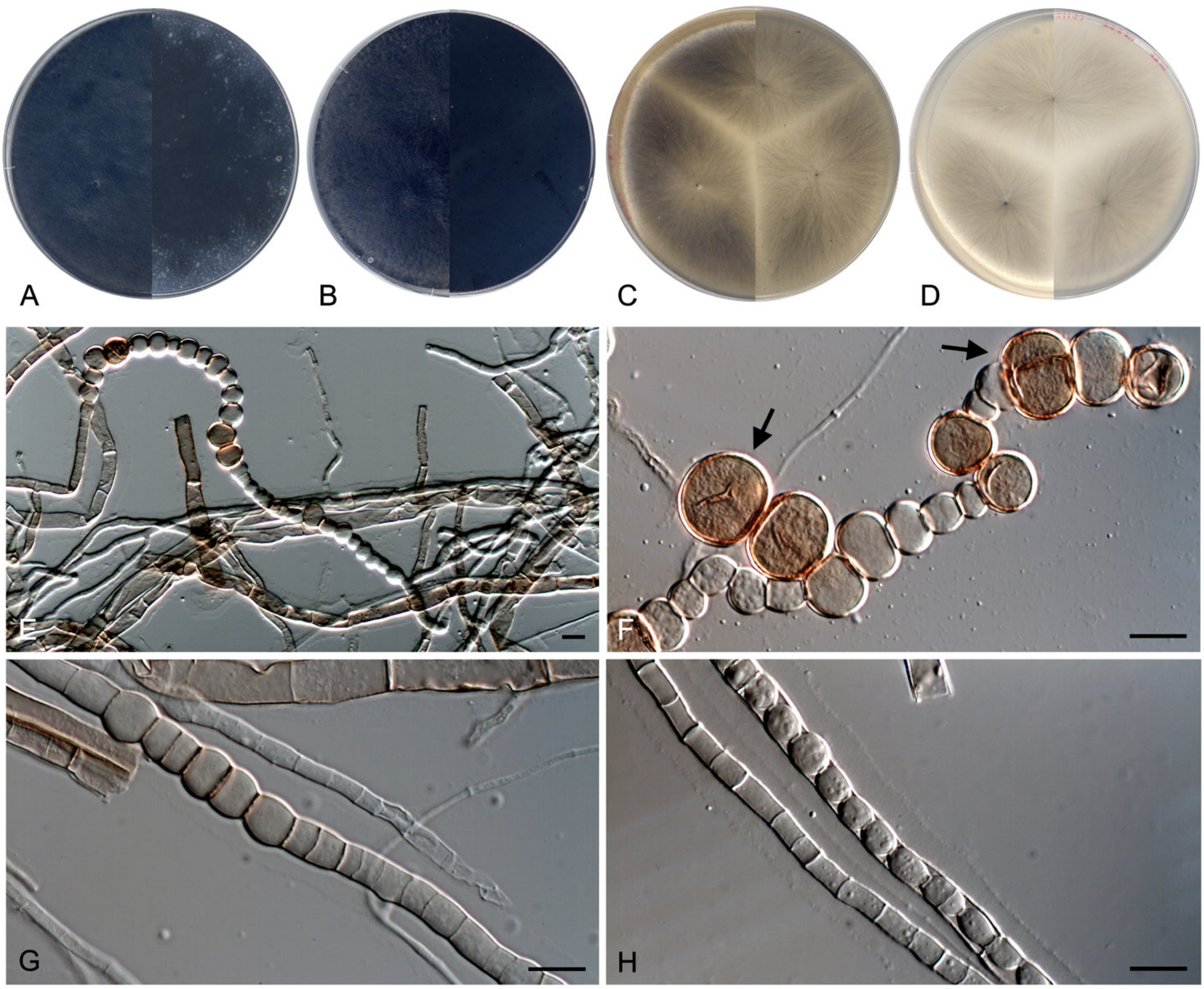

Fig. 9. *Catenatispora terrestris* CBS 151779[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E–G.** Hyaline to dark-brown conidia in simple or ramified chains, some with meristematic proliferation (transverse septa, black arrows). **H.** Endoconidia disposed in chain. DIC Nomarski. Scale bars = 10 µm.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25381, culture ex-type FMR 20025 = CBS 152610).

On OA after 2 wk at 25 °C: *Mycelium* composed of branched, smooth- and thin-walled, septate, hyaline, 1–3 µm wide hyphae. *Conidiophore* reduced to a conidiogenous cell. *Conidiogenous cells* arising laterally or terminally on the hyphae, hyaline, annellidic (Fig. 10E), simple, elongate bottle-shaped to nearly cylindrical, 8–31 × 1.5–2 µm, usually separated from the hypha by a basal septum, tapering progressively towards the apex, apex with 1–4 narrow annellations, rarely phialidic then having a collarette (Fig. 10F). *Conidia* enteroblastic, unicellular, formed in basipetal chains, ellipsoidal, obpyriform or obovoid, 2–5 × 1–2 µm, with a truncate base and a rounded apex (Fig. 10G). *Sexual morph* not produced.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 60–63 mm diam., flat, circular, margins filamentous and regular, surface uncoloured with dark blonde (5D4) patches and with a scarce yellowish white (4A2) aerial mycelium; soluble pigment absent; reverse like the surface. Colonies on MEA 58–62 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured with scarce white (4A1) aerial mycelium; soluble pigment absent; reverse uncoloured. Colonies on OA 67–70 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured with white (3A1) to pastel-yellow (3A4) sparse patches and with a floccose aerial mycelium mainly in the margins; soluble pigment absent; reverse uncoloured with patches yellowish white (3A4). Colonies on PCA 58–62 mm diam., flat, circular, margins entire and regular, surface uncoloured to yellowish white (3A2) with scarce white (4A1) floccose aerial hyphae; soluble pigment absent; reverse uncoloured to yellowish white (3A2). Minimum, optimum and maximum temperature of growth: 12 °C, 25 °C and 35 °C, respectively.

Notes: *Chaetomium annellidicum* is phylogenetically close to *C. telluricola* and *C. rectangulare*, differing from *C. telluricola* by the absence of a sexual morph and the production of an asexual morph (absent in *C. telluricola*). Regarding to *C. rectangulare*, *C. annellidicum* produces annellidic conidiogenous cells instead the phialidic asexual morph of *C. rectangulare* (Wang *et al.* 2016a).

Humicola simplicissima Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853762. Fig. 11.

Etymology: From Latin *simplicissima*, extremely simple, because the fungus only produces vegetative hyphae and conidia indistinguishable from other species of the genus.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch* & *A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25382, culture ex-type FMR 20131 = CBS 151780).

On PCA after 2 wk at 25 °C: *Mycelium* composed of hyaline to subhyaline, septate, branched, smooth- and thin-walled, 1–4 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated into the vegetative hypha. *Conidia* holoblastic, unicellular, solitary or in chains of two, or grouped in small clusters, sessile, on short conical denticles or on short side branches from the hyphae, smooth- and thin- to thick-walled, subhyaline, pale olivaceous brown to brown, globose or subglobose, (6.5–)8–9(–11) × (7–)8–10(–11) µm (Fig. 11E, F). *Synasexual morph* and *sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 17–21 mm diam., flat, circular, margins filamentous and regular, surface pastel yellow (2A4) with white (2A1) aerial hyphae floccose at the centre and sparse at the margins; soluble pigment absent; reverse pastel yellow (2A4). Colonies on MEA 22–23 mm diam., flat, circular, margins entire and regular, surface yellowish white

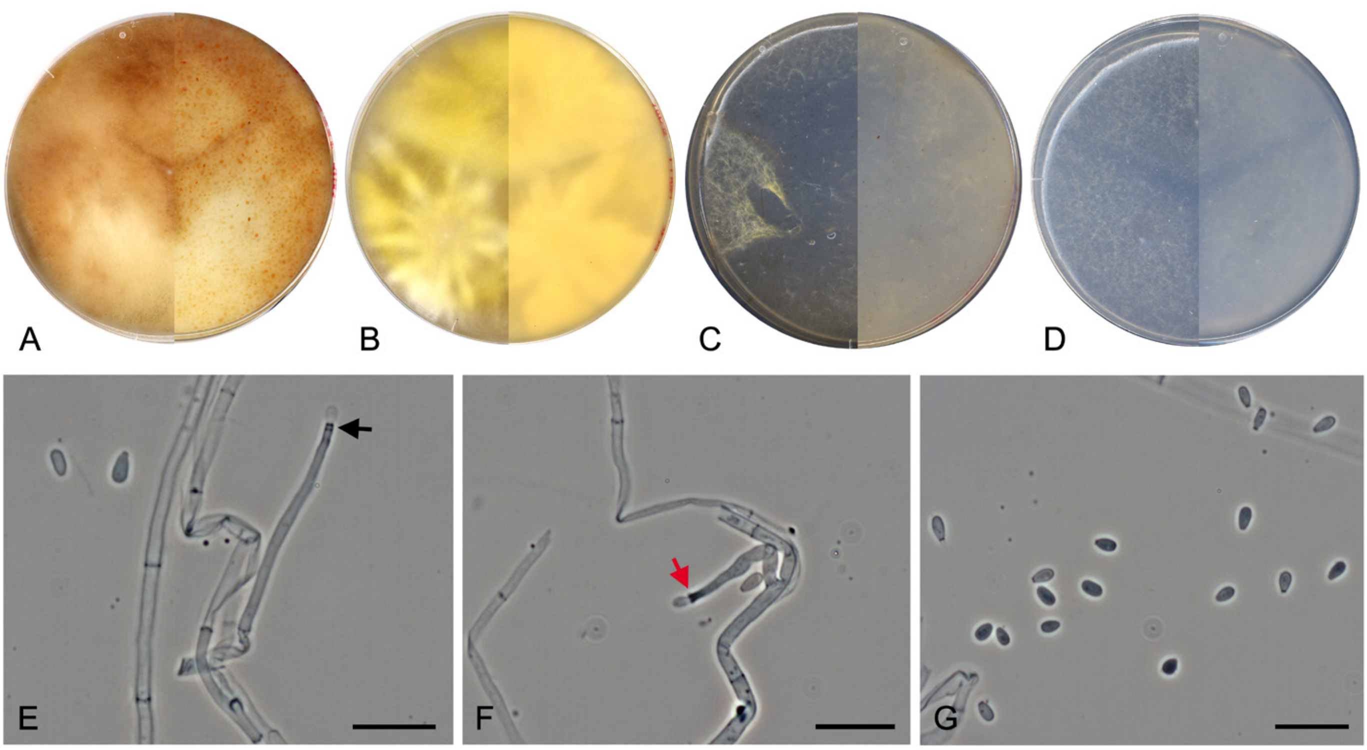

Fig. 10. *Chaetomium annellidicum* CBS 152610[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Annellidic conidiogenous cell (annellations, black arrow). **F.** Phialidic conidiogenous cell (collarette, red arrow). **G.** Conidia. PC. Scale bars = 10 µm.

(4A2) with white (4A1) velvety aerial hyphae, slightly floccose at the centre; soluble pigment absent; reverse pastel yellow (3A4) at the centre, with yellowish white (3A2) margins. Colonies on OA 29–30 mm diam., flat, circular, expansive, margins entire and regular, surface uncoloured with sparse white (4A1) floccose aerial hyphae; soluble pigment absent; reverse uncoloured. Colonies on PCA 12–15 mm diam., flat, circular, margins filamentous and irregular to lobulated, surface olive (3D5) with white (3A1) floccose, abundant and foamy aerial mycelium at the centre, and translucent at the margins; soluble pigment absent; reverse olive-brown (4D4) at the centre, surrounded by olive (3D3), with uncoloured and translucent margins. Minimum, optimum and maximum growth temperature: 15 °C, 25 °C and 30 °C, respectively.

Notes: *Humicola brevis* and *H. distorta* are the phylogenetically closest species to *H. simplicissima*. They differ in the shape and size of their conidia. In *H. brevis*, the conidia are lateral, terminal, and occasionally intercalary, globose, subglobose or pyriform, measuring (3.5–)5–8(–11) × (4–)5–8(–10) µm (Gilman 1957), whereas in *H. distorta* these are globose to oblate, sometimes obovoid or pyriform, hyaline or subhyaline, measuring 6.5–14.5 × 7–9 µm (Wang *et al.* 2019b), and in *H. simplicissima* these are subhyaline, pale olivaceous brown to brown, globose or subglobose, and measuring (6.5–)8–9(–11) × (7–)8–10(–11) µm. *Humicola simplicissima* was isolated via the *ToKaVa* technique; consequently, the fungus is presumptively keratinophilic.

Novoallocanariomyces Sastoque, Stchigel & Cano, ***gen. nov.*** MB 853763.

Etymology: From Latin *novus*-, new, because its phylogenetic relationship with the genus *Allocanariomyces*.

Mycelium mostly aerial, composed of septate, hyaline to pigmented, branched, anastomosing, smooth- and thin-walled, cylindrical to slightly torulose hyphae. *Conidiogenous cells* integrated into the hyphae, monoblastic, producing sessile conidia. *Conidia* unicellular, solitary, arising laterally on the hyphae, on short conical denticles or sessile, hyaline, refractive, thin-walled, smooth to verrucose, subglobose, obovoid or pyriform with a basal hyaline scar and detaching from the hyphae by rhexolytic secession. *Sexual morph* not observed.

Type species: *Novoallocanariomyces verrucisporus* Sastoque, Stchigel & Cano

Novoallocanariomyces verrucisporus Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853766. Fig. 12.

Etymology: From Latin *verrucosum*-, warty, and -*sporae*, spore, because the ornamentation of the conidia.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25383, culture ex-type FMR 19935 = CBS 151781).

On PCA after 8 wk at 25 °C: *Mycelium* mostly aerial, composed of septate, hyaline to brown, smooth- and thin-walled to crater-like ornamented and moderately thick-walled, branched, anastomosing, cylindrical to slightly torulose hyphae, 1.5–6 µm wide (Fig. 12E). *Conidiogenous cells* integrated to the hyphae, monoblastic. *Conidia* unicellular, solitary, arising laterally on the hyphae, on short conical denticles or sessile, hyaline, refractive, thin-walled, smooth to verrucose, subglobose, obovoid or pyriform, 3–5 × 3–4.5 µm, with a basal hyaline scar and detaching from the hyphae by rhexolytic secession (Fig. 12F). *Sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 28–29 mm diam., flat, circular, margins entire and slightly irregular, surface

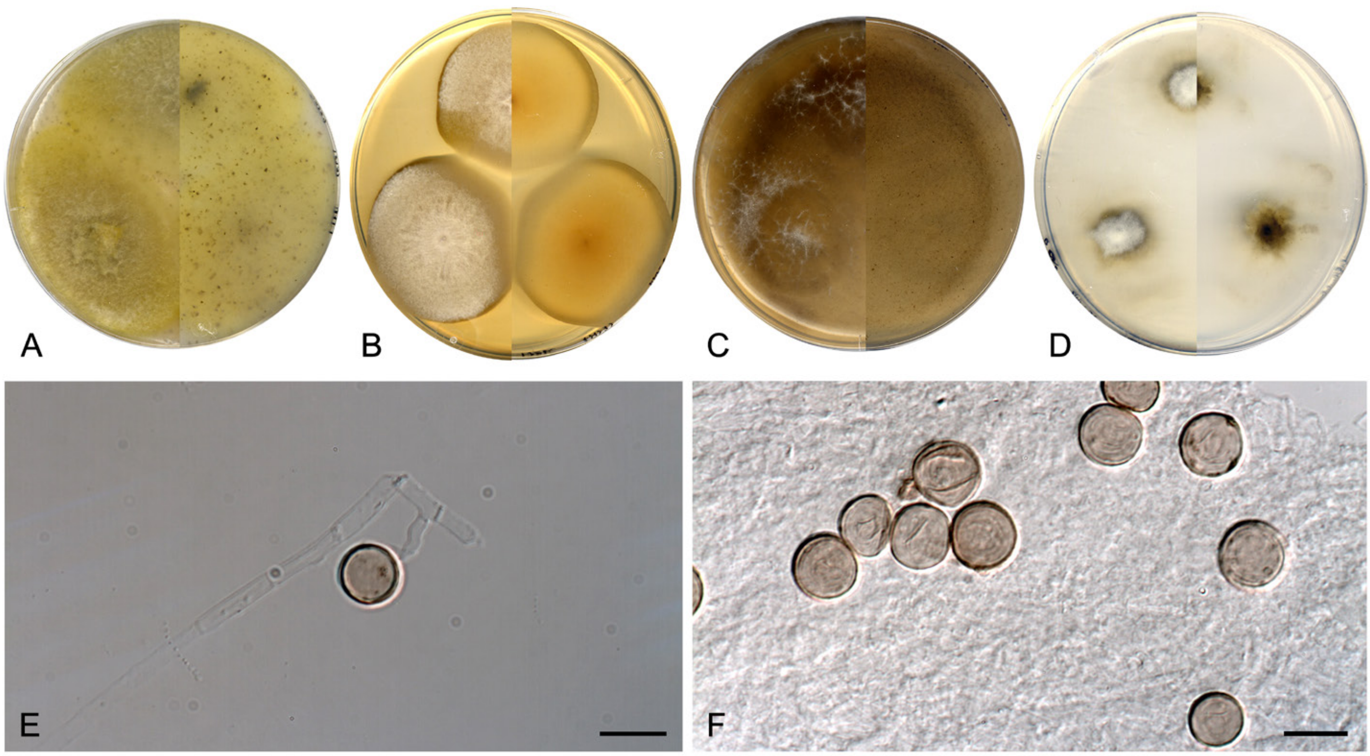

Fig. 11. *Humicola simplicissima* CBS 151780^{T}. **A–D.** Colony on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Holoblastic conidia. DIC Nomarski. Scale bars = 10 µm.

radiated, dark green (3F3) with beige (4B2) aerial mycelium, uncoloured margins; soluble pigment absent; reverse dark green (3F3) at the centre, surrounded by grey (3F2) zone. Colonies on MEA 18–19 mm diam., flat, circular; margins entire and regular; surface cream (4B3), with white (4A1) velvety aerial hyphae at the centre, yellowish white (4A2) at the margins; soluble pigment absent; reverse cream (4B3), yellowish white (4A2) at the margins and at the central area. Colonies on OA 39–40 mm diam., flat, circular, expansive, margins filamentous and regular, surface radiated, olive (3F3) with sparse white (3A1) and floccose aerial mycelium, uncoloured at the margins; soluble pigment absent; reverse olive (3F3), uncoloured at the margins. Colonies on PCA 20–21 mm diam., flat, circular, margins entire and regular, surface with concentric rings, from the centre to the margins old silver (4E2), grey (5C2 to 4D2) and yellowish white (4A2), with sparse greyish white (1B1), floccose aerial hyphae; soluble pigment absent; reverse concentric, from the centre to the margins grey (5E2 to 5C2) greyish beige (4C2) and yellowish white (4A2). Minimum, optimum and maximum growth temperature: 20 °C, 35 °C and 45 °C, respectively.

Note: *Novoallocanariomyces verrucisporus* differs from *Alloc. diversisporus*, the phylogenetic closest taxon, by the production of verrucose sessile conidia (smooth-walled and larger in *Alloc. diversisporus*), and by the presence of brown hyphae with a crater-like ornamentation (smooth-walled and hyaline in *Alloc. diversisporus*).

Novochaetomium Sastoque, Cano & Stchigel, ***gen. nov*.** MB 853767.

Etymology: From Latin *novus*-, new, because the genus is phylogenetically close related to *Chaetomium* but different.

Mycelium composed of septate, hyaline, branched, smooth- and thin-walled hyphae. *Conidiophores* micronematous, reduced to the conidiogenous cell. *Conidiogenous cells* phialidic, arising laterally from hyphae, hyaline, discrete, single, elongate bottle-shaped or cylindrical but tapering progressively toward the apex, with a long neck and a discrete collarette. *Conidia* enteroblastic, unicellular, produced in basipetal chains or solitary but grouped in a mucilaginous mass, subglobose, obovoid or ellipsoidal, truncated at the base and rounded at the apex. *Sexual morph* not seen.

Type species: *Novochaetomium canariense* Sastoque, Cano & Stchigel

Novochaetomium canariense Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853768. Fig. 13.

Etymology: Because of the geographic origin of the fungus.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25384, culture ex-type FMR 19774 = CBS 151782).

On PCA after 2 wk at 25 °C: *Mycelium* composed of septate, hyaline, branched, smooth- and thin-walled, 1–4 µm wide hyphae. *Conidiophores* micronematous, reduced to the conidiogenous cell. *Conidiogenous cells* phialidic, arising laterally from hyphae, hyaline, discrete, 0–1-septate, single, smooth- and thin-walled, elongate bottle-shaped or cylindrical but tapering progressively toward the apex, 7–15 × 1.5–2.5 µm, with a long (up to 5 µm) neck when bottle-shaped, and a discrete cylindric collarette (Fig. 13E, F). *Conidia* enteroblastic, unicellular, produced in basipetal chains or solitary but grouped in a mucilaginous mass, subglobose, obovoid or ellipsoidal, 2–4 × 1.5–2 µm, truncated at the base and rounded at the apex (Fig. 13E, F). *Sexual morph* not seen.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 17–20 mm diam., flat, soft, circular, margins filamentous and regular,

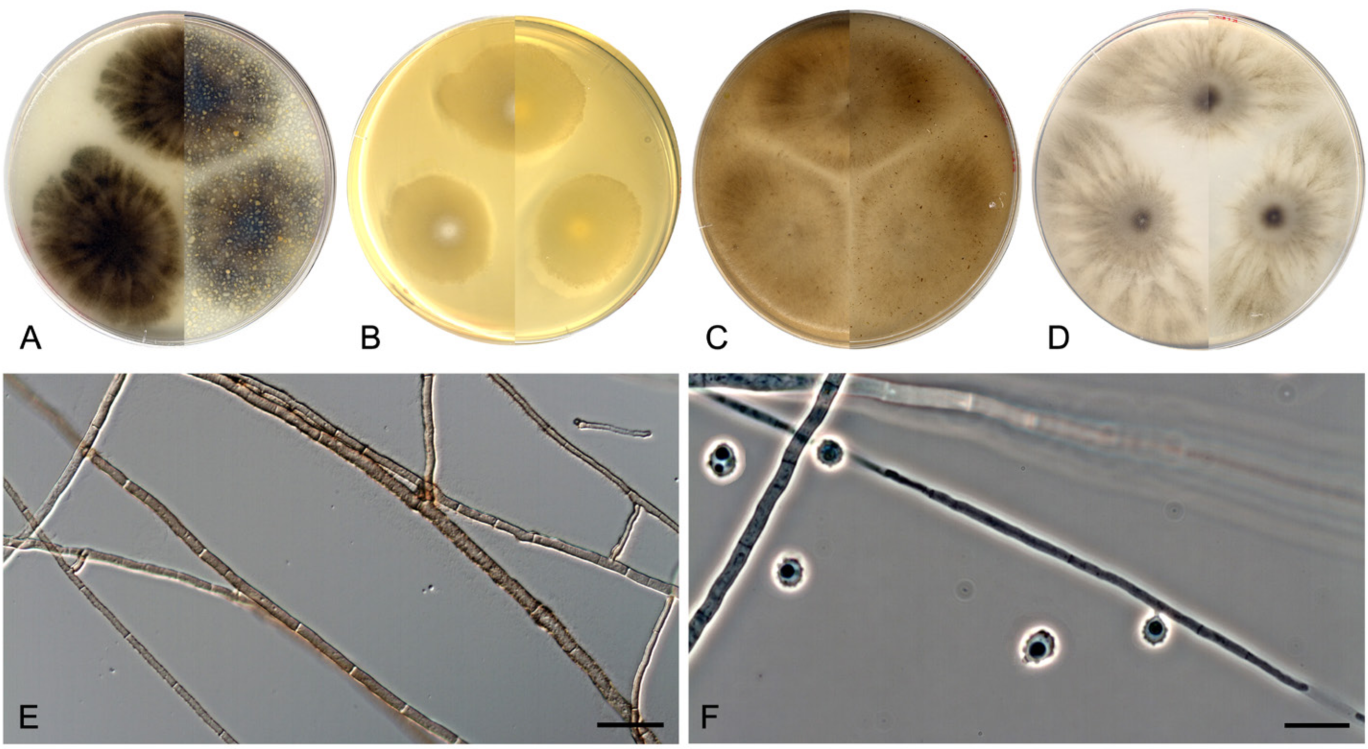

Fig. 12. *Novoallocanariomyces verrucisporus* CBS 151781^T. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Ornamented hyphae. **F.** Verrucose sessile conidia. E. DIC Nomarski. F. PC. Scale bars = 10 µm.

surface pale yellow (2A3) with abundant compact and white (2A1) aerial hyphae at the centre; soluble pigment absent; reverse pastel yellow (2A4). Colonies on MEA 26–27 mm diam., flat, circular, expansive, margins filamentous and regular, surface cream (4A3) with floccose white (4A1) aerial mycelium at the centre and sparse in the margins; soluble pigment absent; reverse yellow (3A6) at the centre and margins pale yellow (3A3). Colonies on OA 30–32 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured with floccose white (3A1) aerial mycelium at the centre and sparse at the margins; soluble pigment absent; reverse uncoloured but yellowish white (3A2) at the centre. Colonies on PCA 19–22 mm diam., flat, circular, margins entire and regular, surface uncoloured and translucent, with floccose white (4A1) aerial hyphae, mainly at the centre; soluble pigment absent; reverse uncoloured. Minimum, optimum and maximum temperature of growth: 5 °C, 30–35 °C and 40 °C, respectively.

Note: *Novochaetomium canariense* differs from *Steirochaetomium canariensis*, the phylogenetically closest taxon, by the presence of a phialidic asexual morph (absent in *St. canariensis*) and by lacking chlamydospores (which are present in *St. canariensis*).

Ovatospora phialospora Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853769. Fig. 14.

Etymology: From Greek *φιάλη*- (phiálē), saucer, bowl, and -*σπορά* (sporá), seed, because the fungus produces conidia from phialides.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25385, culture ex-type FMR 20022 = CBS 151783).

On OA after 2 wk at 25 °C: *Mycelium* composed of septate, hyaline, smooth- and thin-walled, branched, anastomosing, 1–4 µm wide hyphae. *Conidiophores* semi-micronematous, arising as very short (up to 5 × 3 µm) side branches, with or without a basal septum, bearing a single conidiogenous cell at the top (Fig. 14E), or micronematous and eventually reduced to the conidiogenous cell (Fig. 14F, G). *Conidiogenous cells* phialidic, arising singly on the conidiophore or laterally on the hyphae, discrete or non-septate at the base (adelophialides), hyaline, smooth- and thin-walled, with a conspicuous neck (1–3 × 1–1.5 µm), obpyriform, ampulliform to bottle-shaped, 3–11 µm long, 2–5 µm at the widest part, 1–3 µm wide at the base (Fig. 14E–G). *Conidia* enteroblastic, unicellular, smooth- and thin-walled, bacilliform, ellipsoidal or obovoid, 2–5 × 1.5–2.5 µm, truncate at the base and rounded at the apex, produced in basipetal chains or solitary but sticking together by a mucous substance (Fig. 14F, G). *Ascomata* sterile, superficial, solitary, hyaline to slightly olivaceous brown or reddish brown, hairy, globose or nearly so, 12–50 µm diam.; *peridial wall* translucent, hyaline to brown, 1–2-layered, 2–4 µm thick, of *textura epidermoidea*, composed of prismatic cells of up to 7 µm long in the main axis, covered by septate, pale brown to brown, verrucose to tuberculate, thin-walled, sinuous hairs, 5–80 × 1–2 µm, rounded at the end (Fig. 14H).

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 45–48 mm diam., flat, circular, expansive, margins filamentous and regular, surface pale yellow (2A3) with sparse white (2A1) and thin aerial mycelium; soluble pigment absent; reverse pastel yellow (2A4). Colonies on MEA 40–41 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured with scarce white (4A1) aerial mycelium; soluble pigment absent; reverse uncoloured to yellowish white (4A2) at the centre. Colonies on OA 54–55 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured with sparse white (3A1), floccose and thin aerial mycelium; soluble pigment absent; reverse uncoloured. Colonies on PCA 44–45 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured to yellowish white (3A2) with scarce

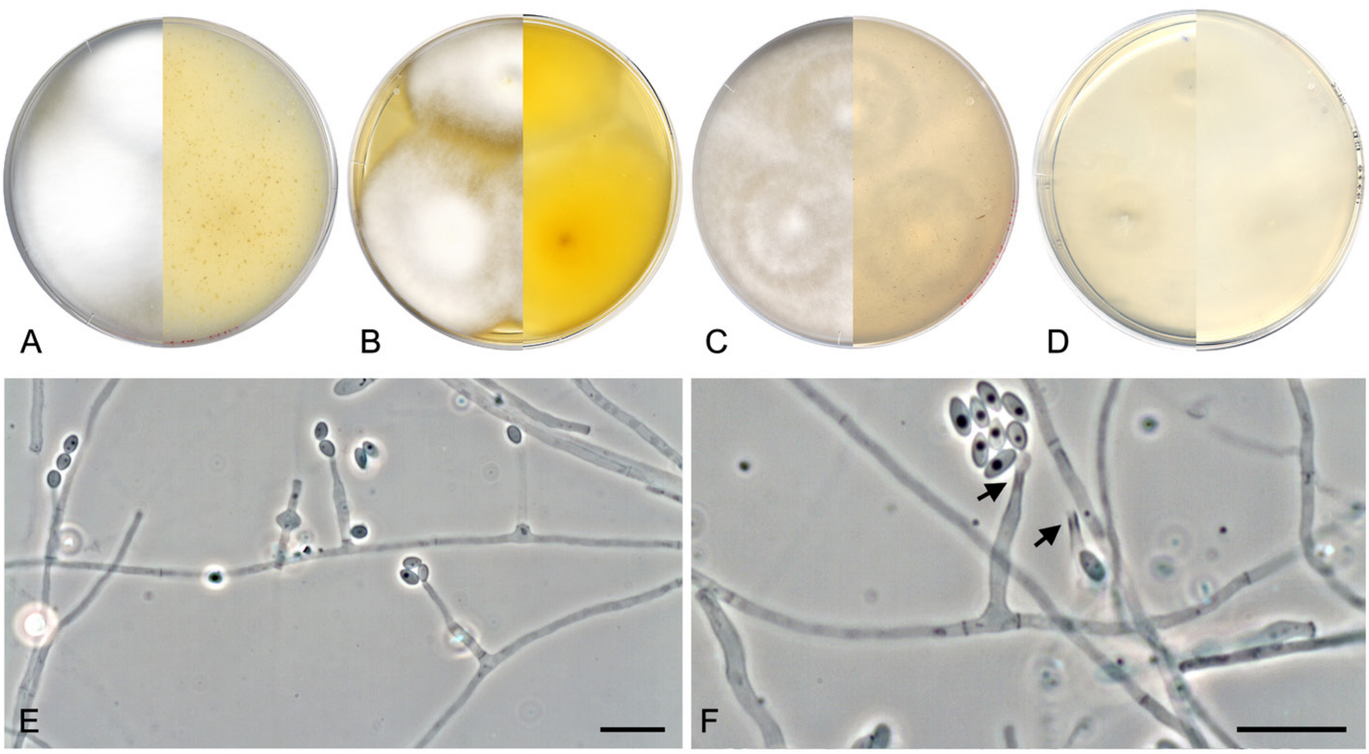

Fig. 13. *Novochaetomium canariense* CBS 151782T. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Phialidic asexual morph. **F.** Phialides with discrete cylindric collarette (black arrows). PC. Scale bars = 10 µm.

white (4A1) and floccose aerial hyphae mainly at the centre; soluble pigment absent; reverse uncoloured but yellowish white (3A2) at the centre. Minimum, optimum and maximum temperature of growth: 15 °C, 37 °C and 45 °C, respectively.

Note: *Ovatospora phialospora* differs from *O. senegalensis*, its phylogenetic closest species, by producing sterile ascomata and phialidic conidia (whereas *O. senegalensis* produces fertile ascomata and no asexual morph) (Ames 1963).

Paraarxotrichum Sastoque, Cano & Stchigel, ***gen. nov.*** MB 853770.

Etymology: From Greek *παρά*- (pará), near, because this genus is phylogenetically close but distant enough to *Arxotrichum*.

On PCA after 2 mo at 25 °C: *Mycelium* composed of septate, branched, smooth- and thin-walled, hyaline hyphae, becoming torulose and dark brown with age. Microsclerotium-like structures mainly submerged in the culture media, subglobose, ovoid, star-shaped or more irregularly-shaped, composed of dark brown, smooth- and thin-walled, globose, subglobose, cylindric, barrel-shaped or ellipsoid cells. *Asexual* and *sexual morphs* not observed.

Paraarxotrichum sterile Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853771. Fig. 15.

Etymology: From Latin *sterilis*, sterile, because the fungus does not produce sexual/asexual reproductive structures.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25388, culture ex-type FMR 20031 = CBS 151785).

On PCA after 2 mo at 25 °C: *Mycelium* composed of septate, branched, smooth- and thin-walled, hyaline, 1–3.5 µm wide hyphae, becoming torulose and dark brown with the age, 2–13 µm wide (Fig. 15E). Microsclerotium-like propagules mainly submerged in the culture media, subglobose, ovoid, star-shaped or more irregularly-shaped, 12–115 × 9–93 µm, composed of 0–1(–2)-septate, dark brown, smooth- and thin-walled, globose, subglobose, cylindric, barrel-shaped or ellipsoid cells, measuring 4–15 × 4–13 µm (Fig. 15F). *Asexual* and *sexual morphs* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 50–51 mm diam., flat, circular, expansive, margins filamentous and regular,

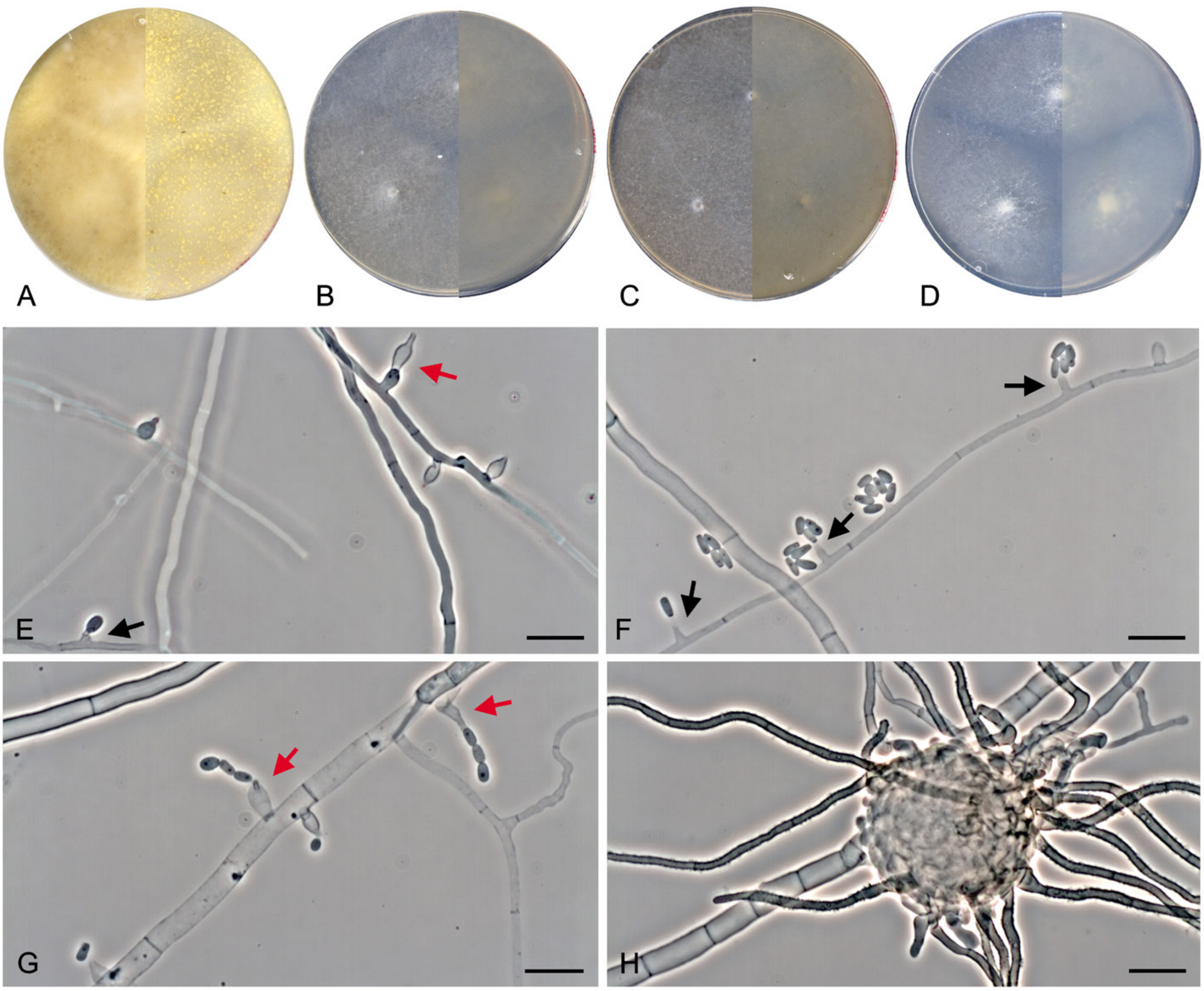

Fig. 14. *Ovatospora phialospora* CBS 151783T. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E–G.** Integrated phialides (adelophialides; black arrows) and phialides (red arrows). **F, G.** Conidia in chains or solitary. **H.** Sterile hairy ascomata. PC. Scale bars = 10 µm.

surface uncoloured but dark brown (7F4) at the margins, with a scarce white (6A1) aerial mycelium; greyish pink (11C6) soluble pigment produced; reverse uncoloured, but brownish (8F4) at the margins. Colonies on MEA 46–49 mm diam., flat, circular, margins filamentous and regular, surface cream (4B3), with a scarce white (4A1) floccose aerial mycelium; soluble pigment absent; reverse cream (4B3). Colonies on OA 56–60 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured, without aerial mycelium; soluble pigment absent; reverse uncoloured. Colonies on PCA 44–45 mm diam. flat, circular, expansive, margins entire and regular, surface uncoloured, with a scarce white (4A1) floccose aerial mycelium at the centre; soluble pigment absent; reverse uncoloured. Minimum, optimum and maximum temperature of growth: 12 °C, 25 °C and 40 °C, respectively.

Note: *Paraarxotrichum sterile* is easily distinguished from *Arxotrichum* spp., because the former produces microsclerotium-like structures and *Arxotrichum* spp. form chrysosporium-like unicellular conidia, and/or chaetomium-like ascomata (Wang *et al.* 2022).

Pseudohumicola duospora Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853774. Fig. 16.

Etymology: From Latin *due*-, two, -*sporae*, spores, because the fungus produces two sort of conidia.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25389, culture ex-type FMR 20132 = CBS 152421).

On PCA after 2 wk at 25 °C: *Mycelium* composed of septate, hyaline to slightly pigmented, branched, anastomosing, smooth- and thin-walled, 1.5–5 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated to the vegetative hypha. *Conidia* holoblastic, unicellular, solitary or in chains of two or three, subhyaline to dark brown, sessile, on short conical denticles or short side branches from the hyphae, smooth- and thin-walled, becoming thick-walled when old, globose, subglobose, obovoid or ovoid, (4–)7–8(–9) × (4–)8–9(–10) µm (Fig. 16E). *Synasexual morph*: *Conidiophores* micronematous, reduced to the conidiogenous cell. *Conidiogenous cells* phialidic, arising laterally from hyphae, discrete, single, hyaline, elongated bottle-shaped to cylindrical, 3–10 × 1.5–3 µm, occasionally with a collarette (Fig. 16F) and, sometimes, proliferating, giving origin a secondary conidiogenous cells (Fig. 16H). *Conidia* enteroblastic, unicellular, hyaline, smooth- and thin-walled, obovoid, 1.5–2 × 2–3.5 µm, truncated at the base and with a rounded apex, formed in basipetal chains (Fig. 16G). *Sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 17–20 mm diam., flat, circular, margins filamentous and regular, surface uncoloured, with white (6A1) floccose aerial hyphae at the centre and sparse at the margins; soluble pigment absent; reverse uncoloured. Colonies on MEA 34–35 mm diam., flat, circular, margins entire and regular to slightly lobulated, surface cream (4A3) with sparse floccose white (8A1) aerial hyphae at the centre; soluble pigment absent; reverse yellowish white (4A2) to pale yellow (4A4). Colonies on OA 35–36 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured, with floccose white (4A1) aerial hyphae at the centre; soluble pigment absent; reverse yellowish white (4A2). Colonies on PCA 28–30 mm diam., flat, circular, margins entire and irregular, surface cream (3A2), with a white (3A1) aerial mycelium at the centre; soluble pigment absent; reverse yellowish white (3A2) with translucent margins. Minimum, optimum and maximum temperature of growth: 15 °C, 25 °C and 37 °C, respectively.

Notes: *Pseudohumicola duospora* differs from *Ps. fragilis*, its phylogenetically closest species, by producing smaller holoblastic

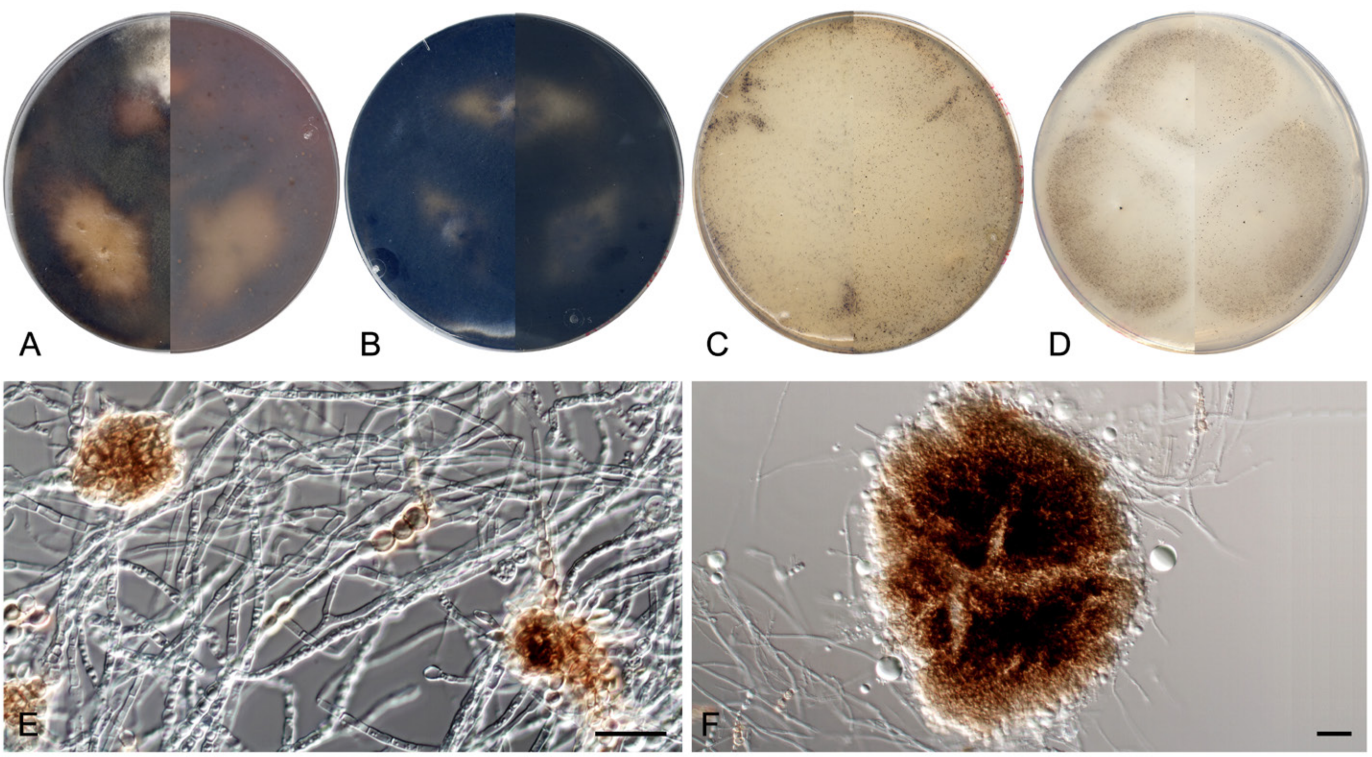

Fig. 15. *Paraarxotrichum sterile* CBS 151785[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Hyphae and microsclerotium-like propagules. **F.** Detail of a microsclerotium-like propagule. DIC Nomarski. Scale bars = 25 µm.

conidia and by the presence of a phialidic synasexual morph (absent in *Ps. fragilis*). *Pseudohumicola duospora* was isolated via the *ToKaVa* technique; consequently, is suspected to be keratinophilic.

Pseudohumicola fragilis Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853775. Fig. 17.

Etymology: From Latin *fragilis*, fragile, because the conidia collapse and break easily in wet mountings.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2008, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25390, culture ex-type FMR 20029 = CBS 151786).

On PCA after 2 wk at 25 °C: *Mycelium* composed of hyaline, septate, branched, anastomosing, smooth- and thin-walled, 1–4 µm wide hyphae. *Conidiophores* undifferentiated. *Conidiogenous cells* integrated to the vegetative hypha. *Conidia* holoblastic, unicellular, solitary, less frequently in chains of two, sessile with wide base or not, on short conical denticles or on short side branches from the hyphae, smooth- and thin-walled, becoming thick-walled when old, subhyaline, pale brown to brown, globose, subglobose, obovoid, pyriform, less frequently ovoid, (7–)8–11 × (7–)8–11(–12) µm (Fig. 17E, F). *Synasexual morph* and *sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 40–42 mm diam., flat, circular, margins entire and regular, brown (5E4), with scarce white (8A1) aerial hyphae at the centre, and yellowish white (4A2) at the margins; soluble pigment absent; reverse bronze (5E5). Colonies on MEA 39–40 mm diam., flat, circular, margins entire and regular, cream (4B3), with scarce and floccose white (8A1) aerial hyphae at the centre; soluble pigment absent; reverse cream (4B3). Colonies on OA 43–45 mm diam., flat, circular and expansive, margins filamentous and regular, uncoloured and translucent, with scarce floccose white (4A1) aerial hyphae at the centre; soluble pigment absent; reverse uncoloured. Colonies on PCA 35–36 mm diam., flat, circular, margins entire and irregular, uncoloured and translucent, with a white (4A1) to yellowish white (2A2) aerial mycelium at the centre; soluble pigment absent; reverse uncoloured, pale yellow (2A3) at the centre. Minimum, optimum and maximum temperature of growth: 12 °C, 30 °C and 37 °C, respectively.

Note: *Pseudohumicola fragilis* differs from *Ps. sardinae*, the phylogenetic closest species, by the size of the holoblastic conidia

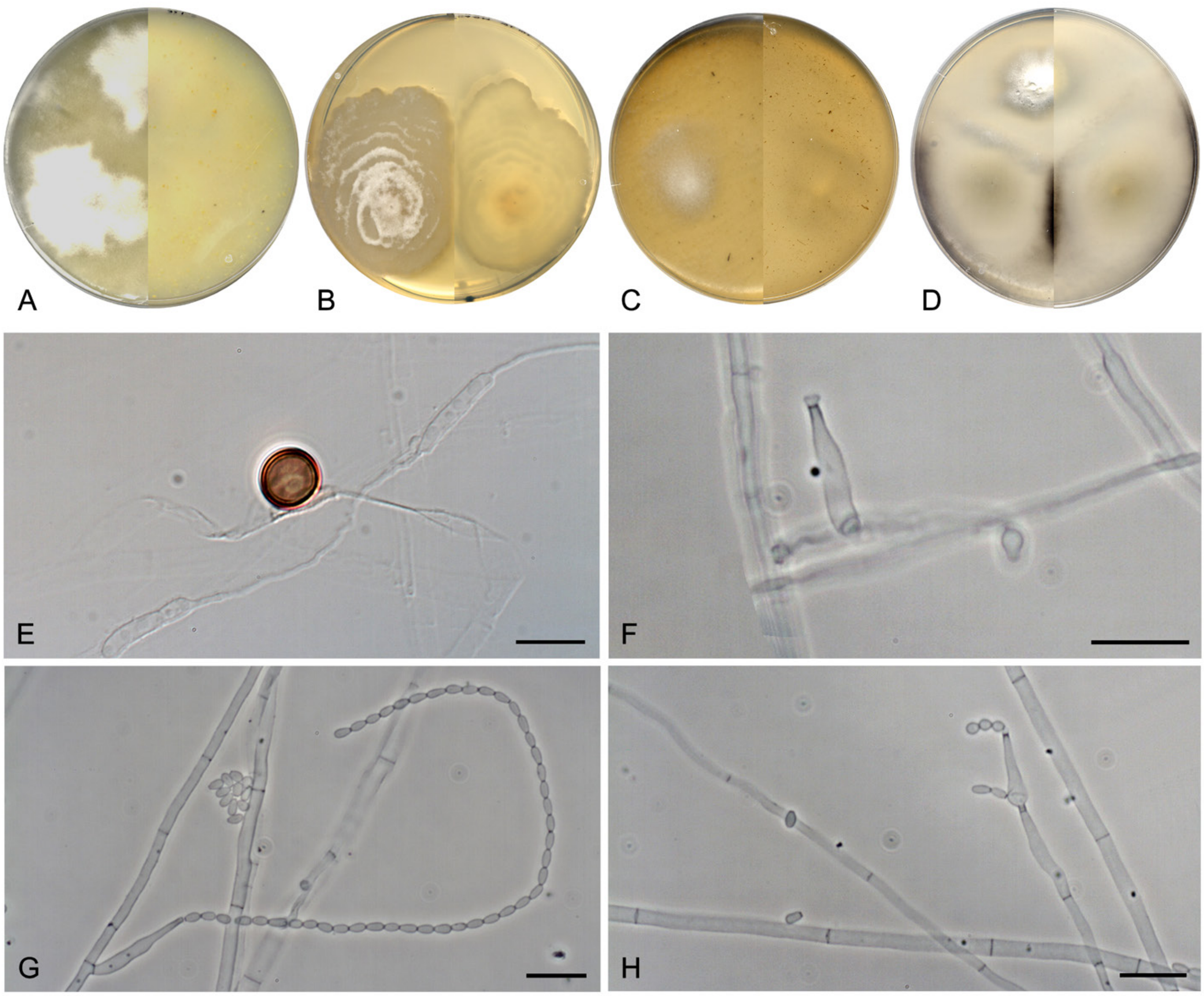

Fig. 16. *Pseudohumicola duospora* CBS 152421T. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Holoblastic conidium. **F–H.** Phialides with long chains of conidia (synasexual morph). E = DIC Nomarski. F–H = PC. Scale bars = 10 µm.

(8.8–9.1 µm diam. in *Ps. sardinae*) and the absence of a phialidic synasexual morph (present in *Ps. sardinae*) (de Bertoldi 1976).

Pseudohumicola nivea (De Bert.) Sastoque, Stchigel & Cano, ***comb. nov.*** MB 853826. Fig. 18.
Basionym: *Humicola nivea* De Bert., *Canad. J. Bot*. **54**: 2766. 1976.

Typus: **Italy**, *Talitrus saltator*, gastroenteric cavity, 1970, coll. and isol. *M. de Bertoldi* (**lectotype** designated here CBS H-7239, MBT 10031032, culture ex-type CBS 469.76 = MUCL 19436 = FMR 6578).

On PCA after 2 wk at 25 °C: *Mycelium* composed of septate, branched, smooth- and thin-walled, hyaline to light brown, 1.5–3.5 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated to the hyphae. *Conidia* holoblastic, unicellular, solitary, less frequently in short chains or forming few-celled clusters, sessile or on short conical denticles, on short side branches, or intercalary (then, holothallic), subhyaline, brown to dark brown, smooth- and thick-walled, becoming verrucose when old, globose, subglobose, cylindric, fusiform, occasionally obovoid, 5–11 × 4.5–11 µm (Fig. 18E). *Synasexual morph*: *Conidiophores* micronematous, reduced to the conidiogenous cells. *Conidiogenous cells* phialidic, arising laterally on the hyphae, discrete, single, hyaline, smooth- and thick-walled, cylindrical but ventricose near the base or below the middle of its length, and tapering slightly towards the top, 4–15 × 1.5–3.5 µm. *Conidia* enteroblastic, unicellular, hyaline, smooth- and thin-walled, ovoid, 2–3 × 1–2 µm, truncated at the base and with a rounded apex, formed in basipetal chains (Fig. 18F). *Sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 20–22 mm diam., flat, circular, margins entire and regular, uncoloured, without aerial mycelium; soluble pigment absent; reverse uncoloured. Colonies on MEA 27–29 mm diam., flat, circular, margins entire and regular, light orange (5A4) with a floccose white (5A1) aerial mycelium at the centre, margins orange white (5A2); reverse pale orange (5A5) with cream (5A2) margins. Colonies on OA 35–37 mm diam., flat, circular, expansive, translucent, margins entire and regular, uncoloured, with a sparse white (4A1) aerial mycelium at the centre; soluble pigment absent; reverse uncoloured, coffee (5F7) at the centre. Colonies on PCA 25–28 mm diam., flat, circular, margins entire and irregular to lobulated, yellowish brown (5F5), with a white (5A1) aerial mycelium and uncoloured margins; soluble pigment absent; reverse orange white (5A2) at the centre, surrounded by a brown (5F3) halo, margins uncoloured. Minimum, optimum and maximum temperature of growth on PDA after 7 d: 15 °C, 25 °C and 37 °C, respectively.

Additional materials examined: **The Netherlands**, rabbit dung, 2009, coll. and isol. *Th.D. Geydan-Rivera*, strain CBS 125842 = FMR 20619. **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque*, strains FMR 20030 and FMR 20139.

Notes: A previous study suggested that *H. aurea*, *H. glauca*, *H. lutea*, *H. nivea*, *H. piriformis*, *H. repens*, *H. sardiniae*, and *H. variabilis*, all of them described by de Bertoldi (1976), would be synonyms of *Ps. semispiralis* based on molecular comparison of the ITS region. Because the *rpb2* and *tub2* sequences were not available, they were synonymized as *Humicola fuscoatra* var. *fuscoatra* until their phylogenetic position could be confirmed (Wang *et al.* 2019b). In a recent study, the phylogenetic tree generated using the concatenated molecular markers ITS, LSU, *rpb2* and *tub2*, showed that *Ps. glauca* and *Ps. debertoldii* were different species, and belonging to the genus *Pseudohumicola* (Sastoque *et al.* 2025). *Pseudohumicola nivea* is phylogenetically closely related to *Ps. glauca*, but differs morphologically by the presence of a phialidic synasexual morph and in the size and shape of the conidia (globose, subglobose,

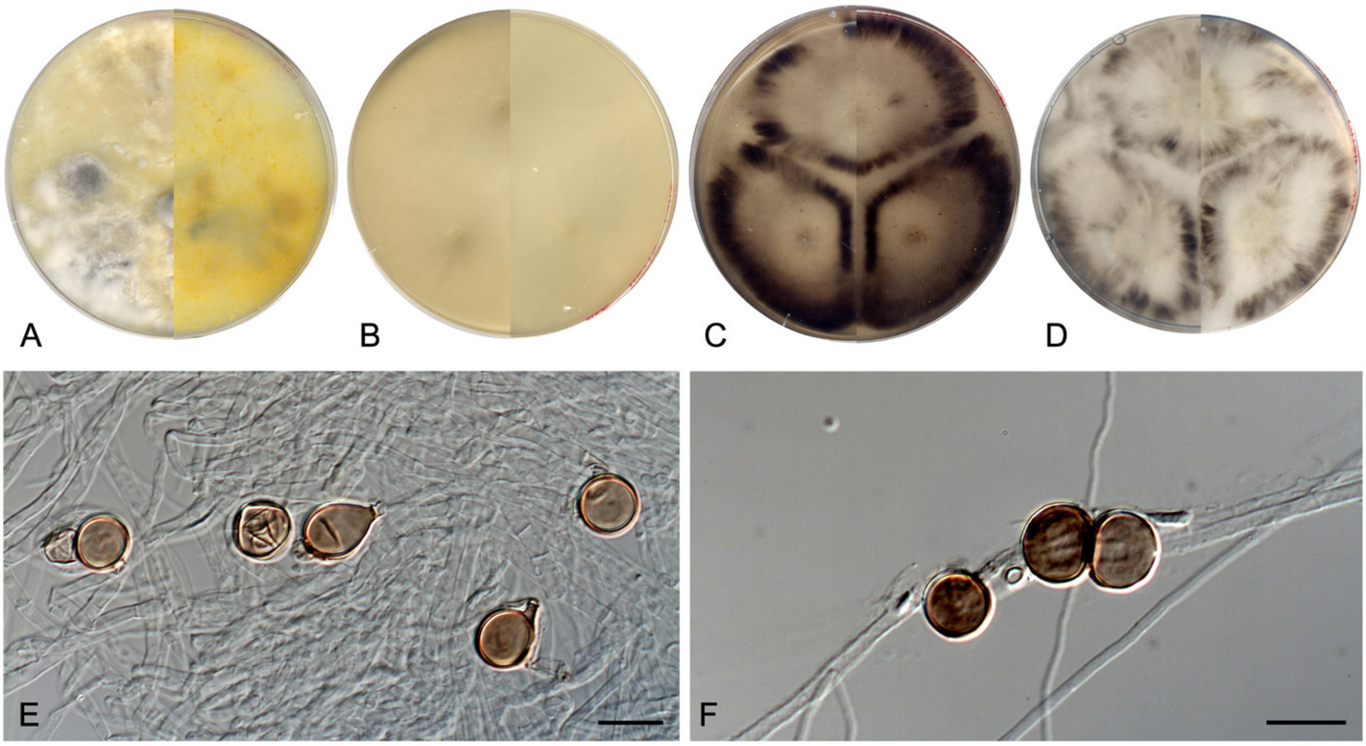

Fig. 17. *Pseudohumicola fragilis* CBS 151786ᵀ. **A–D.** Colony on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Holoblastic conidia. DIC Nomarski. Scale bars = 10 µm.

oblate, ellipsoid, obovoid, pyriform, occasionally ovoid or cylindric and measuring (4–)7–8(–9) × (4–)8–10(–15) µm in *Ps. glauca* vs the globose, subglobose, cylindric, fusiform, or occasionally obovoid, and with a size of 5–11 × 4.5–11 µm in *Ps. nivea*) (de Bertoldi 1976, Sastoque *et al.* 2025).

Pseudohumicola repens (De Bert.) Sastoque, Cano & Stchigel, ***comb. nov.*** MB 853827. Fig. 19.
Basionym: *Humicola repens* De Bert., *Canad. J. Bot.* **54**: 2761. 1976.

Typus: **Italy**, from wheat-cultivated soil, Sassarri, Sardinia, 1969, coll. and isol. *M. de Bertoldi* (**lectotype** designated here CBS H-7235, MBT 10031033, culture ex-type CBS 458.76 = FMR 20099).

On PCA after 2 wk at 25 °C: *Mycelium* composed of hyaline, septate, branched, smooth- and thin-walled, 1–2 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated to the hyphae. *Conidia* holoblastic, unicellular, solitary, sessile or on short conical denticles, smooth- and thick-walled, covered by a mucilaginous and dark brown substance, subhyaline to brown, globose, subglobose, or obovoid, (5–)6.5–10(–10.5) × (5–)6.5–10(–10.5) µm (Fig. 19E, F). *Synasexual morph* and *sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on OA 37–38 mm diam., flat, circular, margins filamentous and regular, surface uncoloured, brown (4F4) at the centre, radiated due to a sparse grey (5B1) aerial mycelium at the centre; soluble pigment absent; reverse similar in colour that the surface. Colonies on CMA 26-31 mm diam., flat, circular, expansive, margins entire and regular, dark green (3F3) at the centre, with a floccose blond (4C4) aerial mycelium, margins moss green (1E7); soluble pigment absent; reverse ivy (1F3), surrounding by olive yellow (2C8) area, olive (1F4) at the margins. Colonies on MEA 15–16 mm diam., flat, circular, margins entire and irregular, cream (4B4), with a floccose white (4A1) aerial mycelium at the centre; reverse yellowish white (3A2), olive green (3D7) at the centre, surrounded by a light yellow (3A5) halo. Colonies on PCA 20–22 mm diam., flat, circular, margins entire and regular, surface black (6F3) at the centre, with a medium grey (1E1) aerial mycelium, olive brown (4F6) radiated and uncoloured margins (4A1); soluble pigment absent; reverse concentrically sulcate, from the centre to the margins successively black (6F3), brown (4F4), olive brown (4E3) and white (4A1). Minimum, optimum and maximum temperature of growth on PDA after 7 d: 15 °C, 25 °C and 37 °C, respectively.

Note: *Pseudohumicola repens*, located close to *Ps. lutea* in our phylogenetic analysis, differs in the size of conidia, measuring (5–)6.5–10(–10.5) × (5–)6.5–10(–10.5) µm in *Ps. repens* and (7.5–)10.8–11.8(–14.5) × (7.2–)10.4–11.2(–12) µm in *Ps. lutea* (de Bertoldi 1976, Oliveira Condé *et al.* 2023).

Pseudohumicola sardiniae (De Bert.) Sastoque, Stchigel & Cano, ***comb. nov.*** MB 853828. Fig. 20.
Basionym: *Humicola sardiniae* De Bert., *Canad. J. Bot.* **54**: 2761. 1976.

Typus: **Italy**, from soil of a vineyard, Sassarri, Sardegna, 1969, coll. and isol. *M. de Bertoldi* (**lectotype** designated here CBS H-7234, MBT 10031034, cultures ex-type CBS 456.76 = MUCL 19430 = FMR 20614).

On PCA after 2 wk at 25 °C: *Mycelium* composed of hyaline, septate, branched, smooth- and thin-walled, 1–4 µm wide hyphae. *Conidiophores* absent. *Conidiogenous cells* integrated to the hyphae. *Conidia* holoblastic, unicellular, solitary, less frequently in short chains or forming few-celled clusters, sessile with a wide base or on short conical denticles, or intercalary (then, holothallic), subhyaline to dark brown, smooth- and thick-walled, becoming verrucose when old, globose, subglobose, obovoid,

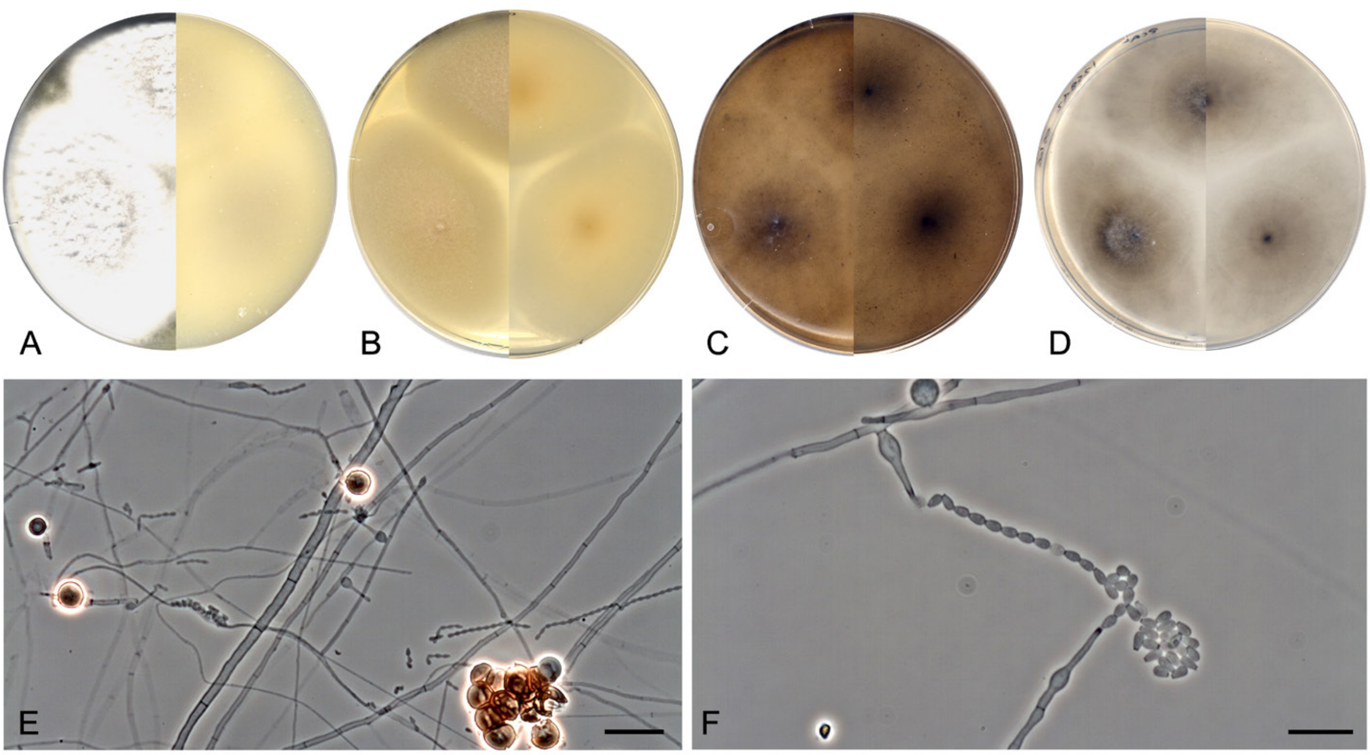

Fig. 18. *Pseudohumicola nivea* CBS 125842[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Holoblastic conidia and phialidic synasexual morph. **F.** Phialides with a long chain of conidia. PC. Scale bars: E = 25 µm; F = 10 µm.

piriform, ellipsoid or fusoid, (4–)5–11(–13) × (3.5–)5–10(–11) µm, covered by a mucilaginous and dark brown substance (Fig. 20E). *Synasexual morph*: *Conidiophores* micronematous, reduced to the conidiogenous cells. *Conidiogenous cells* phialidic, arising laterally from hyphae, discrete, single, hyaline, cylindrical to elongated with wide base, 4–20 × 1.5–4 µm. *Conidia* enteroblastic, unicellular, hyaline, smooth- and thin-walled, ovoid, 2–3 × 1–2 µm, truncated at the base and with a rounded apex, formed in basipetal chains (Fig. 20F). *Sexual morph* not observed.

Culture characteristics (after 7 d at 25 °C): Colonies on CMA 18–21 mm diam., flat, circular, margins entire and regular, uncoloured, without aerial mycelium; soluble pigment absent; reverse uncoloured. Colonies on MEA 30–31 mm diam., flat, circular, margins entire and regular, brown (5E5) with a floccose white (5A1) aerial mycelium at the centre and cream (4B4) at the margins; soluble pigment absent; reverse concentrically sulcate, from centre to margin: cream (4B3), yellowish brown (5F5), brown (5E5), and cream (4B3). Colonies on 33–34 mm diam., flat, circular, margins entire and regular, uncoloured, with a floccose white (4A1) aerial mycelium at the centre; soluble pigment absent; reverse uncoloured but cream (4B3) at the centre. Colonies on PCA 26–27 mm diam., flat, circular, margins entire and regular, uncoloured but olive brown (4F3) at the centre and with a white (5A1) aerial mycelium; soluble pigment absent; reverse similar in colour than the surface. Minimum, optimum and maximum temperature of growth on PDA after 7 d: 15 °C, 30 °C and 37 °C, respectively.

Note: *Pseudohumicola sardiniae* is phylogenetically close to *Ps. fragilis*, which differs by the size of the blastoconidia (measuring (4–)5–11(–13) × (3.5–)5–10(–11) µm in *Ps. sardiniae* and (7–)8–11 × (7–)8–11(–12) µm in *Ps. fragilis*) and the absence of holothallic conidia and a phialidic synasexual morph in *Ps. fragilis* (de Bertoldi 1976).

Aspergillaceae

Penicillium abortivum Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853772. Fig. 21.

Etymology: From Latin *abortivum*, abortive, because produce sterile ascomata.

In: *Penicillium* subgenus *Penicillium* section *Eladia* series *Eladia.*

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25386, culture ex-type FMR 19752 = CBS 151784).

On OA after 2 wk at 25 °C: *Mycelium* abundant, composed of hyaline, septate, branched, anastomosing, smooth- and thin-walled, 1–4 µm wide hyphae. *Conidiophores* macronematous, solitary, erect, straight, mono- to biverticillate; *stipes* hyaline, 0–2-septate, smooth- and thin-walled, cylindric, 12–62 × 1.5–2 µm; *branches* unequal in length, 5–10 × 1.5–2.5 µm, bearing terminally 1–5 conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth- and thin-walled, cylindrical to bottle-shaped, 6–14 × 1.5–3 µm, with a short and narrow neck and an inconspicuous collarette. *Conidia* enteroblastic, unicellular, hyaline, smooth- and thin-walled, subglobose to broadly ellipsoidal or barrel-shaped, 2–3 × 1.5–3 µm, forming long chains in basipetal succession and with a scar at the base, separated by inconspicuous disjunctors (Fig. 21E–G). *Ascomata* sterile, superficial, solitary, 2–3-layered, 2–4 µm broad, hyaline to irregularly pigmented of orange brown, of *textura angularis*, globose or subglobose, (8–)12–65(–70) × (8–)12–62(–66) µm, composed by thick-walled, flattened polygonal cells of up to 10 µm diam. (Fig. 21H).

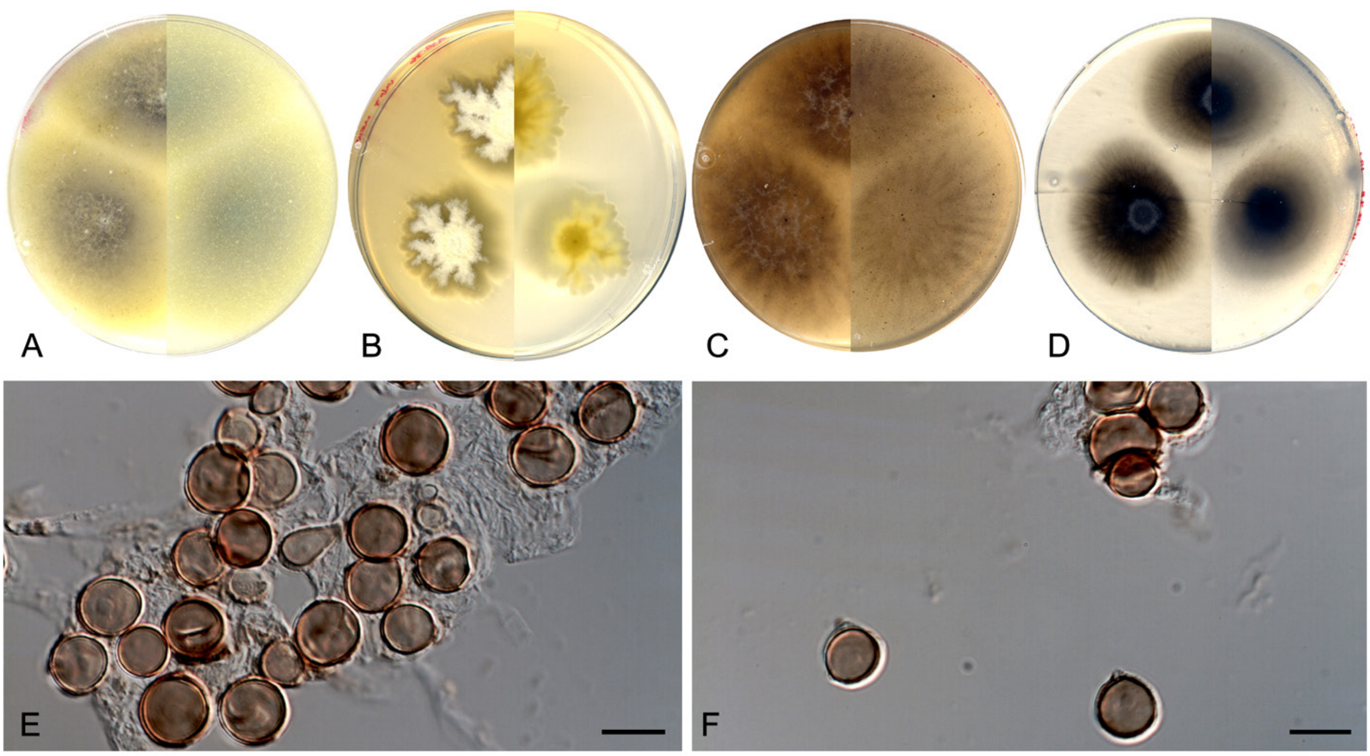

Fig. 19. *Pseudohumicola repens* CBS 458.76[T]. **A–D.** Colony on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Holoblastic conidia. DIC Nomarski. Scale bars = 10 µm.

Culture characteristics (after 7 d at 25 °C): Colonies on CZA 9–10 mm diam., flat, circular, margins filamentous and regular, surface uncoloured to greyish white (1B1), with a white (4A1) floccose and dense mycelium, forming incipient ascomata; soluble pigment absent; reverse white (4A1), translucent at the margins. Colonies on MEA 27–28 mm diam., flat, circular, margins filamentous and regular, surface pale yellow (4A3), velvety with a white (4A1) aerial mycelium and granulose by presence of white (4A1) sterile ascomata; soluble pigment absent; reverse white (4A2), pale yellow (4A3) at the centre. Colonies on OA 12–15 mm diam., flat, circular, margins filamentous and regular, surface dark blonde (5D4), with white (4A1), floccose, sparse aerial hyphae, and granulose by presence of white (4A1) sterile ascomata; soluble pigment absent; reverse orange white (5A2). Colonies on YES 20–21 mm diam., flat, circular, restricted, margins entire and irregular, surface wrinkled and velvety, with white (4A1) and dense aerial hyphae, dark blonde (5D4) at the margins; soluble pigment absent; reverse light yellow (4A3), yellowish white (4E2) at the margins. Minimum, optimum and maximum temperature of growth: 15 °C, 30 °C and 37 °C, respectively.

Notes: *Penicillium abortivum* differs from *P. sacculum* and *P. senticosum*, the phylogenetic nearest species, in the production of hyaline, smooth- and thin-walled conidia in *P. abortivum*, being these dark olive green, thick-walled, and coarsely roughened or echinulate in *P. sacculum* and in *P. senticosum*. Also, *P. abortivum* produces sterile cleistothecial ascomata, while these are fertile in *P. senticosum* and absent in *P. sacculum* (Houbraken & Samson 2011).

Penicillium doramasicum Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853773. Fig. 22.

Etymology: Because the fungus has been isolated from the *Parque Rural de Doramas*.

In: *Penicillium* subgenus *Aspergilloides* section *Exilicaulis* series *Erubescentia*.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* **(holotype** CBS H-25388, culture ex-type FMR 20207 = CBS 151785).

On OA after 2 wk at 25 °C: *Mycelium* abundant, composed of septate, hyaline, non-refractive, branched, smooth- and thin-walled, 0.5–3 µm wide hyphae. *Conidiophores* macronematous, solitary, erect, straight, monoverticillate; *stipes* 0–1-septate, hyaline, smooth- and thin-walled, cylindric, 9–17 × 1–1.5 µm, bearing 1–3(–5), conidiogenous cells at the top. *Conidiogenous cells* phialidic, hyaline, smooth- and thin-walled, cylindrical to ventricose, 5–10 × 1.5–2.5 µm, with an indistinct neck. *Conidia* enteroblastic, unicellular, refractive, hyaline, smooth to verrucose, thin- to moderately thick-walled, globose, subglobose to broadly ellipsoidal or pyriform, 2–2.5 × 1.5–2 µm, flattened at the base, produced in basipetal succession to form long chains, separated by conspicuous disjunctors (Fig. 22E, F). *Ascomata* sterile, superficial, solitary, hyaline to irregularly pigmented in reddish brown, 2–3-layered, up to 5 µm thick, globose, subglobose or ovoid, (8–)12–65(–70) × (8–)12–62(–66) µm, composed of thin-walled polygonal cells of up to 10 µm diam. (Fig. 22G, H).

Culture characteristics (after 7 d at 25 °C): Colonies on CZA 14–15 mm diam., flat to convex, circular, margins filamentous and regular, cream (4A3), with a white (4A1) floccose and dense mycelium,

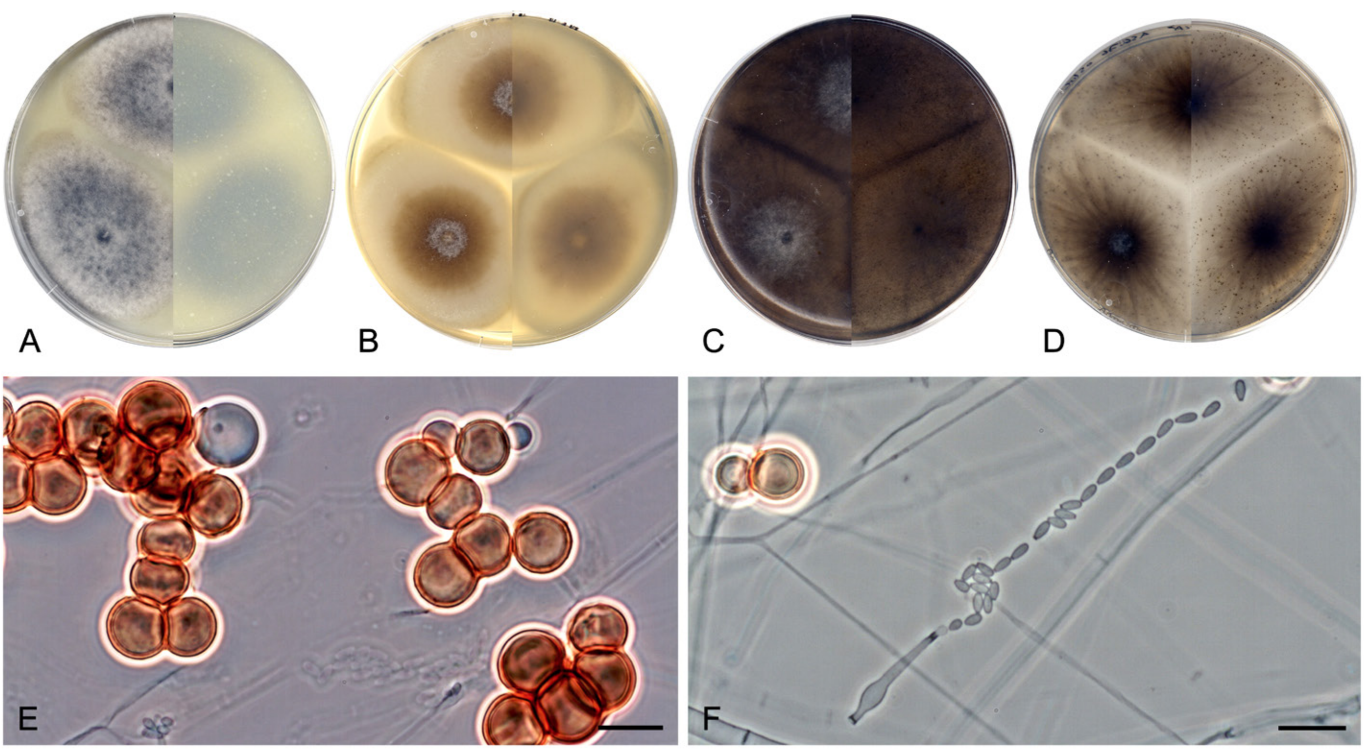

Fig. 20. *Pseudohumicola sardiniae* CBS 456.76[T]. **A–D.** Colonies on CMA, MEA, OA, PCA (4-wk-old; 25 °C; surface, left; reverse, right). **E.** Holoblastic conidia. **F.** Phialide with a long chain of conidia (synasexual morph). PC. Scale bars = 10 µm.

translucent at the margins; soluble pigment absent; reverse white (4A1), champagne (4B4) at the centre, translucent at the margins. Colonies on MEA 20–22 mm diam., flat to pulvinate, circular; margins entire and regular, pale yellow (4A4), with a white (4A1) floccose and dense mycelium, absent at the margins; soluble pigment absent; reverse cream (4A2), yellow (4A5) at the centre. Colonies on OA 15–16 mm diam., flat, circular, margins entire and regular, cream (4B3) with white (4A1), velvety and slightly dense aerial hyphae at the centre; soluble pigment absent; reverse cream (4B3). Colonies on YES 20–21 mm diam., flat, circular, restricted, wrinkled and velvety, margins entire and regular, white (4A1); soluble pigment absent; reverse yellow (4A5), brown (6E7) at the centre. Minimum, optimum and maximum temperature of growth: 15 °C, 30 °C and 40 °C, respectively.

Notes: *Penicillium doramasicum* differs from *P. erubescens*, the phylogenetic closest species, by the production of sterile ascomata (fertile in *P. erubescens*) and of smooth-walled conidiophores and verrucose conidia (verrucose conidiophores and smooth-walled conidia in *P. erubescens*) (Scott 1968). Regarding *P. hermansii*, the other phylogenetically closest species, the former differs from *P. doramasicum* by the absence of sclerotia or ascomata, and by their delicately ornamented conidiophores and smooth-walled conidia (Houbraken *et al.* 2019).

Spiromastigoidaceae

Spiromastigoides globospora Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853776. Fig. 23.

Etymology: From Latin *globosis*-, globose, and -*sporae*, spore, referring to the conidial morphology.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (**holotype** CBS H-25391, culture ex-type FMR 19927 = CBS 151787).

On OA after 2 wk at 25 °C: *Mycelium* abundant, composed of hyaline, septate, branched, anastomosed, smooth- and thin-walled, 1–2 µm wide hyphae. *Conidiophores* indistinguishable from the vegetative hyphae. *Conidia* holoblastic when sessile, produced on short conical

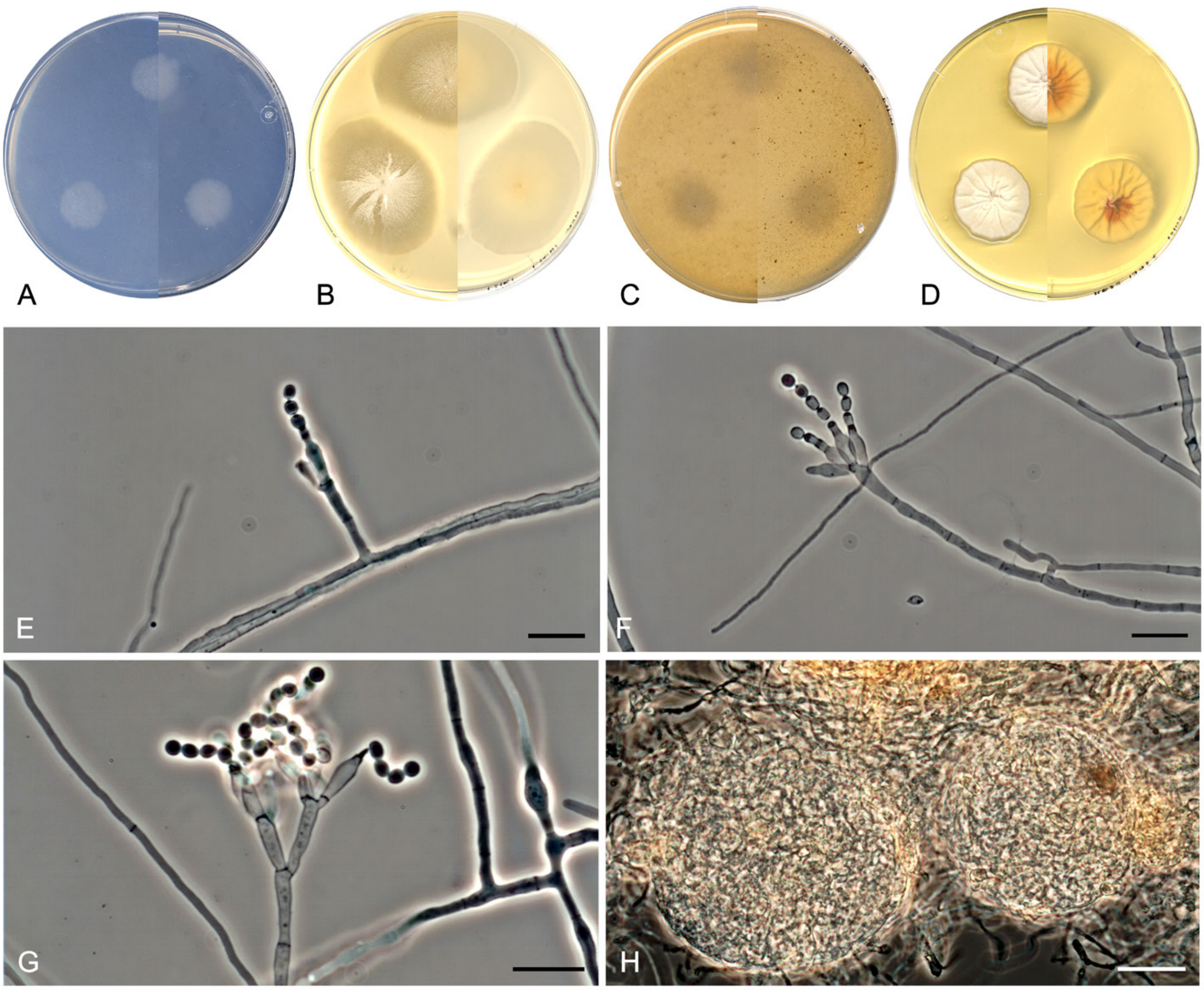

Fig. 21. *Penicillium abortivum* CBS 151784[T]. **A–D.** Colonies on CZA, MEA, OA, YES (2-wk-old; 25 °C; surface, left; reverse, right). **E–G.** Mono- and biverticillate conidiophores and conidia in chains. **H.** Sterile ascomata. PC. Scale bars: E–G = 10 µm; H = 25 µm.

denticles, on short lateral branches from the hyphae, or terminal, 1–2(–3)-celled, hyaline, highly refractive, solitary or in chains up to 5 (Fig. 23F), with a longitudinal or transverse septum (Fig. 23E), smooth- and thin-walled, sometimes covered by a mucilaginous substance, mostly globose, less frequently subglobose, ellipsoidal, obovoid, pyriform to clavate, 3–8 × 3–7 µm, sometimes generating secondary holoblastic conidia (Fig. 23G); *holothallic conidia* intercalary, 1–2(–3)-celled, with a longitudinal or transverse septum, hyaline, highly refractive, mostly globose, occasionally subglobose, ovoid, obovoid, clavate, cylindrical, 3–8 × 2–6 µm; truncated at the base or at both ends secession rhexolytic, frequently bearing attached 1–3 hyphal cells (Fig. 23H). *Sexual morph* absent.

Culture characteristics (after 14 d at 25 °C): Colonies on CZA 8–9 mm diam., flat, circular, restricted, margins filamentous and lobulated, surface uncoloured to white (4A1), with velvety white (4A1) aerial hyphae; soluble pigment absent; reverse white (4A1). Colonies on MEA 12–14 mm diam., convex to pulvinate, circular, restricted, margins entire and regular, surface amber yellow (4B6), velvety with a white (4A1) aerial mycelium mostly at the centre; soluble pigment absent; reverse pale yellow (4A4). Colonies on OA 7–8 mm diam., flat, circular, restricted, margins entire and regular, surface sand (4B3) without aerial hyphae, slightly shining and granulose; soluble pigment absent; reverse champagne (4B4). Colonies on SDA 9–10 mm diam., pulvinate, circular, restricted, margins entire, regular or slightly corrugated, surface cream (4A3) with a white (4A1) velvety mycelium at the centre; soluble pigment absent; reverse like the surface. Minimum, optimum and maximum temperature of growth on PDA after 7 d: 12 °C, 25 °C and 35 °C, respectively.

Notes: Spiromastigoides globospora produces holoblastic conidia often surrounded by a layer of mucilage, and sometimes with a longitudinal or transversal septum, which has not been observed in other species of the genus (Rizzo *et al.* 2014, Hirooka *et al.* 2016, Stchigel *et al.* 2017, Rodríguez-Andrade *et al.* 2021).

Sporormiaceae

Westerdykella canariensis Sastoque, Cano & Stchigel, ***sp. nov.*** MB 853824. Fig. 24.

Etymology: Because the fungus has been isolated from the Canary Islands archipelago.

Typus: **Spain**, Canary Islands, Gran Canaria, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M.*

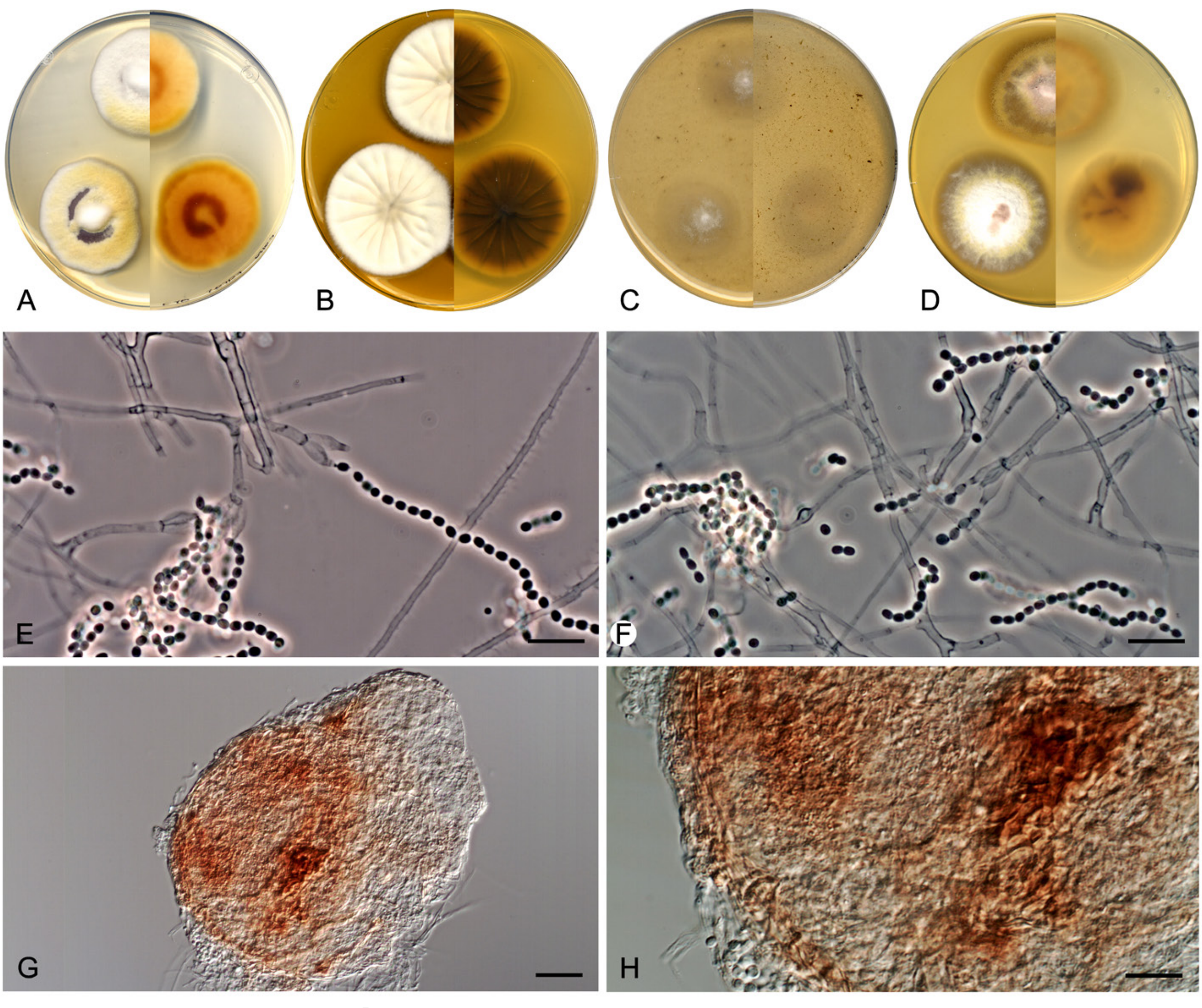

Fig. 22. *Penicillium doramasicum* CBS 151785^T. **A–D.** Colonies on CZA, MEA, OA, YES (2-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Monoverticillate conidiophores and conidia in long chains. **G, H.** Sterile ascomata. E, F. PC. G, H. DIC Nomarski. Scale bars: E, F, H = 10 µm; G = 25 µm.

Calduch & A.M. Stchigel, isol. *A.P. Sastoque* (**holotype** CBS H-25393, culture ex-type FMR 20026 = CBS 151789).

Additional material examined: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (culture FMR 20007).

On PCA after 4 wk at 25 °C: *Mycelium* mostly submerged, composed of septate, branching, smooth- and thin-walled, subhyaline to brown, 1–4 µm wide hyphae. *Ascomata* abundant, superficial and submerged, solitary to aggregate, olivaceous brown to dark brown under reflected light, glabrous, non-ostiolate, globose, 150–300 µm diam. (Fig. 24D, E). *Peridial wall* translucent, pale brown with patches of brown to dark brown cells, glabrous; *outer wall* 1–2-layered, 4–5 µm thick, of *textura angularis* to *textura epidermoidea*, composed of flattened, smooth- and thin-walled, polyhedral cells but rounded at the angles, 3–6 µm diam. (Fig. 24F); *inner wall* 3–4-layered, up to 15 µm thick, composed of hyaline, flattened, smooth- and thin-walled, polyhedral, 10–12 µm diam. cells. *Asci* bitunicate, subglobose, ovoid to ellipsoidal, 23–42 × 10–19 µm, non-stalked, with 32 irregularly arranged ascospores (Fig. 24G). *Ascospores* unicellular, hyaline to pale brown when young, brown to dark brown when mature, ellipsoidal, ovoid or slightly reniform (5–)6–7.5(–8) × (2.5–)3–3.5(–4) × 3–3.5 µm, rounded at both ends, mostly bi-guttulate, without germ pores or germ slits (Fig. 24H,I). *Asexual morph* not seen.

Culture characteristics (after 7 d at 25 °C): Colonies on OA 22–24 mm diam., flat, circular, expansive, margins filamentous and regular, surface uncoloured to brown (5E5), with a scarce white (4A1) aerial mycelium, ascomata absent after 30 d; soluble pigment absent; reverse uncoloured to brown (5E5). Colonies on PCA 22–23 mm diam., flat, circular, margins filamentous and regular, surface yellowish grey (4B1) with a scarce and sparse floccose white (4A1) aerial mycelium, with greyish brown (7F3) superficial and submerged ascomata appearing after 21 d; soluble pigment absent; reverse greyish yellow (4B3) but yellowish white (4A2) at the centre and the margins. Colonies on PDA 18–21 mm diam., convex, slightly wrinkled, circular, margins entire and regular, surface pale yellow (4A4) with a velvety white (4A1) aerial mycelium; soluble pigment absent; reverse yellowish white (4A2) and pale yellow at the centre (4A3). Minimum, optimum and maximum temperature of growth: 15 °C, 25 °C and 37 °C, respectively.

Notes: *Westerdykella canariensis* differs from *W. reniformis*, the phylogenetic closest species, and *W. ornata*, the type species

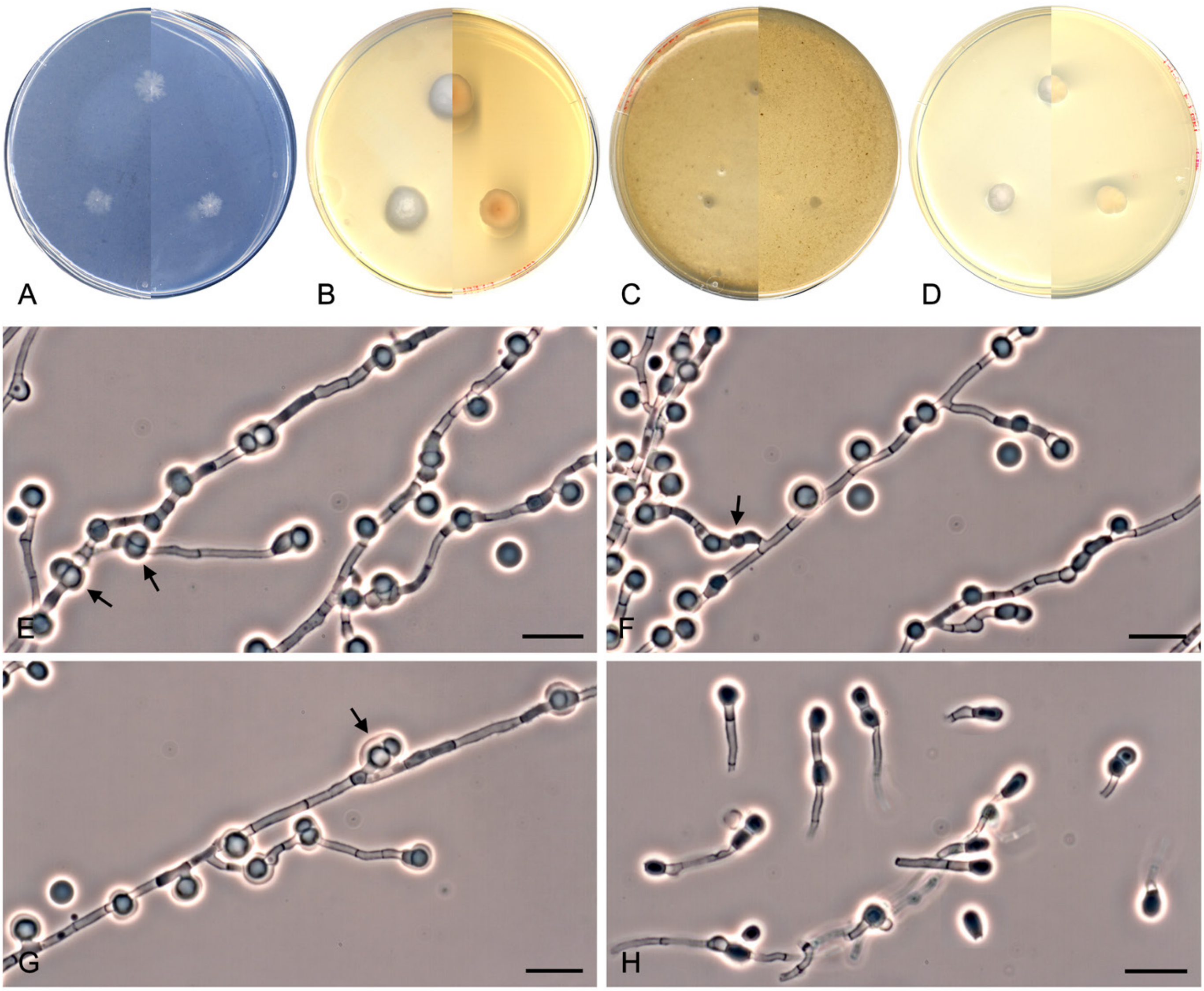

Fig. 23. *Spiromastigoides globospora* CBS 151787^{T}. **A–D.** Colonies on CZA, MEA, OA, SDA (2-wk-old; 25 °C; surface, left; reverse, right). **E.** Terminal, lateral and intercalary conidia, some of them showing a longitudinal septum (black arrows). **F.** Chains of conidia (black arrow). **G.** Conidia surrounded by a compact mucous substance (black arrow). **H.** Thallic and arthric conidia. PC. Scale bars = 10 µm.

of the genus, in the size and shape of the asci and ascospores. *Westerdykella canariensis* produces subglobose, ovoid to ellipsoidal asci measuring 23–42 × 10–19 µm, and these are globose to subglobose and of 12–18 × 11–17 µm in *W. reniformis*, and subglobose to ellipsoidal and of 25–32 × 16–22 µm in *W. ornata*. In *W. reniformis* the ascospores are brown to dark brown and measuring (5–)6–7.5(–8) × (2.5–)3–3.5(–4) × 3–3.5 µm, with walls ornamented with striations and without germ pores or slits, while these are reniform, black, smooth-walled, having a central germ slit and measuring 2–4 × 4–6 µm in *W. reniformis*, while in *W. ornata* these are nearly globose, brown, ornated by irregular spiral bands, with not germ pores or slits and measuring 6.2–7 × 6–6.8 µm.

Thermoascaceae

Thermoascus simplicissimus Sastoque, Stchigel & Cano, ***sp. nov.*** MB 853821. Fig. 25.

Etymology: From Latin *simplicissimus*, very simple, because its simple reproductive asexual structures.

Typus: **Spain**, Canary Islands, Gran Canaria Island, *Parque Rural de Doramas*, from soil of *Finca de Osorio*, 10 Aug. 2009, coll. *M. Calduch & A.M. Stchigel*, isol. *A.P. Sastoque* (holotype CBS H-25392, culture ex-type FMR 20242 = CBS 151788).

On OA after 2 wk at 30 °C: *Mycelium* abundant, composed of septate, hyaline, branching, anastomosing, smooth- and thin-walled, 1.5–7 µm wide hyphae. *Conidiophores* macronematous, solitary, erect, straight, penicillate; *stipes* hyaline, mostly unbranched, 0–5-septate, smooth- and thin-walled, cylindric, 8–51 × 2.5–4.5 µm, bearing 0–2 branches at the top; *branches* hyaline, non-septate, smooth- and thin-walled, cylindric but slightly wider at the middle or at the 1/3 upper part, 4–25 × 3–5 µm, bearing 1–2 conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth- and thin-walled, bottle-shaped, (10.5–)13–38(–46) × 2–5 µm, with a long and narrow neck. *Conidia* enteroblastic, unicellular, hyaline, smooth- and thin-walled, subglobose to ellipsoidal or obovoid, 4–8 × 2–5 µm, produced in basipetal succession to form long chains, with a basal scar (Fig. 25E, F). *Stromata* superficial, solitary or aggregate, hyaline to yellowish orange, globose to subglobose,

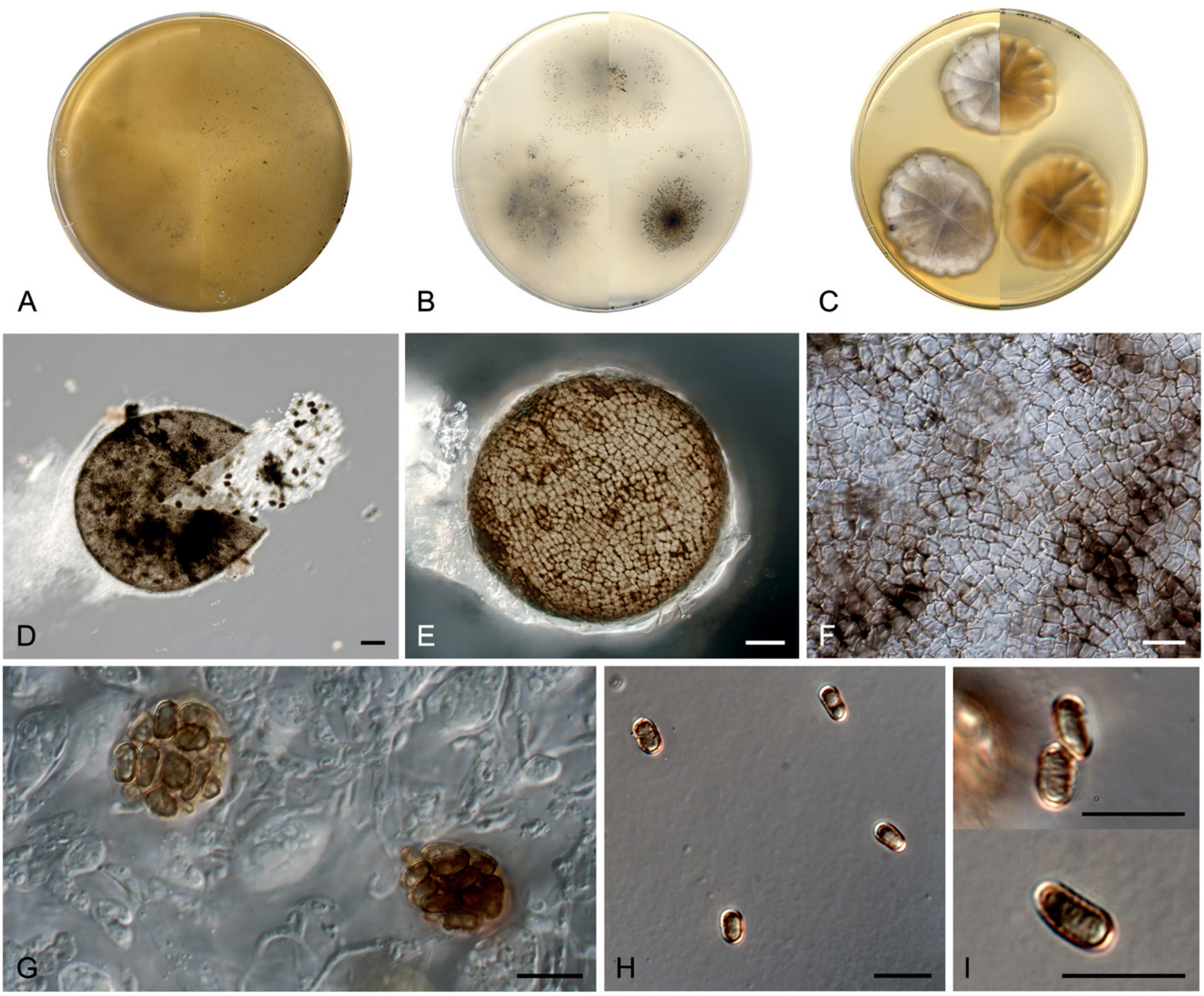

Fig. 24. *Westerdykella canariensis* CBS 151789[T]. **A–C.** Colonies on OA, PCA, PDA (4-wk-old; 25 °C; surface, left; reverse, right). **D, E.** Ascomata. **F.** Detail of the peridium. **G.** Asci within ascospores. **H.** Mature ascospores. **I.** Mature ascospores showing irregular spiral bands ornamentation without germ pores. DIC Nomarski. Scale bars: D = 50 µm; E = 25 µm; F–I = 10 µm.

65–370 × 75–310 µm, tomentose, with an outer wall 100–125 µm thick, composed of several layers of hyaline to yellowish-orange, thick-walled polygonal cells, and an inner wall of hyaline, branching, 1–2 µm wide hyphae (Fig. 25G, H).

Culture characteristics (after 7 d at 30 °C): Colonies on CZA 33–34 mm diam., flat, circular, margins entire and irregular, surface white (2A1) to yellowish white (2A2) with white (2A1), floccose and sparse aerial mycelium, mainly at the centre; soluble pigment absent; reverse white (2A1), uncoloured at the margins. Colonies on MEA 42–44 mm diam., flat, circular, margins filamentous and irregular, surface cream (4B3) with floccose and white (4A1) aerial mycelium; soluble pigment absent; reverse yellowish white (4A2), cream (4B3) at the margins. Colonies on OA 32–33 mm diam., flat, circular, expansive, margins filamentous and irregular, surface dark blonde (5D4) with white (4A1), floccose and scarce aerial hyphae; soluble pigment absent; reverse dark blonde (5D4). Colonies on YES 43–44 mm diam., flat, circular, margins filamentous and irregular to lobulate, surface wrinkled and densely floccose, with white (4A1) aerial hyphae; soluble pigment absent; reverse light yellow (4A3), with yellowish white (4A2) margins. Minimum, optimum and maximum growth temperature: 15 °C, 30 °C and 45 °C, respectively.

Notes: *Thermoascus simplicissimus* and *T. verrucosus* are phylogenetically close related and can be distinguished among them because *T. simplicissimus* produces sterile stromata instead the fertile ascomata in *T. verrucosus*. Also, both species differ in the size and shape of their conidiophores. *Thermoascus verrucosus* produces conidiophores bearing three cylindrical phialides tapering abruptly upwards to form a long neck, and cylindrical, truncated on both sides, pale yellow, 9–13 × 2.5–4.0 µm conidia, while the conidiophores of *T. simplicissimus* have 1–2 bottle-shaped phialides at the top, and produces hyaline, subglobose to ellipsoidal or obovoid, 4–8 × 2–5 µm conidia (Samson & Tansey 1975).

DISCUSSION

Only four studies addressing soil-borne microfungi have been conducted in the Canary Islands archipelago (Castañeda-Ruíz *et al*. 2000, Zachow *et al*. 2009, Hernández-Restrepo *et al*. 2017, Sastoque *et al*. 2025). These investigations revealed a heterogeneous fungal assemblage, ranging from rhizosphere-associated taxa to lineages adapted to volcanic substrates. In Tenerife, Zachow *et al*. (2009) reported mainly *Trichoderma* species and several basidiomycetes from the rhizosphere, whereas Hernández-Restrepo *et al*. (2017)

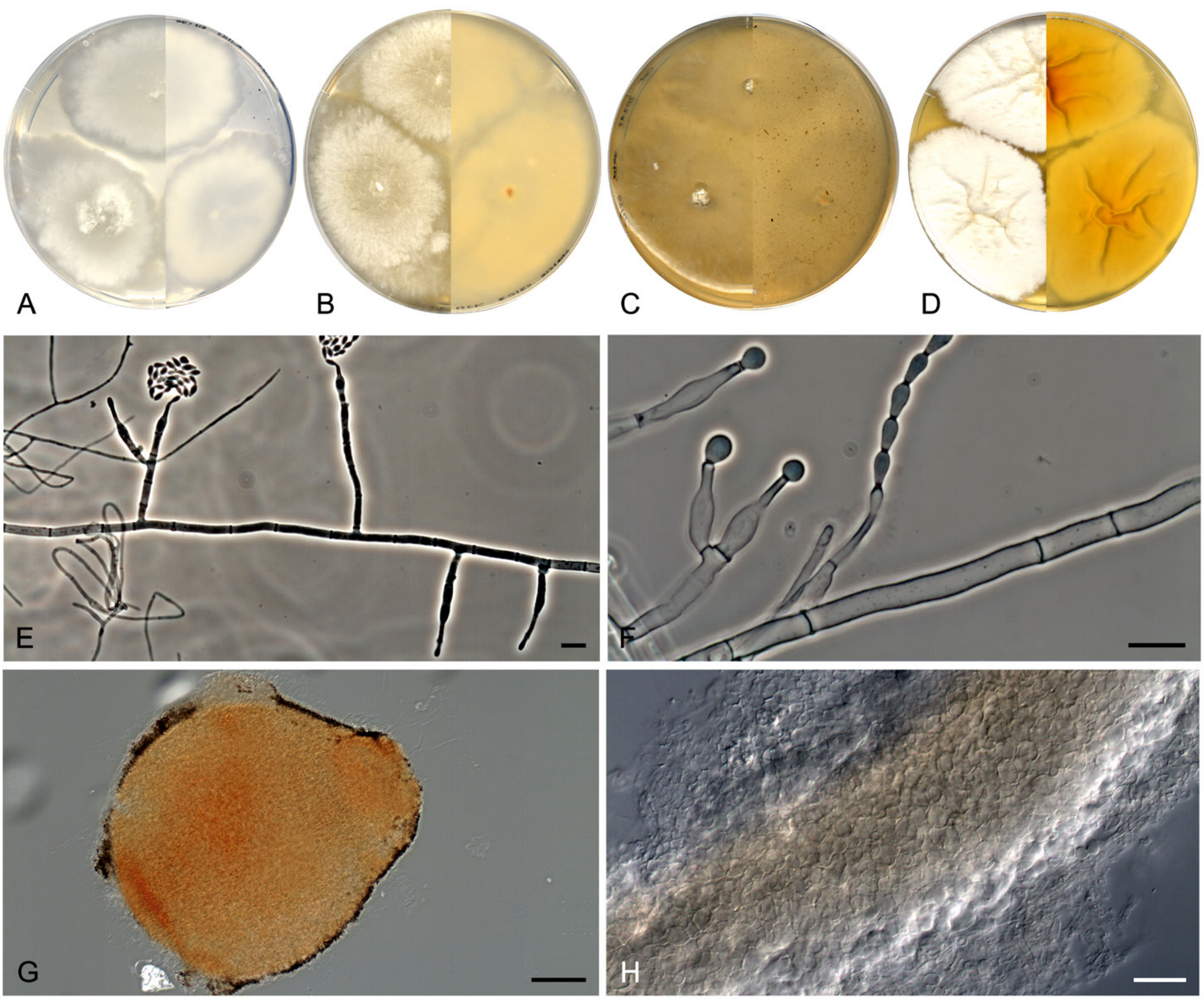

Fig. 25. *Thermoascus simplicissimus* CBS 151788[T]. **A–D.** Colonies on CZA, MEA, OA, YES (2-wk-old; 25 °C; surface, left; reverse, right). **E, F.** Conidiophores and conidia in chains. **G.** Stroma. **H.** Stroma section. E, F. PC. G, H. DIC Nomarski. Scale bars: E, F = 10 µm; G = 100 µm; H= 25 µm.

recorded *Endophragmiella dimorphospora* from Gran Canaria. More recently, Sastoque *et al*. (2025) demonstrated that *Chaetomiaceae* represents a dominant component of fungal communities inhabiting volcanic soils in La Palma, describing three new genera, ten new species and numerous new records.

Our results are consistent with these observations, as *Chaetomiaceae* were also predominant in soils from Gran Canaria. A total of 15 previously known species belonging to this family were identified, together with four new genera and 12 new species. In addition, novel taxa belonging to *Penicillium*, *Spiromastigoides*, *Thermoascus* and *Westerdykella* were recovered, further highlighting the taxonomic richness of these soils.

The *Chaetomiaceae*, introduced by Winter (1885) with *Chaetomium* as the type genus, belong to the order *Sordariales* (von Arx *et al*. 1986) and include taxa with a wide ecological amplitude, occurring mainly as saprobes but also as mycoparasites and opportunistic pathogens (Ellis 1981, Zhang *et al*. 2006, Violi *et al*. 2007, Lumbsch & Huhndorf 2010, Ahmed *et al*. 2016, Wang *et al*. 2016a, b, 2019b, 2022, Mehrabi *et al*. 2020, Sastoque *et al*. 2025). The family currently comprises 52 genera. In the present study, new species were assigned to *Allocanariomyces*, *Botryotrichum*, *Canariomyces*, *Chaetomium*, *Ovatospora*, *Humicola* and *Pseudohumicola*, and three new genera (*Catenatispora*, *Novochaetomium* and *Paraarxotrichum*) are proposed.

The genus Allocanariomyces, introduced by Mehrabi *et al*. (2020), is characterized by non-ostiolate ascomata and aleurioconidial asexual morphs like those of *Canariomyces*. *Allocanariomyces diversisporus* differs from the two previously accepted species by the absence of a sexual morph and by its markedly variable conidia. Its thermotolerance, shared with *Alloc. americanus*, contrasts with the poorly documented growth limits of *Alloc. tritici*, whose ascospore ornamentation appears inconsistent with observations of the lectotype. The newly introduced genus *Novoallocanariomyces* forms a well-supported clade sister to *Alloc. diversisporus* and is distinguished by smaller, smooth to verrucose conidia, while sharing a similar thermal profile.

Botryotrichum is defined by the presence of a characteristic asexual morph and, in some species, a sexual morph resembling that of *Chaetomium murorum*. *Botryotrichum solisexuale* lacks an asexual morph and is readily distinguished from its closest relatives by the morphology of its ostiolate ascomata and helical hairs. Its growth range and recovery using the *ToKaVa* technique suggest keratinolytic capabilities, as previously reported for related taxa.

Canariomyces, transferred from *Microascaceae* to *Chaetomiaceae* by Wang *et al*. (2019a), comprises seven species producing both sexual and asexual morphs, although the latter may occur alone. *Canariomyces similis* is distinguished by the absence of a sexual morph and by reduced conidial variability relative to closely related species.

Chaetomium has undergone extensive taxonomic redefinition, and its current circumscription encompasses 43 species with ostiolate or non-ostiolate ascomata and diverse hair morphologies. *Chaetomium annellidicum* differs from its closest relatives by the absence of a sexual morph and by the presence of annellidic conidiogenous cells, rather than the phialidic conidiogenesis typical of related species.

Ovatospora includes nine species isolated from a wide range of substrates, including volcanic soils. *Ovatospora phialospora* is phylogenetically close to *O. senegalensis* but is distinguished by the absence of mature ascomata, the presence of a phialidic asexual morph and its thermotolerant growth profile.

Recent phylogenetic studies have led to the division of *Humicola* into *Humicola* sensu stricto and *Pseudohumicola*. The latter is characterized by aleurioconidia with germ pores and, when present, ascomata with terminally coiled hairs. Two new species of *Pseudohumicola* are introduced here and can be differentiated by conidiogenesis and synasexual morph production. In addition, several species described by de Bertoldi (1976) are transferred to *Pseudohumicola* based on multilocus phylogenetic evidence, and the identity of several strains previously assigned to *Humicola fuscoatra* is clarified.

Three new monospecific genera of *Chaetomiaceae* are proposed. *Catenatispora* is distinguished from *Batnamyces* by the production of endoconidia in long chains and by a higher maximum growth temperature. *Novochaetomium* is closely related to *Steirochaetomium* but differs by producing a phialidic asexual morph and by its lower minimum temperature for growth. *Paraarxotrichum* is phylogenetically allied to *Arxotrichum* but lacks a sexual morph and forms microsclerotia-like structures.

Outside *Chaetomiaceae*, new species of *Penicillium*, *Spiromastigoides*, *Westerdykella* and *Thermoascus* were identified. These taxa are distinguished from their closest relatives by combinations of reproductive morphology, conidial ornamentation and growth temperature. Notably, *Thermoascus simplicissimus* exhibits a lower minimum growth temperature than is typical for the genus, expanding the known physiological range of *Thermoascaceae*.

Overall, this study confirms volcanic soils of the Canary Islands as reservoirs of considerable fungal novelty and provides a refined taxonomic framework for several lineages, particularly within *Chaetomiaceae*.

CONCLUSIONS

The isolation techniques applied in this study proved effective for recovering a diverse assemblage of soil-borne ascomycetes from Gran Canaria Island, with *Chaetomiaceae* emerging as the dominant fungal lineage. Although representatives of other well-established soil-associated genera, including *Penicillium*, *Spiromastigoides*, *Thermoascus* and *Westerdykella* were also detected, the taxonomic novelty uncovered within *Chaetomiaceae* was particularly notable.

Based on a polyphasic taxonomic approach integrating morphology, physiology and multilocus phylogenetic analyses, numerous previously known species were confirmed, together with the introduction of four new genera and 17 new species. These findings substantially expand the known diversity of *Chaetomiaceae* and related taxa in volcanic soils and further support the Canary Islands as an important reservoir of undescribed fungal lineages.

Phylogenetic reconstruction also allowed the clarification of several long-standing taxonomic ambiguities within *Humicola*. Multiple species previously treated under *Humicola* were shown to belong to *Pseudohumicola*, resulting in new combinations and a more coherent generic circumscription based on robust molecular evidence.

Overall, this study contributes to a refined systematic framework for *Chaetomiaceae* and allied genera and underscores the relevance of integrative taxonomic approaches for resolving species boundaries and generic concepts in soil-inhabiting ascomycetes.

DECLARATION ON CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Table S1. List of primers and annealing temperatures used for amplification of gene targets.