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Original article

Brazilian Atlantic Forest and Pampa Biomes in the spotlight: an overview of *Aspergillus*, *Penicillium*, and *Talaromyces* (*Eurotiales*) species and the description of *Penicillium nordestinense* sp. nov.

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ABSTRACT

The knowledge of the geographical distribution of fungi is essential to promote the understanding of global and national fungal diversity patterns. In this study, we provide a literature-based checklist of *Aspergillus*, *Penicillium*, and *Talaromyces* species recorded in the biomes of the Brazilian Atlantic Forest and the Brazilian Pampa. Only *Penicillium digitatum* was reported for the Pampa biome. For the Atlantic Forest, a total of 169 species (68 *Aspergillus*, 79 *Penicillium*, and 22 *Talaromyces*) are reported, of which 20 are typified with specimens from this biome, including the novel species *Penicillium nordestinense* (section *Lanata-Divaricata*) that is described in this study. *Penicillium nordestinense* is phylogenetically related to the invalidly described species *Penicillium setosum*, and this species is validated here. Soil was the most common substrate from where species were reported. Several reported species are well known in biotechnological processes. *Penicilliopsis zonata* and *Sclerocleista ornata*, species previously treated in *Aspergillus*, are recorded. This checklist reflects the limited knowledge of fungal species in tropical environments, such as the Brazilian Atlantic Forest and Pampa biomes. This information is a good framework for understanding the Brazilian diversity of *Aspergillus*, *Penicillium*, and *Talaromyces* and provides data for future fungal biogeographical studies in tropical environments.

Keywords: ascomycetes, Aspergillaceae, biodiversity, conservation hotspot, Trichocomaceae

Introduction

The Atlantic Forest is the second largest tropical forest in South America, and one of the most diverse on the planet, containing over 2,960 tree species (Zwiener *et al.* 2020), 2,645 tetrapoda species (Figueiredo *et al.* 2020), and 1,401 species of social insects (Feitosa *et al.* 2020). This rainforest harbors a high level of endemic species of the global fauna and flora (Myers *et al.* 2000; Grelle *et al.* 2021). The Atlantic Forest is a biome that, which currently covers approximately 15 % of the Brazilian territory, and is a place

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for approximately 72 % of the Brazilian population (SOS Mata Atlântica 2017). The Atlantic Forest is considered a global conservation hotspot because of its highincidence of endemic species, and high rate of habitat loss because of anthropogenic pressure (solely 12.4 % of the forest that originally existed still subsists) (CIB 2000; Myers *et al.* 2000; SOS Mata Atlântica 2021).

The degradation of the Atlantic Forest is one of the most alarming conservation challenges in the world. The forest destruction for agriculture and biofuels, charcoal market, deforestation for cattle ranching, and wild animal hunting has resulted in the elimination of several species and has potentially contributed to the erosion of the genetic diversity of species (Brown & Brown 1992; Ferrer-Paris *et al.* 2019; Wilson *et al.* 2021). It is logical to suppose that several species have already been extinct before their discovery and several others will be extinct soon (Morellato & Haddad 2000). Owing to its high level of endemism and diversity in numerous groups of organisms, the Atlantic Forest has been recognized as a top priority for conservation in South America (Klumpp *et al.* 1996; Myers *et al.* 2000; Marques *et al.* 2020).

The Pampa biome covers an area of approximately 700,000 km2, extending across the territories of Argentina, Brazil, Uruguay, and Paraguay (IBGE 2004). The Brazilian Pampa is the second smallest biome in the country, occupying an area of 176,496 km^2 (2.10 % of the national territory), present solely in the state of Rio Grande do Sul. The Pampas are in the southern temperate zone, with well-defined seasons (Roesch *et al.* 2009), having a subtropical predominantly rainy climate, with no systematic dry period and negative temperatures in winter (IBGE 2019). The dense forest in this biome is not very expressive, and predominantly consists of herbaceous and shrub type vegetation (Roesch *et al.* 2009). In the Brazilian Pampa, 23 % of its territory is composed of pastures (BRASIL 2010), facilitating the implementation of agricultural activities. Compared to other Brazilian biomes, the Pampa has a high percentage of agricultural land use and it has a small number of conservation units (Ferreira *et al.* 2012). Human activities like cultivation of exotic crops for commercial purposes and changes in the ecosystem for agricultural activities have aggravated the deforestation of Brazilian Pampa (Sulzbacher *et al.* 2018). It is estimated that approximately 48.70 % of this biome has already been modified by human activity, leaving approximately 5 % of native forest (BRASIL 2010).

Fungi are crucial in ecosystems, acting as decomposers of organic material, sometimes pathogens, and mutualistic partners of approximately all terrestrial multicellular organisms (Heilmann-Clausen *et al.* 2015). For example, lichenized fungi mediate most primary production and nitrogen fixation in desert and polar ecosystems (Honegger 2012); mycorrhizal fungi are important for nutrient cycling, for mineral weathering and carbon storage in forest ecosystems (Courty *et al.* 2010); fungal endophytes are mutualistic and prevent damage against biotic and abiotic factors (Bamisile *et al.* 2018). Despite these, the importance of fungi in the maintenance and quality of life on the planet is rarely considered in the conservation actions (Heilmann-Clausen *et al.* 2015). In Brazil, the knowledge of the fungal biodiversity has been a way to strengthen the importance of the protection and conservation of biomes (Sette *et al.* 2013). Biodiversity checklists are an important step in providing relevant information for the conservation planning and service of the environment (Piepenbring *et al.* 2020). A checklist of fungal species in tropical forests is particularly important for the comparison of regions, enabling identification of threatened species and their habitats, and providing data for ecological/biogeographical predictive modeling of species in local and global conservation strategies (Barbosa *et al.* 2020).

In 2015, the Brazilian fungal diversity was estimated to have approximately 5,719 species, distributed over 1,246 genera of the 102 orders, with the Atlantic Forest having the largest number of records (approximately 3,017 species) and Pampa with 84 species (Maia *et al.* 2015). However, this estimation was mainly based on the data made available by mycologists in the database of the Flora do Brasil - Algas, Fungos e Plantas project (http://floradobrasil.jbrj.gov.br/), making the Brazilian fungal diversity still underestimated. For example, endophytic and bee-related fungi were not considered by Maia *et al.* (2015). A few other lists of fungi from Brazil have been recently published, revealing a remarkable fungal diversity, which is still found in the country (*e.g.*, Bezerra *et al.* 2019; Barbosa *et al.* 2020; Chikowski *et al.* 2020).

Aspergillus, *Penicillium*, and *Talaromyces* (*Eurotiales*, *Eurotiomycetes*) are considered among the most common genera of filamentous ascomycetes, with species often associated with specific foods, soil, vegetation, dung, as well as indoor and extreme environments (*e.g.*, Visagie *et al.* 2014; Yilmaz *et al.* 2014; Barbosa *et al.* 2017, 2018, 2020; Chen *et al.* 2016; Barros-Correia *et al.* 2020; Freire *et al.* 2020). A few of the most recent attempts to present a natural classification for these groups were presented by Houbraken & Samson (2011), Samson *et al.* (2011), Visagie *et al.* (2014), and Yilmaz *et al.* (2014). The number of species described in these genera increased rapidly, from 339 *Aspergillus*, 354 *Penicillium*, and 88 *Talaromyces* species accepted in 2014, to 446 *Aspergillus*, 483 *Penicillium*, and 171 *Talaromyces* species accepted in 2020 (Houbraken *et al.* 2020). Nonetheless, several environments remain understudied and can harbor a large number of species to be discovered, especially in tropical regions (Hawksworth & Lücking 2017).

Following the extensive overview of *Aspergillus*, *Penicillium* and *Talaromyces* species in the Caatinga forest published by Barbosa *et al.* (2020), this study aimed to summarize the records of *Aspergillus*, *Penicillium*, and *Talaromyces* species/names in the Atlantic Forest and Pampas biome by presenting a current list of valid species names, their substrate and distribution. In addition, we present the description of *Penicillium nordestinense* sp. nov. from pollen samples stored inside nests of *Melipona scutellaris*.

Materials and methods

Study area

This list was formed by recording data from the cities included in the Brazilian Atlantic Forest (Atlantic Forest) and Pampa biomes. The Atlantic Forest comprises 16 Brazilian states (Fig. 1): Alagoas, Bahia, Ceará, Espírito Santo, Goiás, Mato Grosso do Sul, Minas Gerais, Paraíba, Pernambuco, Paraná, Piauí, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Santa Catarina, and São Paulo (IBGE 2019). The Pampa biome is solely located in the Rio Grande do Sul.

Data collection

An extensive literature review was conducted. Data gathered from published papers and books up to December 2020, issued in English, Portuguese, and Spanish were included. We located papers using the similar strategies of search and rules adopted in Barbosa *et al.* (2020): Thomson Reuters' ISI Web of Science, Google Scholar, and a website with works of Augusto Chaves Batista and his collaborators (http://batista.fungibrasil.net/), as well as by scanning bibliographies and reading books. Master's/PhD dissertations and information from websites were not considered, with the exception of the online version of the List of Species of the Brazilian Flora e Funga(Flora e Funga do Brasil 2020 - http://floradobrasil.jbrj.gov.br/). Unidentified taxa were not included (*e.g.*, *Aspergillus* sp.) because they cannot be placed in a correct section or species in a genus, and in some cases, they can be representing the same species already listed. The used sections and species names are based on the most recent lists of accepted species in Houbraken *et al.* (2020), and subsequently published names were verified in the Index Fungorum and MycoBank databases.

Species description

The novel species described here was obtained from pollen samples stored inside the nests of *M. scutellaris* in 2019. The pollen samples were collected and analysed as described by Barbosa *et al.* (2017).

Morphological description of the strains were performed under standardized growth conditions. Culture media used for characterization included: Czapek yeast autolysate agar (CYA), malt extract agar (MEA), yeast extract sucrose (YES) agar, dichloran 18 % glycerol (DG18) agar, CYA supplemented with 5 % NaCl (CYAS), oatmeal agar (OA),

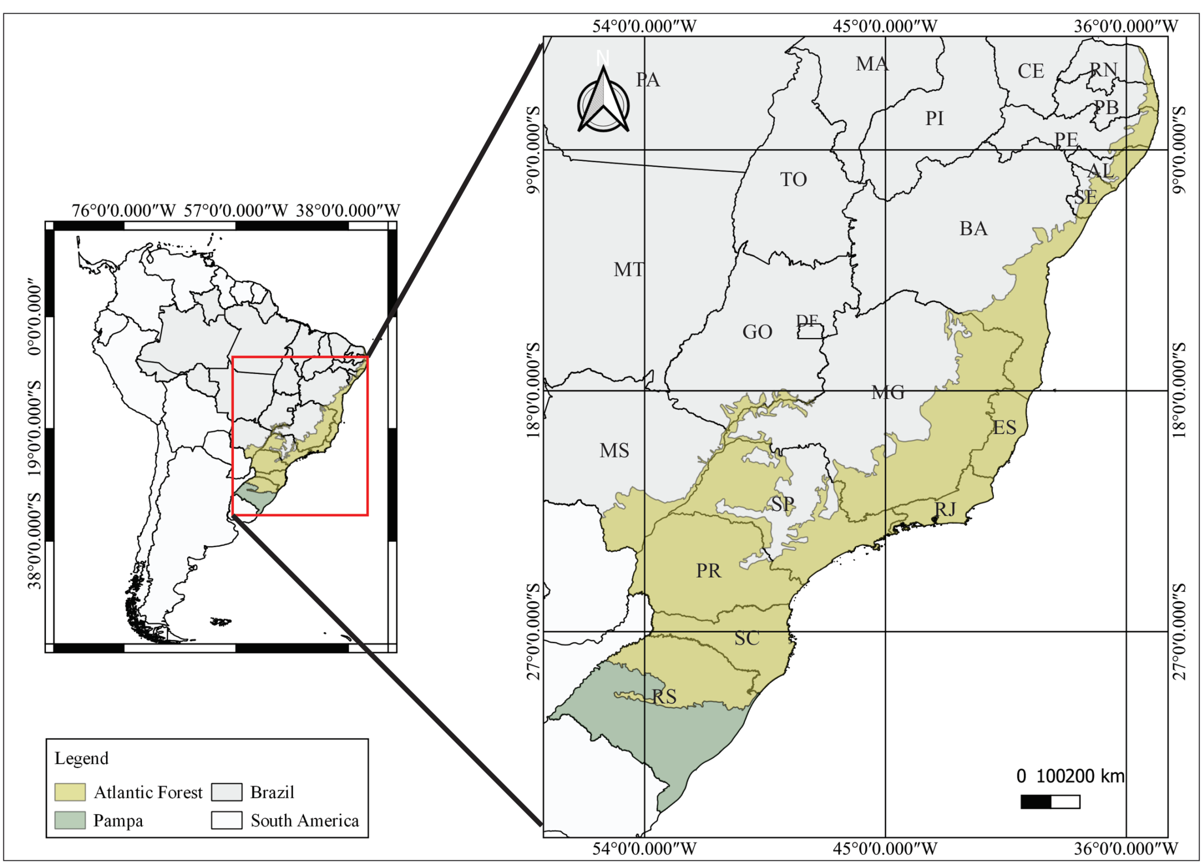

Figure 1. Geographical location of the Brazilian Atlantic Forest and Pampa biomes.

and creatine sucrose agar (CREA). Media preparation, inoculation, incubation, and microscope preparations were conducted as described by Samson *et al.* (2010). Additional CYA and MEA plates were incubated at 15, 30, and 37 °C. Colony diameters were measured after 7 days of incubation, and colony characteristics were recorded. Microscopic observations were made from colonies grown on MEA, and the presence of a sexual stage was investigated in cultures incubated on CYA, MEA, and OA, and the cultures were incubated for at least 40 days at 25 °C. Lactic acid (60 %) was used as a mounting fluid, and 96 % ethanol was used to remove excess conidia. Color names and alphanumeric codes used in descriptions refer to Rayner (1970). Features of the novel species were compared to their closest relatives based on notes provided in previous studies.

Genomic DNA extractions were made from 7-day-old colonies grown on MEA using the Promega DNA isolation kit (Wizard Genomic DNA Purification Kit). A polymerase chain reaction (PCR) amplification of the ITS barcode (ITS1, 5.8S rDNA, and ITS2), tubulin (*BenA*), calmodulin (*CaM*), and RNA polymerase II, the second largest subunit (*RPB2*) genes, was performed using the methods described by Visagie *et al.* (2014). PCR products were purified using the Exonuclease/Alkaline Phosphatase mix (Cellco Biotec.), and sequenced on the sequencing platform at UFPE (Recife, Brazil) using the same primer pairs. For phylogenetic analysis, sequence datasets were generated by combining the newly generated sequences with reference (ex-type) sequences from previous studies deposited in the nucleotide database at NCBI (GenBank). The sequences were aligned using MAFFT v.7 (Katoh & Standley 2013), and manually optimized using MEGA v. 6.06 (Tamura *et al.* 2013). Initially, the positioning of the new species in section *Lanata-Divaricata* was analyzed using a concatenated dataset with *BenA* and *CaM* sequences. After this initial analysis, more comprehensive ITS, *BenA*, *CaM*, and *RPB2* sequence datasets for series *Janthinella* were generated and analyzed. The combined datasets for section *Lanata-Divaricata* and series *Janthinella* were made by concatenating the individual alignments using Mesquite v. 3.04 (Maddison & Maddison 2016). Phylogenetic trees were constructed by maximum likelihood analyses (ML) using RAxML-HPC v. 8.2.8 (Stamatakis 2014) BlackBox with 1,000 rapid bootstrap inferences via the CIPRES science gateway (http://www.phylo.org/) (Miller *et al.* 2012), adopting default parameters. Bayesian inference (BI) analysis was performed in MrBayes 3.2.2 (Ronquist *et al.* 2012). In the Bayesian analyses, every 1,000 generations were sampled, and the first 25 % of the samples were discarded. The most suitable substitution model was determined separately for each gene region using jModelTest v. 2.1.7 (Posada 2008). Trees were visualized in FigTree v. 1.1.2 (Rambaut 2016), and edited in Adobe Illustrator v. 5.1. BI posterior probabilities (pp) and bootstrap (bs) values were labelled at the nodes. Branches with full support in BI and ML analyses were thickened. Values below 0.95 pp and 70 % bs support were not shown, or they were indicated with a hyphen.

Results

According to the conducted literature survey, 84 papers (Atlantic Forest: 78, Pampa: 6) published between 1955 and 2020 reported members of *Eurotiales*, and were included in this checklist. In total, 169 species (68 *Aspergillus*, 79 *Penicillium*, and 22 *Talaromyces*) have been recorded in the Atlantic Forest. *Penicillium digitatum* was the only reported species for the Pampa biome. In *Aspergillus*, the reported species are distributed over 17 sections, with section *Nidulantes* and *Nigri* species being the most common. In *Penicillium*, species classified in 16 sections are listed, they mainly belong to sections *Lanata-Divaricata* and *Sclerotiorum*. Regarding the genus *Talaromyces*, four sections have been recorded, with *Talaromyces* being the most common. According to our survey, 19 species were typified in previous studies with material from the Atlantic Forest biome: *A. barbosae*, *A. bezerrae*, *A. brasiliensis*, *A. labruscus*, *A. recifensis*, *P. apimei*, *P. barbosae, P. brasilianum*, *P. fernandes*, *P. guaibinense*, *P. limae, P. meliponae*, *P. mellis*, *P. reconvexovelosoi*, *P. restingae*, *T. brasiliensis, T. mycothecae*, *T. Pernambucoensis*, and *T. pigmentosus*. In addition, *Penicillium nordestinense* is described here as a new species, see "Taxonomy" section.

Regarding the distribution of records by Brazilian states, Pernambuco has the highest number of records (43 *Aspergillus* spp., 67 *Penicillium* spp., 20 *Talaromyces* spp.), followed by São Paulo (27 *Aspergillus* spp., 29 *Penicillium* spp., 11 *Talaromyces* spp.), and Rio de Janeiro (22 *Aspergillus* spp., 27 *Penicillium* spp., 7 *Talaromyces* spp.). The most common substrates are soil (291 records), water (97), and leaf litter (39).

Taxonomy

The new species *P. nordestinense* is described below and the phylogenetically closely related species *P. setosum* is validated.

Penicillium nordestinense J.E.F. Santos & R.N. Barbosa **sp. nov.** Fig. 2.

MycoBank MB 842080

Etymology: "*nordestinense*", referring to the region Northeast of Brazil (Nordeste, in Portuguese). In this region is the state of Pernambuco, where the type species was isolated.

Type: Brazil: Pernambuco: Paulista, ex pollen samples inside nests of *M. scutellaris*, 7°55'46.9"S 34°53'12.0"W, September 2019, collected and isolated by R.N. Barbosa. Holotype URM 83558, (slide preparation) deposited in the URM fungarium (Recife, Brazil); ex-type strain URM 8423, deposited in the URM culture collection (Recife, Brazil).

ITS barcode: OV265270. Alternative markers: *BenA* = OV265324; *CaM* = OV265272; *RPB2* = OM927721

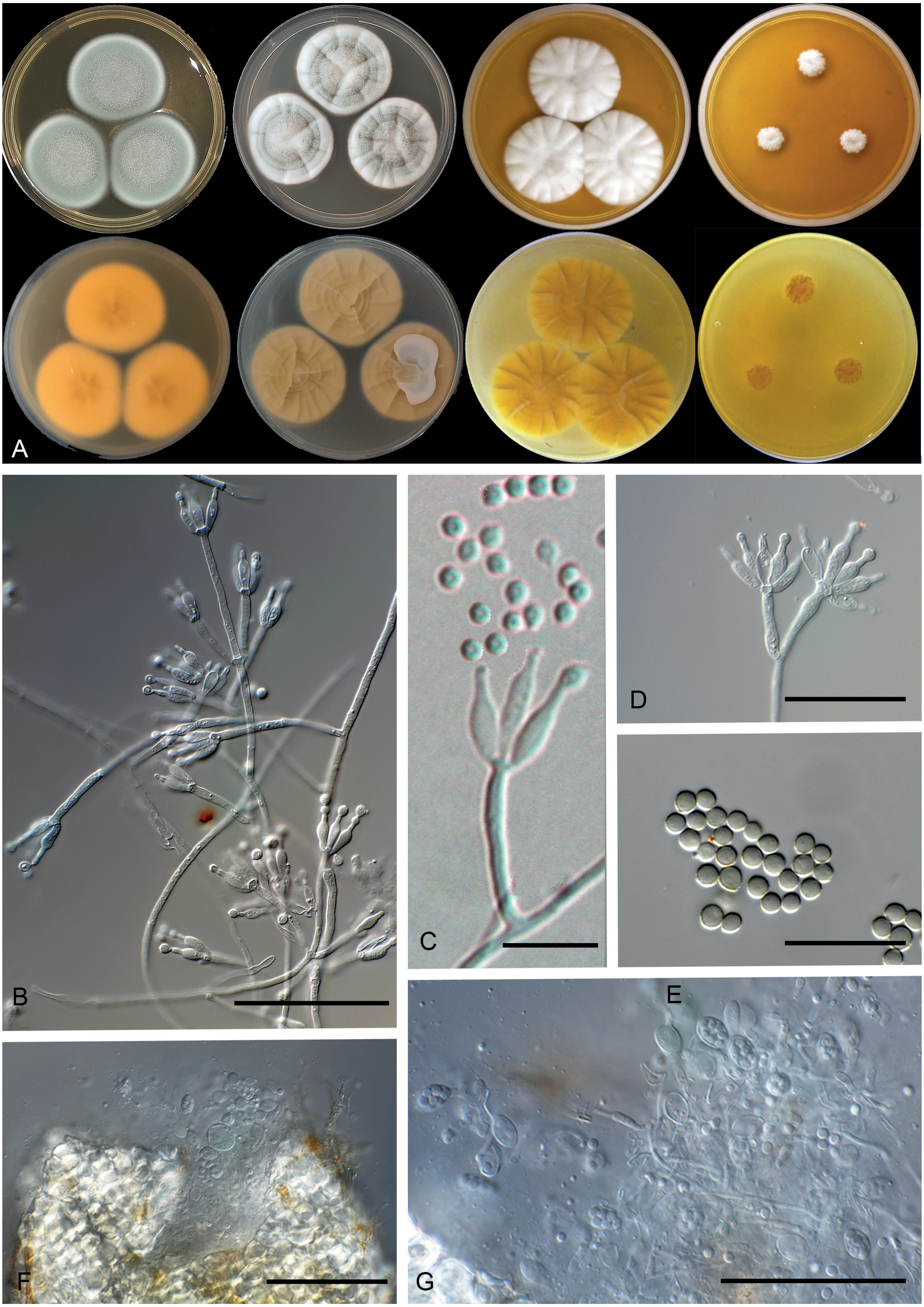

Figure 2. Morphological features of the new species *Penicillium nordestinense*. **A**- Colonies from left to right (top row) MEA, CYA, YES and DG18; (bottom row) obverse of MEA, CYA, YES and DG18. **B, C, D**- Conidiophores. **E**- Conidia. **F, G**- Asci 8-spored, ellipsoidal to ovoid observed in CBS 564.85. Scale bars 10 µm.

Diagnosis: Growing more slowly on MEA (36–38 mm), YES (35–38 mm) and CYAS (11–13 mm) incubated at 25 °C than phylogenetically related species.

Colony diam, 7 d (mm): CYA 25 °C 37–38; MEA 25 °C 36–38; YES 25 °C 35–38; DG18 25 °C 10–11; OA 25 °C 27–29; CYAS 25 °C 11–13; CREA 25 °C 16–18; CYA 15 °C 5–6; 30 °C 40–43; 37 °C 35–39; MEA 15 °C 5; 30 °C 30–35; 37 °C 32–36.

Colony characters: CYA, 25 °C, 7 days: colonies radially sulcate, umbonate; margins entire, low, narrow; mycelium white; colony texture velvety; sporulation moderate; conidial color *en masse* indeterminate; exudate absent; soluble pigment absent; reverse straw (46). MEA, 25 °C, 7 days: colonies plane; margins entire, low, narrow; mycelium white; colony texture velvety; sporulation moderate; conidial color *en masse* pale olivaceous gray (120); exudate absent; soluble pigment absent, reverse saffron (10). YES, 25 °C, 7 days: colonies radially sulcate, raised at center; margins entire, low, narrow; mycelium white; colony texture velvety; sporulation weak; conidial color *en masse* indeterminate; exudate absent; soluble pigment absent; reverse pale luteous (11). DG18, 25 °C, 7 days: moderately elevated, slightly raised at center; margins low, entire; mycelium- white; colony texture slightly floccose; sporulation weak; conidial color *en masse* indeterminate; exudate absent; soluble pigment absent; reverse pale luteous (11). OA, 25 °C, 7 days: colonies plane; margins regular; mycelium white; colony texture velvety; sporulation sparse; conidial color *en masse* pale olivaceous gray (120); exudate absent; soluble pigment absent; reverse inconspicuous, sexual morph observed in CBS 564.85, buff (45) when young, dull yellow to umber (9) in the age. CYAS, 25 °C, 7 days: colonies umbonate, margins regular; margins entire, mycelium smoke gray (105); texture velvety; exudate absent; soluble pigment absent; reverse honey (64). CREA, 25 °C, 7 days: moderate growth, acid production absent.

Micromorphology: Conidiophores monoverticillate, sometimes also biverticillate and divaricate. Stipes smooth-walled, (20–)40–75(–125) × 2–3 µm; non-vesiculate. Phialides 3–5 per stipe, sometimes solitary, ampulliform, 7–13 × 2–3 µm. Conidia smooth-walled, globose to subglobose, 2–3 µm. Ascomata not observed in URM 8423T and 8424, present in CBS 564.85, sclerotioid, maturing in 2–3 weeks, globose to subglobose (140–)170–320(–400) µm. Asci 8-spored, ellipsoidal to ovoid, 6.5–8.5 × (6.5–)8.5–12(–13.5) µm. Ascospores yellowish, lenticular with inconspicuous furrow, valves spinulose, 2.5–3.5 × 3–4 µm.

Additional material examined: URM 8424 (ITS: OV265271, *BenA*: OV265337, *CaM*: OV265273, *RPB2*: OM927721), Brazil: Pernambuco: Paulista, from pollen samples inside nests of *Melipona scutellaris*, 7°55'46.9"S 34°53'12.0"W, September 2019, collected and isolated by R.N. Barbosa. CBS 564.85 (ITS: OV312015, *BenA:* MH846596, *CaM*: MH846609, *RPB2*: MH846584), Canada: Toronto, culture contaminant of CBS 497.85.

Notes: Phylogenetic analyses (Figs. 3, 4) shows that the novel species is most closely related to *P. setosum* and *P. javanicum*, and that the type URM 8423T and URM 8424 clusters with CBS 564.85. The phylogenetic position of this strain was previously unresolved and was suggested to represent a new species (Tijith *et al*. 2019). The taxonomy of section *Lanata-Divaricata* is challenging due to the morphological similarities among members of this section (Visagie *et al*. 2015). However, a few morphological differences are observed (Fig. 1). *Penicillium setosum* predominantly produces divarcate conidiophores and occasionally solitary phialides, in contrast to *P. nordestinense* that predominantly produces monoverticillate conidiophores. Furthermore, *P. javanicum* has rough-walled stipes, in contrast to the smooth-walled stipes of *P. nordestinense* and *P. setosum*. *Penicillium nordestinense*, *P. setosum* and *P. javanicum* also differ in their growth rates on CYA 25 °C (37–38 *vs*. 50–52 *vs* 33–41 mm), MEA 25 °C (36–38 *vs*. 52–55 *vs*. 40–50 mm), YES 25 °C (35–38 *vs*. 48–53 *vs*. 45–52 mm) and CYAS 25 °C (11–13 *vs*. 50–53 *vs*. 20–30 mm) (Visagie *et al*. 2015, Tijith *et al*. 2019). Interestingly, the recently isolated Brazilian *P. nordestinense* strains do not produce ascomata, while the older strain preserved in CBS does. The production of ascomata is shared with *P. setosum* and *P. javanicum*. The ascospores of these three species lack flanges. The valves of the ascospores of *P. javanicum* are finely roughened, while those of *P. setosum* and *P. nordestinense* are ornamented with spines (Visagie *et al*. 2015; Tijith *et al*. 2019).

Penicillium setosum T.K. George, Houbraken, L. Mathew & M.S. Jisha, **sp. nov**.

MycoBank MB 842377

Synonym: *Penicillium setosum* T.K. George, Houbraken, L. Mathew & M.S. Jisha, Mycology 10: 55. 2018, *nom. inval*. Art. 40.8 (Shenzhen).

Diagnosis and description: See Mycology 10: 55–57 (Tijith *et al*. 2019).

Type: India, Kerala, Kottayam, Withania somnifera (L) Dunal, T.K. George (holotype specimen CBS H-24872, culture ex-type CBS 144865 = DTO 455-G4 = WSR 62 = MCC 1370 = NCFT NO 8222.16 = AMH-9974).

Notes: *Penicillium setosum* is herewith validated, as the original description did not state that the holotype was preserved as a metabolically inactive culture.

*Check list of **Aspergillus**, **Penicillium** and **Talaromyces** from the Brazilian Atlantic Forest and Pampa biomes*

ASPERGILLUS P. Micheli ex Haller, Hist. stirp. Helv. 3: 113. 1768.

Section *Aspergillus* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 548676).

Aspergillus chevalieri (L. Mangin) Thom & Church, Aspergilli: 111. 1926. (MB 292839).

Records: As *Aspergillus allocotus* as contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957c); reported as *Eurotium chevalieri* in sand and beach water

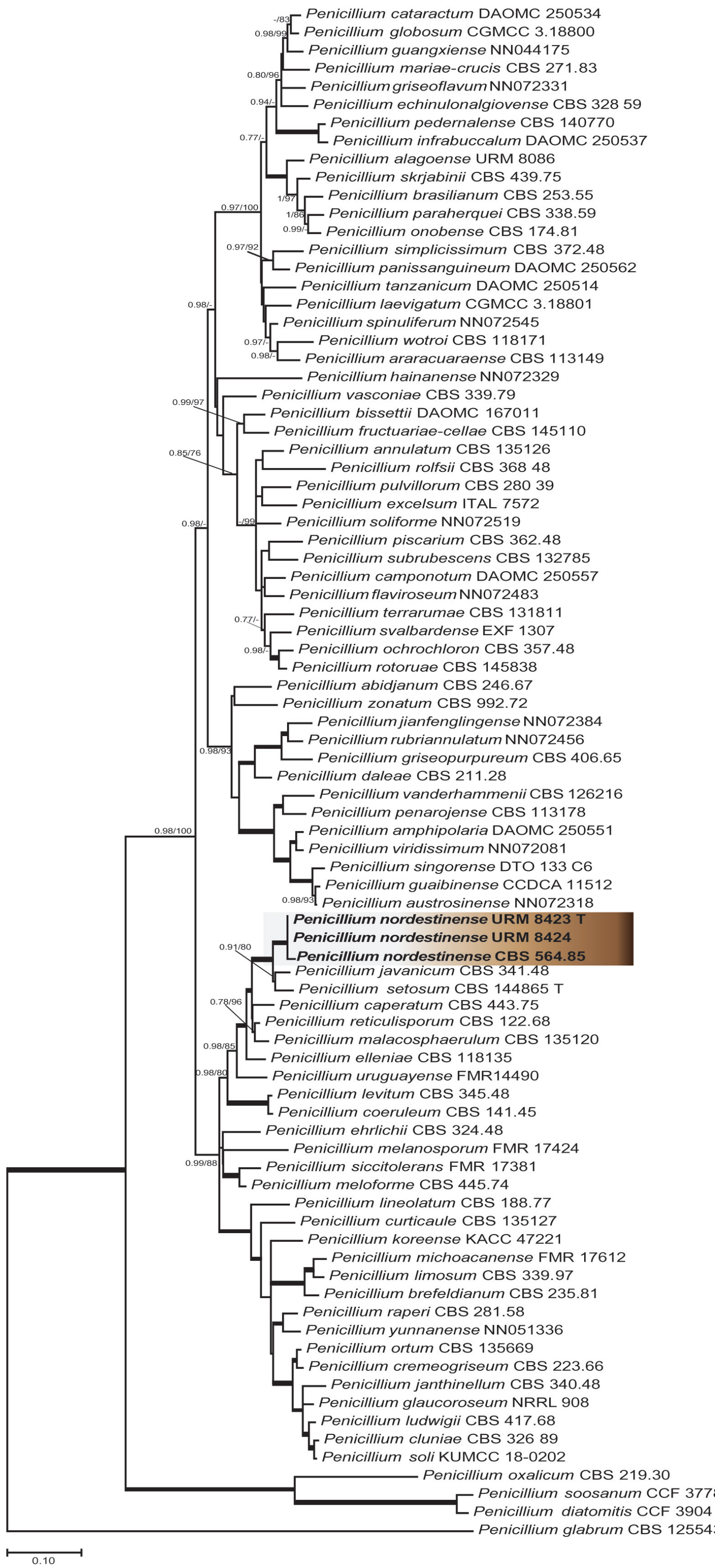

Figure 3. Phylogenetic position of *Penicillium* section *Lanata-Divaricata* strains and the new species *P. nordestinense* based on a combined dataset containing ITS, *BenA*, *CaM* and *RPB2* sequences. The new species is highlighted. Values below 0.95 pp and 70 % are not shown and indicated with a hyphen.

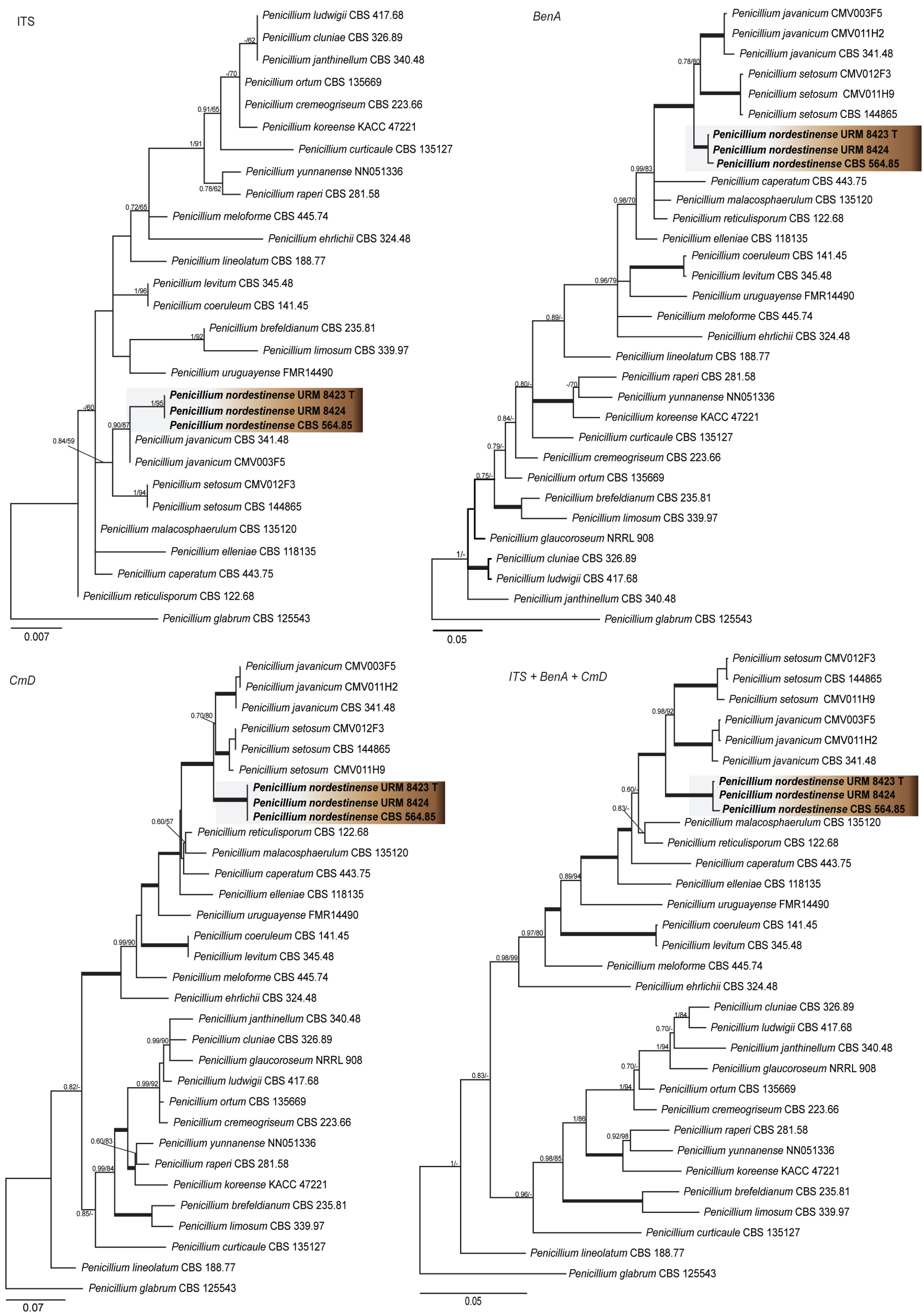

Figure 4. Single gene phylogenies of series *Janthinella* (in the section *Lanata-Divaricata*) strains and the new species *P. nordestinense*. **A**- ITS phylogeny; **B**- *BenA* phylogeny, **C**- *CaM* phylogeny, **D**- combined dataset phylogeny containing ITS, *BenA*, and *CaM* sequences. The new species is highlighted. Values below 0.95 pp and 70 % are not shown and indicated with a hyphen. Branches with posterior probability values of 1.00 and >95 % are thickened.

(Pernambuco-PE, Gomes *et al*. 2008); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); waste of castor (Ceará-CE, Herculano *et al*. 2011).

Note: *Aspergillus allocotus* and *Eurotium chevalieri* were considered synonyms of *A. chevalieri* (Hubka *et al*. 2013).

Aspergillus glaucus (L.) Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. (MB 161735).

Records: Soil and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Santos *et al*. 1998).

Aspergillus proliferans G. Sm, Trans. Brit. Mycol. Soc. 26: 26. 1943. (MB 284312).

Record: As contaminant in laboratory (Bahia-BA, Batista & Maia 1955b).

Aspergillus pseudoglaucus Blochwitz, Ann. Mycol. 27: 207. 1929. (MB 275429).

Records: As *Eurotium glabrum* growing on public telephones (Pernambuco-PE, Coutinho *et al*. 2007); reported as *Eurotium repens* in soil (Pernambuco-PE, Costa *et al*. 2017); in waste of castor (Ceará-CE, Herculano *et al*. 2011).

Note: *Aspergillus repens* (de Bary) Fischer is a later homonym of *Aspergillus repens* (Corda) Sacc. 1882 pertaining to a different species, and *A. pseudoglaucus* is considered the correct name for *Eurotium repens* (Hubka *et al*. 2013).

Section *Candidi* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832512).

Aspergillus candidus Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. (MB 204868).

Records: As contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957c); soil (Pernambuco-PE, Shome 1963); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); air samples (São Paulo-SP, Schoenlein-Crusius *et al*. 2001); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); public telephones (Pernambuco-PE, Coutinho *et al*. 2007); waste of castor (Ceará-CE, Herculano *et al*. 2011).

Section *Cervini* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832497).

Aspergillus cervinus Massee, Bull. Misc. Inform. Kew 1914: 158. 1914. (MB 211549).

Records: Leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010).

Aspergillus nutans McLennan & Ducker, Austral. J. Bot. 2: 355. 1954. (MB 292850).

Record: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010).

Section *Circumdati* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832508).

Aspergillus auricomus (Guég.) Saito, J. Ferment. Technol. 17: 3. 1939. (MB 119950).

Record: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010).

Aspergillus fresenii Subram, Hyphomycetes: 552. 1971. (MB 309222).

Records: As *Aspergillus sulphureus* in beach soil (Pernambuco-PE, Oliveira *et al*. 2011).

Note: For the taxonomic clarification see Visagie *et al*. (2014).

Aspergillus melleus Yukawa, J. Coll. Agric. Imp. Univ. Tokyo 1: 358. 1911. (MB 164593).

Records: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); waste of castor (Ceará-CE, Herculano *et al*. 2011).

Aspergillus ochraceus K. Wilh., Beitr. Kenntn. Aspergillus: 66. 1877. (MB 190223).

Records: Soil (Rio Grande do Sul-RS, Prade *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); sand and beach water (Pernambuco-PE, Gomes *et al*. 2008); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011); endophytic from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al*. 2015). Also reported as *Aspergillus alutaceus* in water and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil and leaf litter (Rio de Janeiro-RJ, Maia & Fraga 2017).

Note: *Aspergillus alutaceus* is considered a synonym of *Aspergillus ochraceus* (see Houbraken *et al*. 2020).

Aspergillus sclerotiorum G.A. Huber, Phytopathology 23: 306. 1933. (MB 277707).

Records: Beach soil (Pernambuco-PE, Pinto *et al*. 1992); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011).

Section *Clavati* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832500).

Aspergillus clavatus Desm, Ann. Sci. Nat., Bot., ser. 2, 2: 71. 1834. (MB 211530).

Records: Water, soil and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Milanez *et al*. 2002; Tauk-Tornisielo *et al*. 2005); soil (Pernambuco-PE, Silva *et al*. 2011); soil (Minas Gerais-MG, Ribeiro *et al*. 2014); soil and leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006).

Aspergillus giganteus Wehmer, Mem. Soc. Phys. Genève 33: 85. 1901. (MB 206765).

Records: Soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005). Also reported as *Aspergillus clavatus* v. *gigantea* in soil (São Paulo-SP, Schoenlein-Crusius *et al*. 2006).

Section *Cremei* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832513).

Aspergillus brunneouniseriatus Suj. Singh & B. K. Bakshi, Trans. Brit. Mycol. Soc. 44: 160. 1961. (MB 326616).

Records: Beach water (Pernambuco-PE, Pinto *et al*. 1992); air samples (São Paulo-SP, Schoenlein-Crusius *et al*. 2001).

Aspergillus stromatoides Raper & Fennell, Gen. Aspergillus: 421. 1965. (MB 326660).

Records: Waste of castor (Ceará-CE, Herculano *et al*. 2011).

Aspergillus wentii Wehmer, Centralbl. Bakteriol. Parasitenk., 2. Abth., 2: 149. 1896. (MB 172623).

Records: Soil (São Paulo-SP, Milanez *et al*. 2002; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); beach soil (Pernambuco-PE, Pinto *et al*. 1992); sand and beach water (Pernambuco-PE, Gomes *et al*. 2008); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Section *Flavi* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832510).

Aspergillus alliaceus Thom & Church, Aspergilli: 163. 1926. (MB 256402).

Records: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Aspergillus flavus Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. (MB 209842).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); soil (São Paulo-SP, Schoenlein-Crusius & Milanez 1998; Milanez *et al*. 2002); soil (Rio Grande do Sul-RS, Prade *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010; Fraga *et al*. 2011); soil (Pernambuco-PE, Silva *et al*. 2011; Costa *et al*. 2017); air samples (São Paulo-SP, Schoenlein-Crusius *et al*. 2001); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); soil and leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); public telephones (Pernambuco-PE, Coutinho *et al*. 2007); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011); leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014); beehives (beebread samples) (Rio de Janeiro-RJ, Keller *et al*. 2014); related to *Atta cephalotes* (Bahia-BA, Reis *et al*. 2015); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); potato baits inside PET bottles (São Paulo-SP, Pasin *et al*. 2019); root (Paraná-PR, Corrêa *et al*. 2019); phytotelmata of the *Aechmea alba* (Bahia-BA, Oliveira & Fortuna 2020). Also reported as *Aspergillus fasciculatus* as contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957a).

Note: Multilocus sequence data indicated that several species in section *Flavi*, including *A. fasciculatus*, are synonyms of *A. flavus* (Varga *et al*. 2011).

Aspergillus oryzae (Ahlb.) Cohn, Jahresber. Schles. Ges. Vaterl. Cult. 61: 226. 1884. (MB 184394).Records: Air (Bahia-BA, Batista & Maia 1955a); beach soil (Pernambuco-PE, Pinto *et al*. 1992); public telephones (Pernambuco-PE, Coutinho *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Aspergillus parasiticus Speare, Bull. Hawaiian Sugar Planters Assoc. Exp. Sta. Pathol. Physiol. Ser. 12: 38. 1912. (MB 191085).

Records: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Aspergillus sojae Sakag. & K. Yamada ex Murak., Rep. Res. Inst. Brewing: 8. 1971. (MB 292860).Record: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010).

Aspergillus tamarii Kita, Centralbl. Bakteriol. 2. Abth. 37: 433. 1913. (MB 191425).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014); soil agroforestry (Pernambuco-PE, Costa *et al*. 2017); soil (Paraná-PR, Corrêa *et al*. 2019). Also reported as *Aspergillus effusus* var. *furcatus* and *Aspergillus flavofurcatus* as contaminant in laboratory by Batista & Maia (1955a); reported as *Aspergillus terricola* in soil agroforestry (Pernambuco-PE, Costa *et al*. 2017).

Note: *Aspergillus terricola* together with *A. flavofurcatis* and *A. tamarii* were placed into an "*A. tamarii* species group" by Kozakiewicz (1989). The name *A. terricola* competes with *A. tamarii*. The former species has priority based on publication date. Sequence data indicate that these isolates belong to the same species. For more details about section *Flavi* see Varga *et al*. (2011) and Frisvad *et al*. (2019).

Section *Flavipedes* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832506).

Aspergillus flavipes (Bainier & Sartory) Thom & Church, Aspergilli: 155. 1926. (MB 265045).Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Section *Fumigati* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832496).

Aspergillus bezerrae J.P. Andrade *et al*., Persoonia 42: 379. 2019. (MB 830186).

Record: Soil sandbank (Bahia-BA, Crous *et al*. 2019a).

Aspergillus brevipes G. Sm, Trans. Brit. Mycol. Soc. 35: 241. 1952. (MB 292837).

Record: Sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003).

Aspergillus duricaulis Raper & Fennell, Gen. *Aspergillus*: 249. 1965. (MB 326627).

Records: Beach oil (Pernambuco-PE, Pinto *et al*. 1992); waste of castor (Ceará-CE, Herculano *et al*. 2011).

Aspergillus fischeri Wehmer, Zentralbl. Bakteriol. Parasitenk, Abt. 2, 18: 390. 1907. (MB 202877).Records: Soil (Pernambuco-PE, Batista & Maia 1957c).

Aspergillus fumigatus Fresen., Beitr. Mykol. 3: 81. 1863. (MB 211776).

Records: Soil (Pernambuco-PE, Shome 1963); soil (São Paulo-SP, Milanez *et al*. 2002; Tauk-Tornisielo *et al*. 2005); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010 ; Fraga *et al*. 2011); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); water (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); soil and leaf litter (São Paulo-SP, Schoenlein-

Crusius *et al.* 2006); public telephones (Pernambuco-PE, Coutinho *et al.* 2007); beach soil (Pernambuco-PE, Oliveira *et al.* 2011); sediment mangrove (Pernambuco-PE, Gomes *et al.* 2011); waste of castor (Ceará-CE, Herculano *et al.* 2011); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014); water and sediment of mangove (São Paulo-SP, Doi *et al.* 2018); dog head state park (Paraná-PR, Vieira *et al.* 2019); soil and leaf litter (Paraná-PR, Corrêa *et al.* 2019).

Aspergillus viridinutans Ducker & Thrower, Austral. J. Bot. 2: 355. 1954. (MB 292864).

Records: sunflower rhizosphere (misspelled as *Aspergillus viride-nutans)* (Pernambuco-PE, Souza-Motta *et al.* 2003).

Section *Janorum* (as "*Jani*") Hubka *et al.*, Mycologia 107: 197. 2015. (MB 832532).

Aspergillus janus Raper & Thom, Mycologia 36: 556. 1944. (MB 284303).

Records: Beach soil and beach water (Pernambuco-PE, Gomes *et al.* 2008); beach soil (Pernambuco-PE, Oliveira *et al.* 2011).

Aspergillus trisporus S.C. Souza *et al.*, Curr. Res. Environ. & Appl. Mycol. 9: 179. 2019. (MB 822378).

Record: Soil (Minas Gerais-MG, Souza *et al.* 2019).

Section *Nidulantes* Gams *et al.* Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832502).

Aspergillus caespitosus Raper & Thom, Mycologia 36: 563. 1944. (MB 284298).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al.* 1992; Gomes *et al.* 2008); sediment mangrove (Pernambuco-PE, Gomes *et al.* 2011); waste of castor (Ceará-CE, Herculano *et al.* 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Aspergillus foveolatus Y. Horie, Trans. Mycol. Soc. Japan 19: 313. 1978. (MB 309221).

Records: As *Emericella foveolata* in dung of armadillo (São Paulo-SP, Horie *et al.* 1996).

Note: *Emericella foveolata* is considered a synonym of *A. foveolatus* (Samson *et al.* 2014).

Aspergillus nidulans (Eidam) G. Winter, Rabenh. Krypt.-Fl., ed. 2, 1: 62. 1884. (MB 182069).Records: Contaminant in laboratory (Pernambuco-PE, Batista & Maia 1955b); soil (Pernambuco-PE, Shome 1963); beach water and soil (Pernambuco-PE, Pinto *et al.* 1992). Also reported as *Emericella nidulans* in sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); beach water and soil (Pernambuco-PE, Gomes *et al.* 2008).

Note: *Emericella nidulans* is considered a synonym of *A. nidulans* (Samson *et al.* 2014).

Aspergillus protuberus Munt-Cvetk, Mikrobiologia 5: 119. 1968. (MB 326650).

Record: Water and sediment of mangrove (São Paulo-SP, Doi *et al.* 2018).

Aspergillus quadrilineatus Thom & Raper, Mycologia 31: 660. 1939. (MB 275888).

Records: As *Emericela nidulans* var. *acristatus* in waste of castor (Ceará-CE, Herculano *et al.* 2011).

Note: *Emericela nidulans* var. *acristatus* is considered a synonym of *A. quadrilineatus* (Hubka *et al.* 2016).

Aspergillus rugulosus Thom & Raper, Mycologia 31: 660. 1939. MycoBank (MB 277104).

Records: As *Emericella rugulosa* var. *lazuline* in soil in a sugar cane plantation (São Paulo-SP, Horie *et al.* 1996).

Note: *Emericella rugulosa* var. *lazuline* is considered a synonym of *A. rugulosus* (Hubka *et al.* 2016).

Aspergillus stellatus Curzi, Atti Reale Accad. Naz. Lincei, Rendiconti Cl. Sci. Fis.19: 428. 1934. (MB 254841).

Records: As *Emericela variecolor* and also *Aspergillus variecolor* in waste of castor (Ceará-CE, Herculano *et al.* 2011).

Note: *Emericela variecolor* and *A. variecolor* are synonyms of *A. stellatus* (Hubka *et al.* 2016).

Aspergillus sublatus Y. Horie, Trans. Mycol. Soc. Japan 20: 481. 1979. (MB 118407).

Records: As *Emericella montenegroi* in roadside soil (São Paulo-SP, Horie *et al.* 1996).

Note: *Emericela montenegroi* is synonyms of *A. sublatus* (Hubka *et al.* 2016).

Aspergillus sydowii (Bainier & Sartory) Thom & Church, Aspergilli: 147. 1926. (MB 279636).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al.* 1992; Gomes *et al.* 2008); leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998; Milanez *et al.* 2002); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); public telephones (Pernambuco-PE, Coutinho *et al.* 2007); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); sediment mangrove (Pernambuco-PE, Gomes *et al.* 2011); waste of castor (Ceará-CE, Herculano *et al.* 2011).

Aspergillus unguis (Émile-Weill & L. Gaudin) C.W. Dodge, Med. Mycol.: 637. 1935. (MB 255264).

Records: Soil (Pernambuco-PE, Shome 1963, Costa *et al.* 2017); Beach soil (Pernambuco-PE, Pinto *et al.* 1992); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010).

Aspergillus versicolor (Vuill.) Tirab., Ann. Bot. (Roma) 7: 9. 1908 (MB 172159).

Records: Beach water (Pernambuco-PE, Pinto *et al.* 1992); soil and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); air samples (São Paulo-SP, Schoenlein-Crusius *et al.* 2001); soil (São Paulo-SP, Milanez *et al.* 2002; Tauk-Tornisielo *et al.* 2005; Schoenlein-Crusius *et al.* 2006); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); public telephones (Pernambuco-PE, Coutinho *et al.* 2007); waste of castor (Ceará-CE, Herculano *et al.* 2011); beehives (beebread samples) (Rio de Janeiro-RJ, Keller *et al.* 2014); decaying plants (Paraná-PR, Dapper *et al.* 2016); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019).

Section *Nigri* Gams *et al.* Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832511).

Aspergillus aculeatinus Noonim *et al*., Int. J. Syst. Evol. Microbiol. 58: 1733. 2008. (MB 505075).

Records: Soil and leaf litter (Minas Gerais-MG, Maia *et al*. 2015; Maia & Fraga 2017).

Aspergillus aculeatus Iizuka, J. Agric. Chem. Soc. Japan 27: 806. 1953. (MB 292831).

Records: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); leaf litter and soil (Minas Gerais-MG, Maia *et al*. 2015); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); potato baits in PET bottles (São Paulo-SP, Pasin *et al*. 2019); leaf litter (Paraná-PR, Corrêa *et al*. 2019).

Aspergillus brasiliensis Varga *et al*. , Int. J. Syst. Evol. Microbiol. 57: 57. 2007. (MB 510581).

Records: Soil (São Paulo-SP, Varga *et al*. 2007); organic material in decomposition (São Paulo-SP, Almeida *et al*. 2017).

Aspergillus carbonarius (Bainier) Thom, J. Agric. Res. 7: 12. 1916. (MB 100545).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); potato baits in PET bottles (São Paulo-SP, Pasin *et al*. 2019).

Aspergillus japonicus Saito, Bot. Mag. (Tokyo) 20: 61. 1906. (MB 160656).

Records: As contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957c); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011); soil (Pernambuco-PE, Costa *et al*. 2017); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); phytotelmata of the *Vriesea procera* (Bahia-BA, Oliveira & Fortuna 2020); water (São Paulo-SP, Takahashi *et al*. 2012).

Aspergillus labruscus Fungaro *et al*., Sci. Rep. 7: 6203, 4. 2017. (MB 815746).

Record: Surface of grape berries (*Vitis labrusca*) (Rio Grande do Sul-RS, Fungaro *et al*. 2017).

Aspergillus niger Tiegh., Ann. Sci. Nat., Bot., ser. 5, 8: 240. 1867.; nom. cons. (Kozakiewicz *et al*. 1992). (MB 284309).

Records: Soil (Pernambuco-PE, Shome 1963, Maia *et al*. 2006; Silva *et al*. 2011; Costa *et al*. 2017); soil (São Paulo-SP, Santos *et al*. 1998; Milanez *et al*. 2002; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); soil (Rio Grande do Sul-RS, Prade *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010; Fraga *et al*. 2011); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); water, soil and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); leaf leaves (São Paulo-SP, Wellbaum *et al*. 1999); air samples (São Paulo-SP, Schoenlein-Crusius *et al*. 2001); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); soil and leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); public telephones (Pernambuco-PE, Coutinho *et al*. 2007); waste of castor (Ceará-CE, Herculano *et al*. 2011); soil (Pernambuco-PE, Oliveira *et al*. 2011); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); endophytic from *Heliconia* spp. (Bahia-BA, Cerqueira *et al*. 2013); endophytic from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al*. 2015); decaying root (Paraná-PR, Oriente *et al*. 2015); endophyte from *Begonia fischeri* (São Paulo-SP, Correia *et al*. 2017); soil and leaf litter (Minas Gerais-MG, Maia & Fraga 2017); Bromeliaceae (Bahia-BA, Palha *et al*. 2018; Santos *et al*. 2018); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); potato baits in PET bottles (São Paulo-SP, Pasin *et al*. 2019); roots (Paraná-PR, Corrêa *et al*. 2019). Also reported as *Aspergillus foetidus* in Bromeliaceae (Bahia-BA, Palha *et al*. 2018).

Note: *Aspergillus foetidus* is considered synonyms of *A. niger* (Varga *et al*. 2011).

Aspergillus welwitschiae (Bres.) Henn, in Wehmer, Centralbl. Bakteriol. Parasitenk., 2. Abth. 18: 394. 1907. (MB 490584).

Records: As *Aspergillus awamori* in beach soil (Pernambuco-PE, Pinto *et al*. 1992); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Note: *Aspergillus awamori* is a synonym of *A. welwitschiae* (Perrone *et al*. 2011).

Section *Ochraceorosei* Frisvad & Samson, Syst. Appl. Microbiol. 28: 451. 2005. (MB 500165).

Aspergillus funiculosus G. Sm, Trans. Brit. Mycol. Soc. 39: 111. 1956. (MB 292845).

Record: Soil (Pernambuco-PE, Costa *et al*. 2017).

Section *Restricti* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832494).

Aspergillus gracilis Bainier, Bull. Soc. Mycol. France 23: 90. 1907. (MB 167554).

Record: Contaminant in laboratory (Pernambuco-PE, Batista *et al*. 1957).

Aspergillus penicillioides Speg., Revista Fac. Agron. Univ. Nac. La Plata 2: 246. 1896. (MB 309234).

Record: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2011).

Aspergillus restrictus G. Sm., J. Textile Inst. 22: 115. 1931. (MB 276290).

Records: Beach soil (Pernambuco-PE, Pinto *et al*. 1992); air samples (São Paulo-SP, Schoenlein-Crusius *et al*. 2001); public telephones (Pernambuco-PE, Coutinho *et al*. 2007).

Section *Sparsi* W. Gams, M. Chr., Onions, Pitt & Samson, Adv. Pen. Asp. Syst.: 61. 1986 (1985). (MB 832514).

Aspergillus panamensis Raper & Thom, Mycologia 36: 568. 1944. (MB 284311).

Record: Soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005).

Aspergillus sparsus Raper & Thom, Mycologia 36: 572. 1944. (MB 284314).

Record: Soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005).

Section *Terrei* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985.(MB 832505).

Aspergillus aureoterreus Samson *et al*. Stud. Mycol. 69: 45. 2011. (MB 560392).

Record: As *Aspergillus terreus* var. *aureus* in waste of castor (Ceará-CE, Herculano *et al*. 2011).

Note: Samson *et al*. (2011) raised this variety to species level.

Aspergillus barbosae A.C.R. Barros-Correia *et al*., Mycological Progress 19: 892. 2020. (MB 830077).

Record: Indoor environment (Pernambuco-PE, Barros Correia *et al*. 2020).

Aspergillus carneus Blochwitz, Ann. Mycol. 31: 81. 1933. (MB 259903).

Records: Contaminant in laboratory (Pernambuco-PE, Batista & Maia 1955b); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (Pernambuco-PE, Maia *et al*. 2006); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019).

Aspergillus niveus Blochwitz, Ann. Mycol. 27: 205. 1929. (MB 272402).

Records: Sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Silva *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011).

Aspergillus neoniveus Samson *et al*. Stud. Mycol. 69: 53. 2011. (MB 560395).

Record: As *Emericella nivea* in sand and beach water (Pernambuco-PE, Gomes *et al*. 2008).

Note: *Emericella nivea* is a synonym of *Aspergillus neoniveus* (Samson *et al*. 2011).

Aspergillus recifensis A.C.R. Barros-Correia *et al*. Mycological Progress 19:895.2020. (MB 830081).

Record: Soil (Pernambuco-PE, Barros Correia *et al*. 2020).

Aspergillus terreus Thom, Amer. J. Bot. 5: 85. 1918. (MB 191719).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005; Raminelli *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010; Fraga *et al*. 2011); soil (Pernambuco-PE, Costa *et al*. 2017); waste of castor (Ceará-CE, Herculano *et al*. 2011); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); unknown substrate in forest (Paraná-PR, Marcolla *et al*. 2020).

Section *Usti* Gams *et al*. Advances in *Penicillium* and *Aspergillus* systematics. 1985. (MB 832504).

Aspergillus deflectus Fennell & Raper, Mycologia 47: 83. 1955. (MB 292841).

Record: Soil (Pernambuco-PE, Costa *et al*. 2017).

Aspergillus puniceus Kwon-Chung & Fennell, Gen. Aspergillus: 547. 1965. (MB 326652).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (Pernambuco-PE, Costa *et al*. 2017).

Aspergillus ustus (Bainier) Thom & Church, Aspergilli: 152. 1926. (MB 281216).

Records: Soil (Pernambuco-PE, Shome 1963, Costa *et al*. 2017); soil (São Paulo-SP, Milanez *et al*. 2002); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019).

Aspergillus calidoustus Varga *et al*. Eukaryot. Cell 7: 636. 2008. (MB 504846).

Record: Phytotelmata of the *Vriesea procera* (Bahia-BA, Oliveira & Fortuna 2020).

PENICILLIUM Link: Fries, Systema Mycologicum 3: 406. 1832.

Section *Aspergilloides* Dierckx, Annls. Soc. Scient. Brux. 25: 85. 1901. (MB 832951).

Penicillium frequentans Westling, Ark. Bot. 11: 133. 1911. (MB 152118).

Record: Public telephones (Pernambuco-PE, Coutinho *et al*. 2007).

Penicillium glabrum (Wehmer) Westling, Ark. Bot. 11: 131. 1911. (MB 120545).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013; Costa *et al*. 2017); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); endophyte from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al*. 2015). Also reported as *Penicillium aurantiobrunneum* in leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998).

Note: *Penicillium aurantiobrunneum* is considered synonym of *P. glabrum* (Houbraken *et al*. 2014).

Penicillium lividum Westling, Ark. Bot. 11: 134. 1911. (MB 178817).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011).

Penicillium montanense M. Chr. & Backus, Mycologia 54: 574. 1962. (MB 335752).

Record: Soil (São Paulo-SP, Santos *et al*. 1998)

Penicillium purpurescens (as "*purpurascens*") (Sopp) Biourge, La Cellule 33: 105. 1923. (MB 335761).

Records: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010).

Penicillium spinulosum Thom, U.S.D.A. Bur. Animal Industr. Bull. 118: 76. 1910. (MB 215401).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (São Paulo-SP, Santos *et al*. 1998; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005).

Penicillium thomii Maire, Bull. Soc. Hist. Nat. Afrique N. 8: 189. 1917. (MB 202819).

Records: Soil and leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); soil (Rio de Janaeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); endophytic from *Begonia fischeri* (São Paulo-SP, Correia *et al*. 2017).

Section *Brevicompacta* Thom, The Penicillia: 289. 1930. (MB 834006).

Penicillium brevicompactum Dierckx, Ann. Soc. Sci. Bruxelles 25: 88. 1901. (MB 149773).

Records: Beach water (Pernambuco-PE, Pinto *et al*. 1992); water and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013, Costa *et al*. 2017); soil (Rio de Janeiro-RJ; Fraga *et al*. 2010); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); waste of castor (Ceará-CE, Herculano *et al*. 2011); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); leaf litter of *Clusia nemorosa* (Bahia-BA, Costa & Gusmão 2015).

Penicillium olsonii Bainier & Sartory, Ann. Mycol. 10: 398. 1912. (MB 121021).

Record: Soil (São Paulo-SP, Santos *et al*. 1998).

Section *Canescentia* Houbraken & Samson, Studies in Mycology 70. 2011.(MB 563135).

Penicillium canescens Sopp, Skr. Vidensk.-Selsk. Christiana Math.-Nat. Kl. 11: 181. 1912. (MB 153765).

Records: Air (São Paulo-SP, Schoenlein-Crusius *et al*. 2001); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013; Costa *et al*. 2017); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); beach soil (Pernambuco-PE, Oliveira *et al*. 2011).

Penicillium janczewskii K.W. Zaleski, Bull. Int. Acad. Polon. Sci., Sér. B., Sci. Nat. 1927: 488. 1927. (MB 120703).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005); soil (Pernambuco-PE, Maia *et al*. 2006; Costa *et al*. 2017); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010; Fraga *et al*. 2011); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012).

Penicillium jensenii K.W. Zaleski, Bull. Int. Acad. Polon. Sci., Sér. B., Sci. Nat. 1927: 494. 1927. (MB 120708).

Record: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010).

Penicillium nigricans Bainier ex Thom, Penicillia: 351. 1930. (MB 119303).

Record: Soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004)

Section *Charlesia* Houbraken & Samson, Studies in Mycology 70. 2011.(MB 563125).

Penicillium chermesinum Biourge, Cellule 33: 284. 1923. (MB 260472).

Records: Beach water (Pernambuco-PE, Pinto *et al*. 1992); inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium fellutanum Biourge, Cellule 33: 262. 1923. (MB 264748).

Records: Water (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Santos *et al*. 1998; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005; Tauk-Tornisielo *et al*. 2009); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010; Fraga & Pereira 2012); air (São Paulo-SP, Schoenlein-Crusius *et al*. 2001); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Section *Chrysogena* Frisvad & Samson, Stud. Mycol. 49: 17. 2004. (MB 700796).

Penicillium chrysogenum Thom, U.S.D.A. Bur. Animal Industr. Bull. 118: 58. 1910. (MB 165757).Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); water (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); public telephones (Pernambuco-PE, Coutinho *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2011); soil (Pernambuco-PE, Cruz *et al*. 2013; Silva *et al*. 2011; Costa *et al*. 2017); water and mangove sediment (São Paulo-SP, Doi *et al*. 2018); leaf and root (Paraná-PR, Corrêa *et al*. 2019); phytotelmata of the *Aechmea alba* (Bahia-BA, Oliveira & Fortuna 2020).

Penicillium dipodomyus (as "*dipodomyis*") (Frisvad *et al*.) Banke *et al*. Int. Mod. Meth. Pen. Asp. Clas.: 271. 2000. (MB 459815).

Record: As *P. dipodomyis* in aquatic reservoirs (Pernambuco-PE, Magalhães *et al*. 2019).

Penicillium rubens Biourge, Cellule 33: 265. 1923. (MB 276884).

Records: Inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018); sugarcane soil (Pernambuco-PE, Ramos *et al*. 2018).

Section *Citrina* Houbraken & Samson, Studies in Mycology 70. 2011.(MB 563132).

Penicillium citrinum Thom, U.S.D.A. Bur. Animal Industr. Bull. 118: 61. 1910. (MB 165293).

Records: Contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957b); soil (São Paulo-SP, Santos *et al*. 1998; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005, Schoenlein-Crusius *et al*. 2006; Tauk-Tornisielo *et al*. 2009); soil (Rio Grande do Sul-RS, Prade *et al*. 2007); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); decomposing leaves (São Paulo-SP, Wellbaum *et al*. 1999); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); beehives (beebread samples) (Rio de Janeiro-RJ, Keller *et al*. 2014); sugarcane soil (Pernambuco-PE, Ramos *et al*. 2018); honey, pollen and nests of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018); phytotelmata of the *Aechmea alba* (Bahia-BA, Oliveira & Fortuna 2020). Also reported as *Penicillium implicatum* in beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); decomposing leaves (São Paulo-SP, Wellbaum *et al*. 1999); soil (São Paulo-SP, Santos *et al*. 1998; Tauk-Tornisielo *et al*. 2005); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Maia *et al*. 2006; Costa *et al*. 2017); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); waste of castor (Ceará-CE, Herculano *et al*. 2011); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); endophytic from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al*. 2015); water and mangove sediment (São Paulo-SP, Doi *et al*. 2018); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019). Also reported as *Penicillium botryosum* as contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957b).

Note: *Penicillium implicatum* and *P. botryosum* are synonyms of *P. citrinum* (see Pitt 1979 and Houbraken *et al*. 2010).

Penicillium miczynskii K.W. Zaleski, Bull. Int. Acad. Polon. Sci., Sér. B., Sci. Nat. 1927: 482. 1927. (MB 271171).

Records: Soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004, Tauk-Tornisielo *et al*. 2005; Schoenlein-Crusius *et al*. 2006); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012).

Penicillium paxilli Bainier, Bull. Soc. Mycol. France 23: 95. 1907. (MB 203838).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); soil (Pernambuco-PE, Maia *et al*. 2006); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); sugarcane soil (Pernambuco-PE, Ramos *et al*. 2018); inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium shearii Stolk & D.B. Scott, Persoonia 4: 396. 1967. (MB 335765).

Record: Inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium steckii K.W. Zaleski, Bull. Int. Acad. Polon. Sci., Sér. B., Sci. Nat. 1927: 469. 1927. (MB 278769).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al*. 1992); inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium sumatraense (as "*sumatrense*") Szilvinyi, Archiv. Hydrobiol.14 Suppl. 6: 535. 1936. (MB 319297).

Record: Inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018)

Penicillium waksmanii K.W. Zaleski, Bull. Int. Acad. Polon. Sci., Sér. B., Sci. Nat.: 468. 1927. (MB 121677).

Records: Beach water (Pernambuco-PE, Pinto *et al*. 1992); soil (São Paulo-SP, Santos *et al*. 1998); water and soil (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); decomposing leaves (São Paulo-SP, Wellbaum *et al*. 1999); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); soil (Pernamuco-PE, Maia *et al*. 2006; Costa *et al*. 2017); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); soil (Pernambuco-PE, Oliveira *et al*. 2011); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); water (São Paulo-SP, Takahashi *et al*. 2012).

Section *Exilicaulis* Pitt, The Genus *Penicillium*: 205. 1980.(MB 832954).

Penicillium citreonigrum Dierckx, Ann. Soc. Sci. Bruxelles 25: 86. 1901. (MB 165197).

Records: Soil (São Paulo-SP, Santos *et al*. 1998; Schoenlein-Crusius *et al*. 2006); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010; Fraga *et al*. 2011; Fraga & Pereira 2012); decomposing leaves (São Paulo-SP, Wellbaum *et al*. 1999); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); sand and water of beach (Pernambuco-PE, Gomes *et al*. 2008); soil (Pernambuco-PE, Cruz *et al*. 2013); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019). Reported as "*Penicillium citreoviride*" in beach water and soil (Pernambuco-PE, Pinto *et al*. 1992).

Note: *Penicillium citreoviride* is considered a synonym of *P. citreonigrum* (Visagie *et al*. 2016).

Penicillium citreosulfuratum Biourge, Cellule 33: 285, 1923. (MB 260947).

Record: Bee pollen of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium corylophilum Dierckx, Ann. Soc. Sci. Bruxelles 25: 86. 1901. (MB 178294).

Records: Beach soil (Pernambuco-PE, Pinto *et al*. 1992); leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Santos *et al*. 1998; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013; Costa *et al*. 2017); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); decomposing leaves (São Paulo-SP, Wellbaum *et al*. 1999); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); endophyte from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al*. 2015); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019); water (São Paulo-SP, Takahashi *et al*. 2012). Reported as *Penicillium humuli* in soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005).

Note: *Penicillium humuli* is considered a synonym of *P. corylophilum* (Visagie *et al*. 2016).

Penicillium decumbens Thom, U.S.D.A. Bur. Animal Industr. Bull. 118: 71. 1910. (MB 156582).

Records: Beach water (Pernambuco-PE, Pinto *et al*. 1992); soil (São Paulo-SP, Santos *et al*. 1998, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005; Tauk-Tornisielo *et al*. 2009); soil (Pernambuco-PE, Maia *et al*. 2006; Silva *et al*. 2011; Cruz *et al*. 2013; Costa *et al*. 2017);

soil (Rio de Janeiro-RJ, Fraga *et al.* 2010; Fraga *et al.* 2011); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al.* 2006); soil and beach water (Pernambuco-PE, Gomes *et al.* 2008); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); waste of castor (Ceará-CE, Herculano *et al.* 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019); water (São Paulo-SP, Takahashi *et al.* 2012).

Penicillium melinii Thom, Penicillia: 273. 1930. (MB 270876).

Record: Soil (Pernambuco-PE, Maia *et al.* 2006; Costa *et al.* 2017).

Penicillium parvum Raper & Fennell, Mycologia 40: 508. 1948. (MB 289101).

Record: Soil (Pernambuco-PE, Costa *et al.* 2017).

Penicillium restrictum J.C. Gilman & E.V. Abbott, Iowa St. Coll. J. Sci. 1: 297. 1927. (MB 276289).

Records: Beach water and soil (Pernambuco-PE, Pinto *et al.* 1992; Gomes *et al.* 2008); soil (São Paulo-SP, Santos *et al.* 1998); soil (Pernambuco-PE, Maia *et al.* 2006; Cruz *et al.* 2013; Costa *et al.* 2017); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010; Rio de Janeiro-RJ, Fraga *et al.* 2011); decomposing leaves (São Paulo-SP, Wellbaum *et al.* 1999); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); leaf litte (São Paulo-SP, Schoenlein-Crusius *et al.* 2006); water (São Paulo-SP, Takahashi *et al.* 2012).

Penicillium vinaceum J.C. Gilman & E.V. Abbott, Iowa St. Coll. J. Sci. 1: 299. 1927. (MB 281754).

Records: Beach water (Pernambuco-PE, Pinto *et al.* 1992); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); soil (Pernambuco-PE, Costa *et al.* 2017).

Section *Fasciculata* Thom, The Penicillia: 374. 1930. (MB 834008).

Penicillium aurantiogriseum Dierckx, Ann. Soc. Sci. Bruxelles 25: 88. 1901. (MB 247956).

Records: Air (São Paulo-SP, Schoenlein-Crusius *et al.* 2001); corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); soil (Pernambuco-PE, Maia *et al.* 2006; Cruz *et al.* 2013; Costa *et al.* 2017); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al.* 2006); endophyte from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al.* 2015); leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019).

Penicillium commune Thom, U.S.D.A. Bur. Animal Industr. Bull. 118: 56. 1910. (MB 164241).

Records: Beach soil (Pernambuco-PE, Pinto *et al.* 1992); soil (Pernambuco-PE Maia *et al.* 2006; Cruz *et al.* 2013; Costa *et al.* 2017); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); public telephones (Pernambuco-PE, Coutinho *et al.* 2007); beach water and soil (Pernambuco-PE, Gomes *et al.* 2008); beach soil (Pernambuco-PE, Oliveira *et al.* 2011); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); endophyte from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al.* 2015); water, leaf and root (Paraná-PR, Corrêa *et al.* 2019).

Penicillium crustosum Thom, The Penicillia: 399. 1930. (MB 262401).

Records: Corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010; Fraga & Pereira 2012); soil (Paraná-PR, Silva *et al.* 2016; Bittencourt *et al.* 2020); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); leaf litter (Paraná-PR, Corrêa *et al.* 2019).

Penicillium echinulatum Raper & Thom ex Fassat., Acta Univ. Carol., Biol. 1974: 326. 1977. (MB 319269).

Records: Soil (São Paulo-SP, Santos *et al.* 1998); soil (Pernambuco-PE, Costa *et al.* 2017); decomposing leaves (São Paulo-SP, Wellbaum *et al.* 1999); air (São Paulo-SP, Schoenlein-Crusius *et al.* 2001); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al.* 2006).

Penicillium gladioli L. McCulloch & Thom, Science 67: 217. 1928. (MB 266048).

Record: Soil (Pernambuco-PE, Maia *et al.* 2006).

Penicillium hirsutum Dierckx, Ann. Soc. Sci. Bruxelles 25: 89. 1901. (MB 152720).

Records: Water, soil and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Santos *et al.* 1998).

Penicillium solitum Westling, Ark. Bot. 11: 65. 1911. (MB 206172).

Records: Corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); beach water and soil (Pernambuco-PE, Gomes *et al.* 2008); soil (Pernambuco-PE, Oliveira *et al.* 2011); soil (Pernambuco-PE, Costa *et al.* 2017); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019).

Penicillium verrucosum Dierckx, Ann. Soc. Sci. Bruxelles 25: 88. 1901. (MB 212252).

Records: Soil (São Paulo-SP, Santos *et al.* 1998); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al.* 2006).

Penicillium viridicatum Westling, Ark. Bot. 11: 88. 1911. (MB 163349).

Records: Leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Santos *et al.* 1998; Schoenlein-Crusius *et al.* 2006); soil (Rio de Janeiro-RJ, Fraga *et al.* 2011).

Section *Gracilenta* Houbraken & Samson. Stud. Mycol. 70: 40. 2011. (MB 563131).

Penicillium apimei R.N. Barbosa *et al.,* Antonie van Leeuwenhoek 111: 1891. 2018. (MB 822208).Record: Honey of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018).

Section *Lanata-Divaricata* Thom, The Penicillia: 328. 1930. (MB 834002).

Penicillium alagoense L.O. Ferro *et al.,* Persoonia 42: 447. 2019. (MB 830760).

Record: As endophyte from leaves of *Miconia* sp. (*Melastomataceae*) (Alagoas-AL, Crous *et al.* 2019a).

Penicillium brasilianum Bat, Anais Soc. Biol. Pernambuco 15: 162. 1957. (MB 302381).

Record: As contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957b).

Penicillium brefeldianum B.O. Dodge, Mycologia 25: 92. 1933. (MB 258851).

Records: Soil (Paraná-PR, Corrêa *et al.* 2019). Also reported as *Eupenicillium brefeldianum* in sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); soil (Pernamuco-PE, Maia *et al.* 2006); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011).

Note: For taxonomic clarification see Houbraken & Samson (2011).

Penicillium echinulonalgiovense S. Abe ex Houbraken & R.N. Barbosa, Antonie van Leeuwenhoek 111: 1895. 2018. (MB 822213).

Record: Bee pollen and nests of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018).

Penicillium guaibinense J.P. Andrade *et al.*, Persoonia 41: 389. 2018. (MB 827182).

Record: Sandbank soil (Bahia-BA, Crous *et al.* 2018).

Penicillium janthinellum Biourge, Cellule 33: 258. 1923. (MB 119134).

Records: Contaminant of *Polyporus spathulatum* (Pernambuco-PE, Batista & Maia 1957b); leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); air (São Paulo-SP, Schoenlein-Crusius *et al.* 2001); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al.* 2005; Schoenlein-Crusius *et al.* 2006); soil (Pernambuco-PE, Maia *et al.* 2006; Silva *et al.* 2011; Cruz *et al.* 2013; Costa *et al.* 2017); beach water and soil (Pernambuco-PE, Gomes *et al.* 2008); waste of castor (Ceará-CE, Herculano *et al.* 2011).

Penicillium javanicum J.F.H. Beyma, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. 26: 17. 1929. (MB 268394).

Records: Soil (Pernambuco-PE, Costa *et al.* 2017); sugarcane soil (Pernambuco-PE, Ramos *et al.* 2018); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019).

Penicillium laevigatum L. Cai *et al.*, Cladistics 35: 537. 2018 *(*2019). (MB 818154).

Record: Bee pollen of *Melipona scutellaris* (Pernambuco-PE, Diao *et al.* 2018).

Penicillium limosum S. Ueda, Mycoscience 36: 451. 1995. (MB 415136).

Record: Sugarcane soil (Pernambuco-PE, Ramos *et al.* 2018).

Penicillium nordestinense J.E.F. Santos & R.N. Barbosa **sp. nov.** MycoBank (MB 842080*)*

Record: Pollen samples inside nests of *Melipona scutellaris* (this study).

Penicillium oxalicum Currie & Thom, J. Biol. Chem. 22: 289. 1915. (MB 121033).

Records: As a contaminant of *Stilbum* sp. (Pernambuco-PE, Batista & Maia 1957b); beach water and soil (Pernambuco-PE, Pinto *et al.* 1992); water and leaves of *Alchornea triplinervia* (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (São Paulo-SP, Santos *et al.* 1998; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al.* 2005; Schoenlein-Crusius *et al.* 2006); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); sediment mangrove (Pernambuco-PE, Gomes *et al.* 2011); leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019).

Penicillium rolfsii Thom, Penicillia: 489. 1930. (MB 276674).

Record: Soil, misspelled as "*P. rolfssi*" (Pernambuco-PE, Cruz *et al.* 2017).

Penicillium simplicissimum (Oudem.) Thom, Penicillia: 335. 1930. (MB 278201).

Record: As contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957b); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al.* 2005; Schoenlein-Crusius *et al.* 2006); soil (Pernambuco-PE, Maia *et al.* 2006; Cruz *et al.* 2013; Costa *et al.* 2017); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010; Fraga *et al.* 2011); beach soil (Pernambuco-PE, Oliveira *et al.* 2011); related to *Atta cephalotes* (Bahia-BA, Reis *et al.* 2015); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019); phytotelmata of the *Aechmea alba* (Bahia-BA, Oliveira & Fortuna 2020).

Penicillium singorense Visagie *et al.*, Stud. Mycol. 78: 119. 2014. (MB 809182).

Record: Bee pollen of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018).

Penicillium wotroi Houbraken *et al.*, Int. J. Syst. Evol. Microbiol. 61: 1474. 2011. (MB 518026).

Records: Honey and inside nests of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018); sugarcane soil (Pernambuco-PE, Ramos *et al.* 2018).

Section *Penicillium* Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. (MB 549140).

Penicillium digitatum (Pers.) Sacc., Fung. Ital. Autogr. Delin.: tab. 894. 1881. (MB 169502).

Records: Soil (Pernambuco-PE, Cruz *et al.* 2013); soil (Rio de Janeiro-RJ: Fraga *et al.* 2010); soil (Rio Grande do Sul-RS, Prade *et al.* 2007).

Penicillium expansum Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. (MB 159382).

Records: Soil (Rio de Janeiro-RJ, Fragra *et al.* 2010); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011).

Section *Ramigena* Thom, The Penicillia: 225. 1930. (MB 834004).

Penicillium cyaneum (Bainier & Sartory) Biourge, Cellule 33: 102. 1923. (MB 251712).

Records: As *Penicillium dierckxii* in agroforestry soil (Pernambuco-PE, Costa *et al.* 2017).

Note: *Penicillium dierckxii* is a synonym of *P. cyaneum* (Houbraken *et al.* 2020).

Section *Ramosum* (as "*Ramosum*") Stolk & Samson, Adv. Pen. Asp. Syst.: 179. 1985.(MB 832722).

Penicillium lanosum Westling, Ark. Bot. 11: 97. 1911. (MB 178497).

Record: Mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011)

Penicillium raistrickii G. Sm., Trans. Brit. Mycol. Soc. 18: 90. 1933. (MB 276069).

Record: Soil and leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006).

Section *Robsamsonia* Houbraken & Frisvad, Persoonia 36: 309. 2016.(MB 815870).

Penicillium glandicola (Oudem.) Seifert & Samson, Adv. Pen. Asp. Syst.: 147. 1986*(*1985). (MB 114761).

Record: Misspelled as *"Penicillium grandicola"* in sediment from mangrove (Pernambuco-PE, Gomes *et al*. 2011).

Penicillium griseofulvum Dierckx, Ann. Soc. Sci. Bruxelles 25: 88. 1901. (MB 120566).

Records: Corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005; Schoenlein-Crusius *et al*. 2006); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013; Costa *et al*. 2017); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Minas Gerais-MG, Ribeiro *et al*. 2014); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); beach soil (Pernambuco-PE, Oliveira *et al*. 2011).

Penicillium vulpinum (Cooke & Massee) Seifert & Samson, Adv. Pen. Asp. Syst.: 144. 1986 *(*1985). (MB 114763).

Records: Soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017).

Section *Sclerotiorum* [as "Sclerotiora"] Houbraken & Samson, Stud. Mycol. 70: 32. 2011. MycoBank (MB 585167).

Penicillium adametzii K.W. Zaleski, Bull. Int. Acad. Polon. Sci., Sér. B., Sci. Nat., 1927: 507. 1927. (MB 119777).

Record: Aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019).

Penicillium bilaiae Chalab, Bot. Mater. Otd. Sporov. Rast. 6: 165. 1950. (MB 302379).

Record: Soil (Pernambuco-PE, Costa *et al*. 2017).

Penicillium barbosae S. Ramos *et al*., Mycological Progress 20: 828. 2021. (MB 837908).

Record: Soil (Pernambuco-PE, Ramos *et al*. 2021).

Penicillium brocae S.W. Peterson *et al*., Mycologia 95: 143. 2003. (MB 373658).

Record: Honey and inside nests of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium fernandesiae R.N. Barbosa *et al*., Antonie van Leeuwenhoek 111: 1895. 2018. (MB 822209).

Record: Inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium herquei Bainier & Sartory, Bull. Soc. Mycol. France 28: 121. 1912. (MB 536431).

Records: Corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); beach soil (Pernambuco-PE, Oliveira *et al*. 2011).

Penicillium limae S. Ramos *et al*., Mycological Progress 20: 832. 2021. (MB 837909).

Record: Soil (Pernambuco-PE, Ramos *et al*. 2021).

Penicillium mallochii K.G. Rivera *et al*., Mycotaxon 119: 322. 2012. (MB 563043).

Record: Honey of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium meliponae R.N. Barbosa *et al*., Antonie van Leeuwenhoek 111: 1897. 2018. (MB 822210).

Record: Honey of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium mellis R.N. Barbosa *et al*., Antonie van Leeuwenhoek 111: 1900. 2018. (MB 822211).Record: Honey of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Penicillium restingae J.P. Andrade *et al*., Persoonia 32: 293. 2014. (MB 807051).

Record: Sandbank (Bahia-BA, Crous *et al*. 2014).

Penicillium reconvexovelosoi J.P. Andrade *et al*., Persoonia 43: 383, 2019. (MB 832747).

Record: Soil of sandbank (Bahia-BA, Crous *et al*. 2019b).

Penicillium sanshaense X.C. Wang & W.Y. Zhuang, Sci. Rep. 7: 8233, 9. 2017. (MB 570337).

Record: Sugarcane soil (Pernambuco-PE, Ramos *et al*. 2018).

Penicillium sclerotiorum J.F.H. Beyma, Zentralbl. Bakteriol. Parasitenk., Abt. 2 96: 418. 1937. (MB 277708).

Records: As contaminant in laboratory (Pernambuco-PE, Batista & Maia 1957b); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); soil (Pernambuco-PE, Maia *et al*. 2006; Cruz *et al*. 2013; Costa *et al*. 2017); honey, pollen and nests of *Melipona scutelaris* (Pernambuco-PE, Barbosa *et al*. 2018); water (São Paulo-SP, Takahashi *et al*. 2012).

Section *Turbata* Houbraken & Samson, Studies in Mycology 70. 2011. (MB 563133).

Penicillium turbatum Westling, Ark. Bot. 11: 128. 1911. (MB 202895).

Records: Sediment mangrove (Pernambuco-PE, Gomes *et al*. 2011); soil (Pernambuco-PE, Costa *et al*. 2017).

TALAROMYCES C.R. Benj., Mycologia 47: 681. 1955.

Section *Helici* Samson, N. Yilmaz & Frisvad, Stud. Mycol. 78: 2014. (MB 809558).

Talaromyces pigmentosus R.N. Barbosa *et al*., Antonie van Leeuwenhoek 111: 1905. 2018 (MB 822216).

Record: Inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Talaromyces varians (G. Sm.) Samson *et al*., Stud. Mycol. 71: 177. 2011. (MB 560677).

Records: As contaminant in laboratory (reported as *Penicillium varians*) (Pernambuco-PE, Batista & Maia 1957b); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); soil (Pernambuco-PE, Costa *et al*. 2017).

Note: *Penicillium varians* does not belong to *Penicillium* and it was tranfered to *Talaromyces* as *T. varians* (Samson *et al*. 2011).

Section *Islandici* (Pitt) Yilmaz, Frisvad & Samson, Stud. Mycol. 78: 2014. (MB 809565).

Talaromyces islandicus (Sopp) Samson *et al.*, Stud. Mycol. 71: 176. 2011. (MB 560654).

Records: As contaminant of *Phytophthora* sp. (reported as *Penicillium islandicum*) (Pernambuco-PE, Batista & Maia 1957b); beach water and soil (Pernambuco-PE, Pinto *et al.* 1992); corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); soil (Pernambuco-PE, Maia *et al.* 2006; Costa *et al.* 2017); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010; Fraga *et al.* 2011); beach soil (Pernambuco-PE, Oliveira *et al.* 2011); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019); water (São Paulo-SP, Takahashi *et al.* 2012).

Note: *Penicillium islandicum* does not belong to *Penicillium* and currently it is treated as *T. islandicum* (Samson *et al.* 2011).

Talaromyces rugulosus (Thom) Samson *et al.*, Stud. Mycol. 71: 177. 2011. (MB 560672).

Records: As contaminant of exsiccate (reported as *Penicillium tardum*) (Pernambuco-PE, Batista & Maia 1957b). Reported as *Penicillium rugulosum* in soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al.* 2005; Tauk-Tornisielo *et al.* 2009); soil (Pernambuco-PE, Maia *et al.* 2006); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); leaf litter (São Paulo-SP, Schoenlein-Crusius *et al.* 2006); beach water and soil (Pernambuco-PE, Gomes *et al.* 2008); leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); water (São Paulo-SP, Takahashi *et al.* 2012).

Note: *Penicillium tardum* is a synonym of *T. rugulosus* (Yilmaz *et al.* 2014).

Talaromyces scorteus (Nakazawa *et al.*) S.W. Peterson & Jurjević, PLoS ONE 8: e78084, 8. 2013. (MB 804734).

Record: Honey and inside nests of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018).

Talaromyces wortmannii (Klöcker) C.R. Benj. Mycologia 47: 683. 1955. (MB 344294).

Records: Beach soil (Pernambuco-PE, Oliveira *et al.* 2011); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); inside nest of *Melipona scutellaris* (Barbosa *et al.* 2018). Also reported as *Talaromyces variabilis* in aquatic reservoirs (Pernambuco-PE, Magalhães *et al.* 2019). Also reported as *Penicillium variabile* as contaminant of exsiccate (Pernambuco-PE, Batista & Maia 1957b); beach water (Pernambuco-PE, Pinto *et al.* 1992); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al.* 2003); corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); public telephones (Pernambuco-PE, Coutinho *et al.* 2007); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); water and soil (Schoenlein-Crusius & Milanez 1998).

Note: *Talaromyces variabilis* is a synonym of *T. wortmanni* (Yilmaz *et al.* 2014).

Section *Talaromyces* Stolk & Samson Stud. Mycol. 2: 56. 1972. (MB 549314).

Talaromyces aculeatus (Raper & Fennell) Samson *et al.*, Stud. Mycol. 71: 174. 2011. (MB 560639).

Records: Reported as *P. aculeatum* in soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al.* 2005).

Talaromyces calidicanius (J.L. Chen) Samson *et al.*, Stud. Mycol. 71: 175. 2011. (MB 560645).

Record: Pollen of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018).

Talaromyces duclauxii (Delacr.) Samson *et al.*, Stud. Mycol. 71: 175. 2011. (MB 560650).

Records: As *Penicillium duclauxii* in corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); soil (Pernambuco-PE, Costa *et al.* 2017).

Note: *Penicillium duclauxii* is currently treated as *Talaromyces duclauxii* (Samson *et al.* 2011).

Talaromyces flavus (Klöcker) Stolk & Samson, Stud. Mycol. 2: 10. 1972. (MB 324416).

Records: Mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019); water and sediment of mangrove (São Paulo-SP, Doi *et al.* 2018).

Talaromyces funiculosus (Thom) Samson *et al.*, Stud. Mycol. 71: 176. 2011. (MB 560653).

Records: Endophyte from *Bauhinia forficata* (Pernambuco-PE, Bezerra *et al.* 2015); aquatic reservoir (Pernambuco-PE, Magalhães *et al.* 2019). Also reported as *Penicillium funiculosum* in corn derived products (Pernambuco-PE, Ribeiro *et al.* 2003); public telephones (Pernambuco-PE, Coutinho *et al.* 2007); mangrove sediment (Pernambuco-PE, Gomes *et al.* 2011); beach soil (Pernambuco-PE, Oliveira *et al.* 2011); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al.* 2005); soil (Rio de Janeiro-RJ, Fraga *et al.* 2011); soil (Pernambuco-PE, Costa *et al.* 2017).

Note: *Penicillium funiculosum* does not belong to *Penicillium* and it was transferred to *Talaromyces* (Samson *et al.* 2011).

Talaromyces macrosporus (Stolk & Samson) Frisvad *et al.*, Antonie van Leeuwenhoek 57: 186. 1990. (MB 126704).

Record: Soil (São Paulo-SP, Tauk-Tornisielo *et al.* 2005).

Talaromyces muroii Yaguchi *et al.*, Mycoscience 35: 252. 1994. (MB 362930).

Record: Sugarcane soil (Pernambuco-PE, Ramos *et al.* 2018).

Talaromyces mycothecae R.N. Barbosa *et al.*, Antonie van Leeuwenhoek 111: 1902. 2018 (MB 822215).

Record: Inside nest of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al.* 2018).

Talaromyces pinophilus (Hedgc.) Samson *et al.*, Stud. Mycol. 71: 176. 2011. (MB 560662).

Records: As *Penicillium pinophilum* in soil (São Paulo-SP, Schoenlein-Crusius & Milanez 1998); soil (Rio de Janeiro-RJ, Fraga *et al.* 2010); soil (Pernambuco-PE, Costa *et al.* 2017);

corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); mangrove sediment (Pernambuco-PE, Gomes *et al*. 2011).

Note: *Penicillium pinophilum* was transferred to *Talaromyces* (Samson *et al*. 2011).

Talaromyces purpureogenus (as "*purpurogenus*") (Stoll) Samson *et al.* , Stud. Mycol. 71: 177. 2011. (MB 585068).

Records: As contaminant in laboratory (reported as *Penicilium purpurogenum*) (Pernambuco-PE, Batista & Maia 1957b); beach water and soil (Pernambuco-PE, Pinto *et al*. 1992; Gomes *et al*. 2008); soil (São Paulo-SP, Santos *et al*. 1998; Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005; Tauk-Tornisielo *et al*. 2009); soil (Rio de Janeiro-RJ, Fraga *et al*. 2010); soil (Pernambuco-PE, Costa *et al*. 2017); corn derived products (Pernambuco-PE, Ribeiro *et al*. 2003); soil and leaf litter (São Paulo-SP, Schoenlein-Crusius *et al*. 2006); public telephones (Pernambuco-PE, Coutinho *et al*. 2007); beach soil (Pernambuco-PE, Oliveira *et al*. 2011); phylloplane from *Caesalpinia echinata* (Pernambuco-PE, Lima & Cavalcanti 2014).

Note: *Penicilium purpurogenum* is currently treated in *Talaromyces* (Samson *et al*. 2011).

Talaromyces verruculosus (Peyronel) Samson, N. Yilmaz, Frisvad & Seifert, Studies in Mycology 70: 177.2011. (MB 560678).

Records: Sugarcane soil (Pernambuco-PE, Ramos *et al*. 2018); aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019). Reported as *Penicillium verruculosum* in beach water (Pernambuco-PE, Pinto *et al*. 1992); sunflower rhizosphere (Pernambuco-PE, Souza-Motta *et al*. 2003); soil (São Paulo-SP, Ruegger & Tauk-Tornisielo 2004; Tauk-Tornisielo *et al*. 2005); soil (Pernambuco-PE, Maia *et al*. 2006; Costa *et al*. 2017); soil and leaf litter (Rio de Janeiro-RJ, Fraga & Pereira 2012); related to *Atta cephalotes* (Bahia-BA, Reis *et al*. 2015).

Note: *Penicillium verruculosum* was transferred to *Talaromyces* (Samson *et al*. 2011).

Section *Trachyspermi* Yaguchi & Udagawa. Mycoscience 37. 1996. (MB 701485).

Talaromyces brasiliensis R.N. Barbosa *et al*., Antonie van Leeuwenhoek 111: 1902. 2018 (MB 822214).

Record: Honey and inside nests of *Melipona scutellaris* (Pernambuco-PE, Barbosa *et al*. 2018).

Talaromyces diversus (Raper & Fennell) Samson *et al*., Stud. Mycol. 71: 175. 2011. (MB 560649).

Record: As *Penicillium diversum* in beachsoil (Pernambuco-PE, Oliveira *et al*. 2011).

Note: *Penicillium diversum* is currently treated in *Talaromyces* (Samson *et al*. 2011).

Talaromyces minioluteus (Dierckx) Samson, N. Yilmaz, Frisvad & Seifert, Studies in Mycology 70: 176. 2011. (MB 560657).

Records: Aquatic reservoir (Pernambuco-PE, Magalhães *et al*. 2019). Reported as *Penicillium minioluteum* in water (Schoenlein-Crusius & Milanez 1998); soil (Pernambuco-PE, Maia *et al*. 2006, Costa *et al*. 2017); beach water and soil (Pernambuco-PE, Gomes *et al*. 2008); leaf litter of *Vismia guianensis* (Ceará-CE, Bahia-BA, Paraíba-PB, Costa & Gusmão 2015); leaf litter of *Clusia nemorosa* (Bahia-BA, Costa & Gusmão 2015).

Note: *Penicillium minioluteum* does not belong to *Penicillium* and it is currently treated in *Talaromyces* (Samson *et al*. 2011).

Talaromyces pernambucoensis R. Cruz *et al*., Persoonia 42: 467. 2019. (MB 830189).

Record: Soil (Pernambuco-PE, Crous *et al*. 2019a).

Talaromyces trachyspermus (Shear) Stolk & Samson, Stud. Mycol. 2: 32. 1972. (MB 324421). Record: Soil (São Paulo-SP, Tauk-Tornisielo *et al*. 2005).

Species previously treated in *Aspergillus*

Penicilliopsis Solms, Ann. Jard. Bot. Buitenzorg 6: 53. 1887. (MB 3806).

Penicilliopsis zonata (Kwon-Chung & Fennell) Samson *et al*., Stud. Mycol. 85: 211. 2016. (MB 819185).

Records: Reported as *Aspergillus zonatus* from air (São Paulo-SP, Schoenlein-Crusius *et al*. 2001) and soil (São Paulo-SP, Schoenlein-Crusius *et al*. 2006).

Note: For taxonomic clarification see Houbraken *et al*. (2020).

Sclerocleista Subram., Curr. Sci. 41: 757. 1972. (MB 4928)

Sclerocleista ornata (Raper *et al*.) Subram., Curr. Sci. 41: 757. 1972. (MB 323241).

Record: As *Aspergillus ornatus* in soil (São Paulo-SP, Schoenlein-Crusius & Milanez 1998).

Note: The genus *Sclerocleista* was introduced to accommodate the sexual morph of *Aspergillus ornatus* (Subramanian 1972). For more details, see Houbraken *et al*. (2020).

Discussion

Tropical regions are typically the most diverse in plants and animals species (Brown 2014; Raven *et al*. 2020), as well as a broad variety of interactions between them (Brown 2014). However, regarding fungi, there is a deficit of data in the literature that estimate the diversity of fungi in the tropics (Hawksworth 2001; Hawksworth & Lücking 2017). Our knowledge about fungal diversity and their roles in tropical ecosystems is still incomplete (Aime & Brearley 2012). Species checklists are essential tools to provide information for ecological studies, biodiversity assessments, conservation reports, and public politics related to biodiversity conservation. A few initiatives are helpful aids for compiling lists of fungal species, such as the MycoBank (https://www.mycobank.org/), Index Fungorum (http://www.indexfungorum.org/), Faces of Fungi (https://www.facesoffungi.org/), The Global Fungal Red List Initiative of the IUCN Red List (https://www.iucnredlist.org/), and mainly on Brazilian fungal diversity, Fungos do Brasil (http://www.cybertruffle.org.uk/brazfung/por/index.htm), Flora e Funga do Brasil 2020 - Algas, Fungos e Plantas (http://floradobrasil.jbrj.gov.br/), and SpeciesLink (https://splink.cria.org.br/).

The soil is the most frequently reported source of *Aspergillus*, *Penicillium*, and *Talaromyces* in the Atlantic Forest, which was also reported by Barbosa *et al.* (2020) in a recent checklist of fungi in the Caatinga forest in Brazil. Other substrates with significant occurrence of species were water and leaf litter. Fungi are present and prominent in all soils, and their fungal communities may have an extreme species richness (Taylor & Sinsabaugh 2015). Those fungi are dispersed through mycelial growth and more rapidly over larger distances via spores, which are dispersed principally by wind (Taylor & Sinsabaugh 2015), but also through insects and other animals (Magyar *et al.* 2016). Owing to their ability to produce a wide variety of extracellular enzymes, fungi are able to break down all types of organic matter and decompose soil components, thereby regulating the balance of carbon and nutrients (Žifčáková *et al.* 2016). The fungal diversity can be affected by soil and plant properties, providing evidence for strong links among soil fungal diversity and plant and soil properties (Yang *et al.* 2017). Most fungi consume living or dead plant materials as their primary nutrients source, and a large number of fungi display some degree of specialization toward their living or dead plant substrates. Thus, plant community composition plays a dominant role in determining the fungal community in an environment (Taylor & Sinsabaugh 2015).

In Brazil, the state of Pernambuco has been historically highlighted in mycological studies because of the existence of the former Institute of Mycology, of the University of Recife (currently the Departamento de Micologia at the Universidade Federal de Pernambuco), which was founded by Augusto Chaves Batista (Bezerra *et al.* 2017). The mycological effort in this region explains the reason for the highest number of fungal records because since 1954, several fungal surveys were developed, and their focus was mainly on the soil (Barbosa *et al.* 2020).

Aspergillus had the highest species richness in the Atlantic Forest. Species of *Aspergillus* are found across the world and might be more dominant in regions with tropical and subtropical climates (Klich 2002). A few species, owing to the production of important metabolites such antibiotics, mycotoxins, enzymes, organic acids, and phenolic compounds, are used in several biotechnological processes (Dagenais & Keller 2009). *Aspergillus* species belonging to sections *Nidulantes* and *Nigri* were the most frequently reported. *Aspergillus nidulans* is the most common section *Nidulantes* species reported in the Atlantic Forest, and produces, like other section *Nidulantes* species, typical biseriate conidiophores with pale brown pigmented stipes, and when present, the ascomata embedded in masses of Hülle cells (Chen *et al.* 2016). A total of 11 species in this section are reported in our checklist. Members of *Aspergillus* section *Nidulantes* are widely distributed in nature and may play significant roles in decomposition processes (Raper & Fennell 1965). The section *Nigri* comprises several species important to agricultural and food production, human and other animal health, and occur frequently throughout the world. The taxonomy of section *Nigri* is confusing and complex because of subtle differences between the species. A few species, such as *A. carbonarius*, *A. japonicus*, and *A. aculeatus*, can be easily recognized using morphologic criteria; however, species related to the *A. niger* (series *Nigri*) are difficult to distinguish using morphologic criteria (Samson *et al.* 2004). Thus, the polyphasic taxonomy has been necessary for accurate identification, as well as description of novel species, for *Aspergillus*, as well as *Penicillium* and *Talaromyces*.

Penicillium is one of the most common and diverse fungal genera, and according to the last list of accepted species, includes 483 species (Houbraken *et al.* 2020). Several *Penicillium* species are economically important as sources of antibiotics, organic acids, enzymes, pharmaceuticals, and several other metabolites; however, a few of them cause food spoilage, produce mycotoxins, and cause human and other animal diseases (Pitt 1994; Frisvad *et al.* 2004). Members of the *Penicillium* section, *Lanata-Divaricata* and *Sclerotiorum* are abundant in the Brazilian Atlantic Forest. *Penicillium* section *Sclerotiorum* was introduced by Houbraken & Samson (2011), and most of the species in this group share the production of yellow to orange mycelia and have a reverse orange or reddish colony and bright-colored sclerotia (Visagie *et al.* 2013). Recently, *P. barbosae* and *P. limae* isolated from sugarcane cultivation soils in Atlantic Forest in northeastern Brazil were described as new in the section *Sclerotiorum*, series *Adametziorum* (Ramos *et al.* 2021). The novel species, *P. nordestinense*, described in this study belongs to section *Lanata-Divaricata*, series *Janthinella*. Species of this section are common in soil (Diao *et al.* 2018) and frequently found on rotting leaf litter (Houbraken *et al.* 2011). Species identification in this section is difficult, and a DNA-based approach using *BenA* sequencing, if needed supplemented with a *CaM* sequence, is suggested for reliable results (Visagie *et al.* 2015). Previous studies reported the occurrence of section *Lanata-Divaricata* species as endophytes (*P. alagoense*, Crous *et al.* 2019a; *P. brasilianum*, *P. cluniae* and *P. echinulonalgiovense*, Freire *et al.* 2020) and in honey, bee pollen, and nests of *M. scutellaris* (Barbosa *et al.* 2018); however, the ecological significance remains unknown.

The genus *Talaromyces* was introduced by Benjamin (1955) to accommodate a group of sexually reproducing *Penicillium* species. In 2011, Samson *et al.* re-evaluated the genus and transferred most species of *Penicillium* belonging to the subgenus *Biverticillium* to *Talaromyces*. In the monographic treatment of the genus by Yilmaz *et al.* (2014), 88 species were accepted and these were classified in seven sections: *Bacillispori*, *Helici*, *Islandici*, *Purpurei*, *Subinflati*, *Talaromyces*, and *Trachyspermi*. Six years later, a new section named *Tenues* was proposed (Sun *et al*. 2020). In our checklist, we found species belonging to sections *Helici*, *Islandici*, *Talaromyces*, and *Trachyspermi*. Species classified in section *Talaromyces* were commonly found occurring in the Atlantic Forest. This is the largest section of the genus *Talaromyces*, and it includes 72 species (Houbraken *et al*. 2020). Members of this section exhibit a great diversity in morphological characters and were isolated from a diverse range of substrates (*e.g.*, Jiang *et al*. 2018; Barbosa *et al*. 2018; Wei *et al*. 2021). Although few members of *Talaromyces* were reported as opportunistic human pathogens, such *T. marneffei*, most of them are producers of anticancer, antibacterial, antifungal, antiproliferative, and antioxidative compounds; several enzymes; and natural pigments (Narikawa *et al*. 2000; Bladt *et al*. 2013; Frisvad *et al*. 2013; Maeda *et al*. 2013; Zhai *et al*. 2016; Kumari *et al*. 2018; Lian *et al*. 2018; Nicoletti *et al*. 2018; Xu *et al*. 2018).

The correct identification and description of new species must follow standardized methodologies to make species identifications across laboratories more consistent (*e.g.*, Samson *et al*. 2010; Houbraken *et al*. 2011; Visagie *et al*. 2014; Yilmaz *et al*. 2014; Frisvad *et al*. 2019). All guidelines were based on polyphasic approaches, including morphology, multigene phylogenies, physiology, and extrolite data. Currently, few studies in Brazilian Atlantic Forest have adopted this approach for species identification (*e.g.*, Fungaro *et al*. 2017; Barbosa *et al*. 2018; Barros-Correia *et al*. 2020) and previous studies that did not use polyphasic methods could have misidentified species in very related and complex groups. We also reinforced the importance of preserving strains in a public reference fungal culture collection (*e.g.*, URM culture collection in Brazil (*Micoteca URM Profa. Maria Auxiliadora Cavalcanti* - https://www.ufpe.br/micoteca) (Barbosa *et al*. 2020).

Although the Atlantic Forest is one of the world's top biodiversity hotspots (Rezende *et al*. 2018) with a diversified mosaic of habitats that harbors several species, there is a gap between species estimates and the number of species discovered. Only 19 names (5 *Aspergillus*, 10 *Penicillium*, and 4 *Talaromyces*) are described on and typified with specimens from the Atlantic Forest. Most of these were isolated from soil and substrates related to stingless bees. This fact is considerably insufficient, considering that we have investigated literature published over 65 years (1955 to 2020). The question "how many *Aspergillus*, *Penicillium*, and *Talaromyces* species there are in Brazil?" is indisputably important to mention here through the vast importance and applicability of these fungal species. Currently, only a few research groups focus on studying the diversity of these fungi in Brazil because of several technical limitations, *e.g.*, several groups are still unable to apply modern identification techniques. In addition, there are very few taxonomy experts and enthusiasts studying *Aspergillus*, *Penicillium*, and *Talaromyces* taxonomy in Brazil (R.N. Barbosa - personal communication). This can be seen, for example, in the scarcity of studies in the Pampa biome. Among the six studies that were analyzed, only one isolate was identified at the species level.

Fungi are the second most species-rich organism group after insects (Purvis & Hector 2000). In this way, it is challenging to conduct fungal inventory, as they are still scarce when compared to other organisms such as plants and animals. Although the fungal diversity has been extensively investigated, and the development of molecular phylogeny has revealed an unexpected fungal diversity with an increased number of novel taxa, it is still necessary to increase and incentivize the development of researches including collection and preservation of specimens in fungal herbaria and culture collections. In addition, the survey and correct use of fungal diversity is relevant to several industry segments (*e.g.*, agriculture, pharmacology, food, and biotechnology).

Conclusions

This checklist indicates that the number of mycological studies for prospective *Aspergillus*, *Penicillium*, and *Talaromyces* diversity in Brazilian Atlantic Forest and Pampa biomes is still scarce and extremely necessary. The soil is the most cited substrate for these species, the conditions of the soil environment are optimal for their growth, mainly because of the abundance of leaf litter and other compounds. Despite the degraded state of the Atlantic Forest and Pampa, the biological potential of several of them still lacks a basic understanding, highlighting the importance of conducting inventories. To date, few species are described from these biomes, and this reflects the importance of increasing the number of mycologists, in particular, specialists in taxonomy. Our data provide a framework to study the biogeography of *Aspergillus*, *Penicillium*, and *Talaromyces* species in tropical environments, and contribute to a better understanding of Brazilian fungal diversity.

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References

Aime MC, Brearley FQ. 2012. Tropical fungal diversity: closing the gap between species estimates and species discovery. Biodiversity and Conservation 21: 2177-2180.

Almeida PZ, Pereira MG, Carvalho CC, *et al*. 2017. Bioprospection and characterization of the amylolytic activity by filamentous fungi from Brazilian Atlantic Forest. Biota Neotropica 17: 2-9.

Bamisile BS, Dash CK, Akutse KS, Keppanan R, Wang L. 2018. Fungal endophytes: Beyond herbivore management. Frontiers in Microbiology 9: 544. doi: 10.3389/fmicb.2018.00544

Barbosa PDPM, Speranza P, Ohara A, Silva EB, Angelis DA, Macedo GA. 2017. Fungi from Brazilian Savannah and Atlantic rainforest show high antibacterial and antifungal activity. Biocatalysis and Agricultural Biotechnology 10:1-8.

Barbosa RN, Bezerra JDP, Santos ACS, *et al*. 2020. Brazilian tropical dry forest (Caatinga) in the spotlight: an overview of species of *Aspergillus*, *Penicillium* and *Talaromyces* (*Eurotiales*) and the description of *P. vascosobrinhous* sp. nov. Acta Botanica Brasilica 34: 409-429.

Barbosa RN, Bezerra JDP, Souza-Motta CM, *et al*. 2018. New *Penicillium* and *Talaromyces* species from honey, pollen and nests of stingless bees. Antonie van Leeuwenhoek 111: 1883-1912.

Barros-Correia ACR, Barbosa RN, Frisvad JC, Houbraken J, Souza-Motta CM. 2020. The polyphasic re-identification of a Brazilian *Aspergillus* section *Terrei* collection led to the discovery of two new species. Mycological Progress 19: 885-903.

Batista AC, Lima IH, Vital AF. 1957. *Aspergillus gracilis* Bainier var. *Sartoryi* (Biourge) Batista, Lima e Vital n.var. - sua importância filogenética. in Instituto de Micologia, Universidade do Recife 4. Mycopathologia et Mycologia Applicata 8: 89-102.

Batista AC, Maia HS. 1955a. Uma nova espécie de *Penicillium* e outros Aspergillales in Instituto de Micologia, Universidade do Recife 24. Anais da Sociedade de Biologia de Pernambuco 13: 11-28.

Batista AC, Maia HS. 1955b. Alguns Aspergillales de contaminação in Instituto de Micologia, Universidade do Recife 18. Anais da Sociedade de Biologia de Pernambuco 13: 91-100.

Batista AC, Maia HS. 1957a. Alguns *Aspergillus* contaminantes de culturas in Instituto de Micologia, Universidade do Recife 13. Anais da Sociedade de Biologia de Pernambuco 15: 181-237.

Batista AC, Maia HS. 1957b. Alguns Penicillia de contaminação in Instituto de Micologia, Universidade do Recife 12. Anais da Sociedade de Biologia de Pernambuco 15: 149-180

Batista AC, Maia HS. 1957c. Estudo taxonômico de um novo *Aspergillaceae*. in Instituto de Micologia, Universidade do Recife 5. Mycopathologia et Mycologia Applicata 8: 103-120.

Benjamin CR. 1955. Ascocarps of *Aspergillus* and *Penicillium*. Mycologia 47: 669-687.

Bezerra JD, Nascimento CC, Barbosa RDN, *et al*. 2015. Endophytic fungi from medicinal plant Bauhinia forficata: Diversity and biotechnological potential. Brazilian Journal of Microbiology 46: 49-57.

Bezerra JD, Maciel MHC, Bezerra JL, Correia OM, Souza-Motta CM. 2017. The contribution of Augusto Chaves Batista (1916-1967) to Mycology in Brazil. Gaia Scientia 11: 250-273.

Bezerra JDP, Silva LF, Souza-Motta CM. 2019. The Explosion of Brazilian Endophytic Fungal Diversity: Taxonomy and Biotechnological Potentials. In: Satyanarayana T, Deshmukh S, Deshpande M. (eds). Advancing Frontiers in Mycology & Mycotechnology. Singapore, Springer. pp 405-433.

Bittencourt KWF, Arfelli VC, Lunkes JC *et al*. 2020. Biochemical Characteristics of *Penicillium crustosum* FP 11 Xylanase II and an assessment of the properties of xylanases produced by the genus *Penicillium*. Annual Research & Review in Biology 35: 64-75.

Bladt TT, Frisvad JC, Knudsen PB, Larsen TO. 2013. Anticancer and antifungal compounds from *Aspergillus*, *Penicillium* and other filamentous fungi. Molecules 18: 11338–11376.

BRASIL. 2010. Quarto Relatório Nacional à Convenção sobre Diversidade Biológica Brasil. Escritório do Programa Nacional de Conservação da Biodiversidade - DCBio. Ministério do Meio Ambiente, Brasília.

Brown JH. 2014. Why are there so many species in the tropics? Journal of Biogeography 41: 8-22.

Brown KSJ, Brown GG. 1992. Habitat alteration and species loss in Brazilian forests. In: Whitmore TT, Sayer JA (eds.). Tropical deforestation and species extinction. England, London, Chapman and Hall. pp. 119-142.

Cerqueira KS, Luz EDM, Magalhães DMA, Bezerra JL. 2013. Fungos endófitos em plantas ornamentais tropicais na Bahia. Agrotrópica (Brasil) 25: 223-232.

Chen AJ, Sun BD, Houbraken J. 2016. New *Talaromyces* species from indoor environments in China. Studies in Mycology 84: 119-144.

Chikowski RS, Lira CRS, Larsson K-H, Gibertoni TB. 2020. A checklist of corticioid fungi (*Agaricomycetes*, *Basidiomycota*) from Brazil. Mycotaxon 135: 467-467.

CIB - Conservation International do Brasil. 2000. Avaliação e ações prioritárias para a conservação da biodiversidade da Mata Atlântica e Campos Sulinos. Brasília, Ministério do Meio Ambiente/SBF. pp. 40.

Corrêa JM, Moraes SS, Henn C, *et al*. 2019. Bioprospecting and enzymatic potential of filamentous fungi from the Bela Vista Biological Refuge in Itaipu, Brazil. Genetics and Molecular Research 18: 1-12.

Correia AML, Lira SP, Assis MA, Rodrigues A. 2017. Fungal endophyte communities in Begonia species from the Brazilian Atlantic rainforest. Current Microbiology 75: 441-449.

Costa FMO, Araújo MAG, Santos PJP, *et al*. 2017. Richness and abundance of filamentous fungi in complex agroforestry multistrata system soil. Revista Brasileira de Agroecologia 12: 1980-9735.

Costa LA, Gusmão LFP 2015. Characterization saprobic fungi on leaf litter of two species of trees in the Atlantic Forest, Brazil. Brazilian Journal of Microbiology 46: 1027-1035.

Courty PE, Buee M, Diedhiou AG, *et al*. 2010. The role of ectomycorrhizal communities in forest ecosystem processes: new perspectives and emerging concepts. Soil Biology & Biochemistry 42: 679-698.

Coutinho FP, Cavalcanti MS, Cordeiro Neto F. 2007. Isolation of filamentous fungi from public telephones of the Metropolitan region of the city of Recife, PE, Brazil. Brazilian Journal of Microbiology 38: 324-329.

Crous PW, Carnegie AJ, Wingfield MJ, *et al*. 2019a. Fungal Planet description sheets: 868-950. Persoonia 42: 291-473.

Crous PW, Luangsa-ard JJ, Wingfield MJ, *et al*. 2018. Fungal Planet description sheets: 785-867. Persoonia 41: 238-417.

Crous PW, Shivas RG, Quaedvlieget W, *et al*. 2014. Fungal Planet description sheets: 214-280. Persoonia 32: 184-306.

Crous PW, Wingfield, MJ, Lombard L, *et al*. 2019b. Fungal Planet description sheets: 951-1041. Persoonia 43, 2019: 223-425. doi: 10.3767/persoonia.2019.43.06

Cruz R, Fonseca JC, Maciel MHC, *et al*. 2017. Extraction of tannase by the new strain of *Penicillium*. Current Biotechnology 6: 308-317.

Cruz R, Santos C, Lima JS, Moreira KA, Souza-Motta CM. 2013. Diversity of *Penicillium* in soil of Caatinga and Atlantic Forest areas of Pernambuco, Brazil: an ecological approach. Nova Hedwigia 97: 543-556.

Dagenais TRT, Keller NP. 2009. Pathogenesis of *Aspergillus fumigatus* in invasive aspergillosis. Clinical Microbiology Reviews 22: 447-465.

Dapper TB, Arfelli VC, Henn C, *et al*. 2016. β-Fructofuranosidase production by *Aspergillus* versicolor isolated from Atlantic forest and grown on apple pomace. African Journal of Microbiology Research 10: 938-948.

Diao YZ, Chen Q, Jiang XZ, *et al*. 2018. *Penicillium* section *Lanata-divaricata* from acidic soil. Cladistics 35: 514-549.

Doi SA, Pinto AB, Canali MC, Polezel DR, Chinellato RAM, Oliveira AJFC. 2018. Density and diversity of filamentous fungi in the water and sediment of Araçá bay in São Sebastião, São Paulo, Brazil. Biota Neotropica 18: 2-9.

Feitosa RM, Morini MS, Martins AC, *et al*. 2020. Social Insects of the Atlantic Forest. In: Marques MCM, Grelle CEV. (eds) The Atlantic Forest: history, biodiversity, threats and opportunities of the megadiverse forest. Springer International Publishing, Switzerland.

Ferreira J, Pardini R, Metzger JP, *et al*. 2012. Towards environmentally sustainable agriculture in Brazil: challenges and opportunities for applied ecological research. Journal of Applied Ecology 49: 535-541.

Ferrer-Paris JR, Zager I, Keith DA, *et al*. 2019. An ecosystem risk assessment of temperate and tropical forests of the Americas with an outlook on future conservation strategies. Conservation Letters 12: 1-10.

Figueiredo MSL, Weber MM, Brasileiro CA, *et al*. 2020. Tetrapod diversity in the Atlantic Forest: maps and gaps. In: Marques, MCM, Grelle, CEV (eds) The Atlantic Forest: history, biodiversity, threats and opportunities of the megadiverse forest. Springer International Publishing, Switzerland. p. 185- 204.

Flora e Funga do Brasil 2020 (em construção). 2020. Jardim Botânico do Rio de Janeiro. http://floradobrasil.jbrj.gov.br/. 02 Jul. 2020.

Fraga ME, Pereira MG, Barbosa DJ, Melo MP. 2010. Diversidade de *Trichocomaceae* isoladas de solo em dois ecossistemas florestais. Ciência Florestal 20: 167-175.

Fraga ME, Pereira MG. 2012. Diversidade de *Trichocomaceae* isolada de solo e serrapilheira de Floresta Atlântica. Floresta e Ambiente 19: 405-413.

Fraga ME, Zonta E, Balieiro FC. 2011. Isolation and selection of filamentous fungi from petroleum contaminated soil. Bioresearch Bulletin 4: 227-235.

Freire KTLS, Araújo-Magalhães GR, Nascimento SS, *et al*. 2020. First report of *Penicillium brasilianum* Bat., P. cluniae Quintan., and *P. echinulonalgiovense* S. Abe ex Houbraken & R.N. Barbosa (Eurotiales, Aspergillaceae) as endophytes from a bromeliad in the Caatinga dry forest in Brazil. Check List 16: 1055–1061.

Frisvad JC, Hubka V, Ezekiel CN, *et al*. 2019. Taxonomy of *Aspergillus* section *Flavi* and their production of aflatoxins, ochratoxins and other mycotoxins. Studies in Mycology 93: 1-63.

Frisvad JC, Smedsgaard J, Larsen TO, *et al*. 2004. Mycotoxins, drugs and other extrolites produced by species in *Penicillium* subgenus *Penicillium*. Studies in Mycology 49: 201–241.

Frisvad JC, Yilmaz N, Thrane U, Rasmussen KB, Houbraken J, Samson RA. 2013. *Talaromyces atroroseus*, a new species efficiently producing industrially relevant red pigments. PLoS ONE 8: e84102. doi: 10.1371/journal.pone.0084102

Fungaro MHP, Ferranti LS, Massi FP, *et al*. 2017. *Aspergillus labruscus* sp. nov., a new species of *Aspergillus* section *Nigri* discovered in Brazil. Scientific Reports 7: 1-9.

Gomes DNF, Cavalcanti MA, Passavante JZO. 2011. Fungos filamentosos isolados de sedimento do manguezal barra das Jangadas, Jaboatão dos Guararapes, Pernambuco, Brasil. Tropical Oceanography 39: 69-78.

Gomes DNF, Cavalcanti MAQ, Fernandes MJS, Lima DMM, Passavante, JZO. 2008. Filamentous fungi isolated from sand and water of" Bairro Novo" and" Casa Caiada" beaches, Olinda, Pernambuco, Brazil. Brazilian Journal of Biology 68: 577-582.

Grelle CEV, Rajão H, Marques MCM. 2021. The Future of the Brazilian Atlantic Forest. In: Marques MCM, Grelle CEV (eds) The Atlantic Forest. Cham, Springer. pp. 487-503.

Hawksworth DL, Lücking R. 2017. Fungal Diversity Revisited: 2.2 to 3.8 Million Species. Microbiology Spectrum 5: 5-4.

Hawksworth DL. 2001. The magnitude of fungal diversity: the 1.5 million species estimate revisited. Mycological Research 105: 1422-1432.

Heilmann-Clausen J, Barron ES, Boddy L, *et al*. 2015. A fungal perspective on conservation biology. Conservation Biology 29: 61-68.

Herculano PN, Lima DMM, Fernandes MJS, *et al*. 2011. Isolation of cellulolytic fungi from waste of castor (*Ricinus communis* L.). Current Microbiology 62: 1416-1422.

Honegger R. 2012. 15 The symbiotic phenotype of lichen-forming Ascomycetes and their endo- and epibionts. In: Hock B. (eds) Fungal Associations. The Mycota (A comprehensive treatise on fungi as experimental systems for basic and applied research). Berlin, Heidelberg, Springer. pp. 287-339.

Horie Y, Miyaji M, Nishimura K, *et al*. 1996. New and interesting species of *Emericella* from Brazilian soil. Mycoscience 37: 137-144.

Houbraken J, Frisvad JC, Samson RA. 2010. Sex in *Penicillium* series Roqueforti. IMA Fungus 1: 171-180.

Houbraken J, Kocsube S, Visagie C. *et al*. 2020. Classification of *Aspergillus, Penicillium, Talaromyces* and related genera (Eurotiales): an overview of families, genera, subgenera, sections, series and species. Studies in Mycology 95: 5-169.

Houbraken J, López-Quintero CA, Frisvad JC, *et al*. 2011. *Penicillium araracuarense* sp. nov., *Penicillium elleniae* sp. nov., *Penicillium penarojense* sp. nov., *Penicillium vanderhammenii* sp. nov. and *Penicillium wotroi* sp. nov., isolated from leaf litter. International Journal of Systematic and Evolutionary Microbiology 61: 1462-1475.

Houbraken J, Samson RA. 2011. Phylogeny of *Penicillium* and the segregation of Trichocomaceae into three families. Studies in Mycology 70: 1-51.

Houbraken J, Visagie CM, Meijer M, *et al*. 2014. A taxonomic and phylogenetic revision of *Penicillium* section *Aspergilloides*. Studies in Mycology 78: 373-451.

Hubka V, Kolařík M, Kubátová A. 2013. Taxonomical revision of *Eurotium* and transfer of species to *Aspergillus*. Mycologia 105:912-937.

Hubka V, Nováková A, Peterson SW. 2016. A reappraisal of *Aspergillus* section *Nidulantes* with descriptions of two new sterigmatocystin-producing species. Plant Systematics and Evolution 302:1267-1299.

IBGE. 2004. Mapa de biomas do Brasil: primeira aproximação. Escala 1:5 000 000. Projeção policônica. https://www.ibge.gov.br/geociencias/cartas-e-mapas/informacoes-ambientais/15842-biomas.html?=&t=acesso-ao-produto. 19 jan. 2021.

IBGE. 2019. Biomas e sistema costeiro-marinho do Brasil: compatível com a escala 1:250 000. Rio de Janeiro, IBGE. pp. 168. https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2101676. 19 jan. 2021.

Jiang XZ, Yu ZD, Ruan YM, Wang L. 2018. Three new species of *Talaromyces* sect. *Talaromyces* discovered from soil in China. Scientific reports 8: 1-11.

Katoh KL, Standley DM. 2013. MAFFT multiple sequence alignment software version 7: improvements in performance and usability. Molecular Biology and Evolution 30: 772-780.

Keller KM, Deveza MV, Koshiyama AS, *et al*. 2014. Fungi infection in honeybee hives in regions affected by Brazilian sac brood Arquivo Brasileiro de Medicina Veterinária e Zootecnia 66: 1471-1478.

Klich MA. 2002. Identification of common *Aspergillus* species. Utrecht, Centraalbureau voor Schimmelcultures.

Klumpp A, Domingos M, Klumpp G. 1996. Assessment of the vegetation risk by fluoride emissions from fertiliser industries at Cubatão, Brazil. Science of the Total Environment 192: 219-228.

Kozakiewicz Z. 1989. *Aspergillus* species on stored products. Mycological Papers 161: 1–188.

Kozakiewicz Z, Frisvad JC, Hawksworth DL, *et al*. 1992. Proposals for nomina specifica conservanda and rejicienda in *Aspergillus* and *Penicillium* (Fungi). Taxon 41: 109-113.

Kumari M, Taritla S, Sharma A, Jayabaskaran C. 2018. Antiproliferative and antioxidative bioactive compounds in extracts of marine-derived endophytic fungus *Talaromyces purpureogenus*. Frontiers in Microbiol 9: e1777. doi: 10.3389/fmicb.2018.01777

Lian W, Wang W, Tan CP, Wang J, Wang Y. 2018. Immobilized *Talaromyces thermophilus* lipase as an efficient catalyst for the production of LML-type structured lipids. Bioprocess and Biosystems Engineering 42: 321-329.

Lima TEF, Cavalcanti MS. 2014. Fungos endófitos e do filoplano de Caesalpinia echinata Lam da Estação Ecológica de Tapacurá, PE. Agrotrópica 26: 43-50.

Maddison WP, Maddison DR. 2016. Mesquite: A modular system for evolutionary analysis. Version 3.61. http://mesquiteproject.org.

Maeda RN, Barcelos CA, Anna LMMS, Pereira N. 2013. Cellulase production by *Penicillium funiculosum* and its application in the hydrolysis of sugar cane bagasse for second generation ethanol production by fed batch operation. Journal of Biotechnology 163: 38-44.

Magalhães KM, Lima MCSD, Santos EM, Correia JMDS, Silva ACBL. 2019. Biodiversity of aquatic environments in a peri-urban Atlantic Forest protected remnant: a checklist. Biota Neotropica 19: 2-6.

Magyar D, Vass M, Li DW. 2016. Dispersal Strategies of Microfungi. In: Li DW. (eds) Biology of Microfungi. Fungal Biology. Springer, Cham. pp. 315–371.

Maia LC, Cavalcanti MAQ, Gibertoni TB, *et al*. 2006. Fungos. In: Porto KC, Almeida-Cortez JS, Tabarelli M (eds). Diversidade Biológica e Conservação da Floresta Atlântica ao Norte do Rio São Francisco, 1st nd. Brasília, Ministério do Meio Ambiente. pp. 75-108.

Maia TF, Fraga ME. 2017. Bioprospecting *Aspergillus* section *Nigri* in Atlantic Forest soil and plant litter. Arquivos do Instituto Biológico 84: 1-7.

Maia TF, Simões-Araújo JL, Inácio CA, Fraga ME. 2015. Characterization of *Aspergillus* section *Nigri* isolates from leaf litter and soil in the Atlantic Forest of Brazil. African Journal of Microbiology Research 9: 301-306.

Marcolla AC, Rasbold L, Silva GC, *et al*. 2020. Screening of filamentous fungi from the Atlantic Forest biome producing enzymes of the pectinolytic complex. Brazilian Journal of Development 6: 57580-57585.

Marques MCM, Trindade W, Bohn A, Grelle CEV. 2020. The Atlantic Forest: an introduction to the megadiverse forest of Southern America. In: Marques, MCM, Grelle, CEV (eds) The Atlantic Forest: history, biodiversity, threats and opportunities of the megadiverse forest. Switzerland, Springer International Publishing. p. 3-23.

Milanez TV, Schoenlein-Crusius IH, Okino LK. 2002. Evaluation of Brazilian terrestrial *Aspergillus* strains for mycotoxin production. Revista Instituto Adolfo Lutz 61: 7-11.

Miller MA, Pfeiffer W, Schwartz T. 2012. The CIPRES science gateway: enabling high-impact science for phylogenetics researchers with limited resources. In: Stewart C. (ed.) Proceedings of the 1st Conference of the Extreme Science and Engineering Discovery Environment: Bridging from the extreme to the campus and beyond. USA, Association for Computing Machinery. p. 1-8.

Morellato LPC, Haddad CFB. 2000. Introduction: The Brazilian Atlantic Forest. Biotropica 32: 786-792.

Myers N, Mittermeier RA, Mittermeier CG, Fonseca Gab, Kent J. 2000. Biodiversity hotspots for conservation priorities. Nature 403: 854-858.

Narikawa T, Shinoyama H, Fujii T. 2000. A β-rutinosidase from *Penicillum rugulosum* IFO 7242 that is a peculiar flavonoid glycosidase. Bioscience, Biotechnology and Biochemistry 64: 1317-1319.

Nicoletti R, Salvatore MM, Andolfi A. 2018. Secondary metabolites of mangrove-associated strains of *Talaromyces*. Marine Drugs 16: 1-12.

Oliveira HVV, Fortuna JL. 2020. Microfungos em fitotelmata de bromélias de um fragmento de Mata Atlântica do Extremo Sul da Bahia. Unisanta BioScience 9: 338-355.

Oliveira LG, Cavalcanti MAQ, Passavante JZO, Fernandes MJS, Lima DMM. 2011. Filamentous fungi isolated from Candeias Beach, Pernambuco, Brazil. Hoehnea 38: 215-220

Oriente A, Tramontina R, de Andrades D, *et al*. 2015. Characterization of a novel *Aspergillus niger* beta-glucosidase tolerant to saccharification of lignocellulosic biomass products and fermentation inhibitors. Chemical Papers 69: 1050-1057.

Palha PMG, Silva JS, Silva JS, *et al*. 2018. Parâmetros ecológicos de fungos em *Bromeliaceae* em ecossistemas naturais e cultivadas na Bahia. Rodriguésia 69: 2025-2033.

Pasin TM, Dos Anjos Moreira E, de Lucas RC, *et al*. 2019. Novel amylase-producing fungus hydrolyzing wheat and brewing residues, *Aspergillus carbonarius*, discovered in tropical forest remnant. Folia Microbiol (Praha) 65: 173-184.

Perrone G, Stea G, Epifani F, *et al*. 2011. *Aspergillus niger* contains the cryptic phylogenetic species *A. awamori*. Fungal Biology 115: 1138-1150.

Piepenbring M, Maciá-Vicente JG, Codjia JEI, *et al*. 2020. Mapping mycological ignorance–checklists and diversity patterns of fungi known for West Africa. IMA fungus 11: 1-22.

Pinto IMDA, Cavalcanti, MAQ, Oliveira-Passavante JZ. 1992. Hongos filamentosos aislados desde el suelo y el agua en la playa de Boa Viagem (Recife, Brasil). Boletín Micológico 7: 39-45.

Pitt JI. 1994. The current role of Aspergillus and Penicillium in human and animal health. Journal of Medical and Veterinary Mycology 32: 17-32.

Pitt JI. 1979. The genus *Penicillium* and its teleomorphic states. London, Academic Press.

Posada D. 2008. jModelTest: Phylogenetic model averaging. Molecular Biology and Evolution 25: 1253-1256.

Prade CA, Matsumura AT, Ott AP, Porto ML. 2007. Diversidade de fungos do solo em sistemas agroflorestais de *Citrus* com diferentes tipos de manejo no município de Roca Sales, Rio Grande do Sul. Biociências 15: 73-81.

Purvis A, Hector A. 2000. Getting the measure of biodiversity. Nature 405: 212–219.

Rambaut A. 2016. FigTree, version 1.4.3. Edinburgh, Institute of Evolutionary Biology, University of Edinburgh.

Raminelli C, Kagohara E, Pellizari VH, Comasseto JV, Andrade LH, Porto AL. 2007. Biotransformations of Mannich bases and propiophenones by Brazilian microorganisms and enzymatic resolution of phenylpropanols by lipase from *Candida antarctica* (Novozym 435). Enzyme and Microbial Technology 40: 362-369.

Ramos SMS, Cruz R, Barbosa RN, *et al*. 2018. *Penicillium* and *Talaromyces* communities of sugarcane soils (*Saccharum officinarum* L.): Ecological and phylogenetic aspects. Journal of Agricultural Science 10: 335-350.

Ramos SMS, Cruz R, Barbosa RN, *et al*. 2021. Two new *Penicillium* section *Sclerotiorum* species from sugarcane soil in Brazil. Mycological Progress 20: 823-835.

Raper KB, Fennell DI. 1965. The genus *Aspergillus*. Baltimore, The Williams and Wilkins Company.

Raven PH, Gereau RE, Phillipson PB, Chatelain C, Jenkins CN, Ulloa C. 2020. The distribution of biodiversity richness in the tropics. Science Advances 6: 1-5.

Rayner RW. 1970. A mycological colour chart. London, Commonwealth Mycological Institute.

Reis SBM, Silva A, Alvarez MR, Oliveira TB, Rodrigues, A. 2015. Fungal communities in gardens of the leafcutter ant *Atta cephalotes* in forest and cabruca agrosystems of southern Bahia state (Brazil). Fungal Biology 119: 1170-1178.

Rezende CL, Scarano FR, Assad ED, *et al*. 2018. From hotspot to hopespot: An opportunity for the Brazilian Atlantic Forest. Perspectives in Ecology and Conservation 16: 208-214.

Ribeiro LFC, Ribeiro LF, Jorge JA, Polizeli MLTM. 2014. Screening of filamentous fungi for xylanases and cellulases not inhibited by xylose and glucose. British Biotechnology Journal 4: 30-39.

Ribeiro SAL, Cavalcanti MAQ, Fernandes MJS, Lima DMM. 2003. Fungos filamentosos isolados de produtos derivados do milho comercializados em Recife, Pernambuco. Brazilian Journal of Botany 26: 223-229.

Roesch LFW, Vieira FCB, Pereira VA, *et al*. 2009. The Brazilian Pampa: A Fragile Biome. Diversity 1: 182-198.

Ronquist F, Teslenko M, Mark P, *et al*. 2012. MrBayes 3.2: efficient bayesian phylogenetic inference and model choice across a large model space. Systematic Biology 61: 539-542.

Ruegger MJS, Tauk-Tornisielo, SM. 2004. Atividade da celulase de fungos isolados do solo da Estação Ecológica de Juréia-Itatins, São Paulo, Brasil. Brazilian Journal of Botany 27: 205-211.

Samson RA, Houbraken J, Kuijpers AFA, Frank MJ, Frisvad JC. 2004. New ochratoxin A or sclerotium producing species in *Aspergillus* section *Nigri*. Studies in Mycology 50: 45-56.

Samson RA, Houbraken J, Thrane U. 2010. CBS KNAW Biodiversity Center. Utrecht, Food and indoor fungi.

Samson RA, Visagie CM, Houbraken J. 2014. Phylogeny, identification and nomenclature of the genus *Aspergillus*. Studies in Mycology 78: 141-174.

Samson RA, Yilmaz N, Houbraken J, *et al*. 2011. Phylogeny and nomenclature of the genus *Talaromyces* and taxa accommodated in *Penicillium* subgenus *Biverticillium*. Studies in Mycology 70: 159-183.

Santos CD, Silva RO, Candeias EL, Vitória NS, Luz EDM, Bezerra J. 2018. Diversidade de fungos em espécies nativas e cultivadas de orquídeas no sul da Bahia. Agrotrópica 30: 101-108.

Santos VBD, Wellbaum C, Schoenlein-Crusius IH. 1998. Filamentous fungi from the soil of the “Ilha dos Eucaliptos” in the “Represa do Guarapiranga” in São Paulo State, SP. Acta Botanica Brasilica 12: 101-110.

Schoenlein-Crusius IH, Milanez AI, Trufem SFB, *et al*. 2006. Microscopic fungi in the Atlantic Rainforest in Cubatão, São Paulo, Brazil. Brazilian Journal of Microbiology 37:267-275.

Schoenlein-Crusius IH, Milanez AI. 1998. Fungos microscópicos da Mata Atlântica de Paranapiacaba, São Paulo, Brasil. Brazilian Journal of Botany 21: 73-79.

Schoenlein-Crusius IH, Trufem SF, Grandi RA, Milanez AI, Pires-Zottarelli CL. 2001. Airborne fungi in the region of Cubatão, São Paulo state, Brazil. Brazilian Journal of Microbiology 32: 61-65.

Sette LD, Pagnocca FC, Rodrigues A. 2013. Microbial culture collections as pillars for promoting fungal diversity, conservation and exploitation. Fungal Genetics and Biology 60: 2-8.

Shome SK. 1963. Human pathogenic fungi from soil in Instituto de Micologia, Universidade do Recife 335, Revista da Faculdade de Medicina da Universidade do Ceará 3: 79-83.

Silva DCV, Tiago PV, Mattos JLS, Paiva LM, Souza-Motta CM. 2011. Isolamento e seleção de fungos filamentosos do solo de sistemas agroflorestais do Município de Bom Jardim (PE) com base na capacidade de produção de enzimas hidrolíticas. Brazilian Journal of Botany 34: 607-610.

Silva NFS, Simões MR, Knob A, *et al*. 2016. Improvement in the bleaching of kraft pulp with xylanase from *Penicillium crustosum* FP 11 isolated from the Atlantic forest. Biocatalysis and Biotransformation 34: 119-127.

SOS MATA ATLÂNTICA. 2017. Relatório Anual de atividades 2017. https://www.sosma.org.br/wp-content/uploads/2018/10/AF_RA_SOSMA_2017_web.pdf.

SOS MATA ATLÂNTICA. 2021. https://www.sosma.org.br/causas/mata-atlantica/. 05 dec 2021.

Souza SC, Pereira VM, Moreira SI, *et al*. 2019. *Aspergillus trisporus*: A new *Jani* section species from Brazilian soil. Current Research in Environmental & Applied Mycology 9: 175-186.

Souza-Motta CM, Cavalcanti MAQ, Fernandes MJS, *et al*. 2003. Identification and characterization of filamentous fungi isolated from the sunflower (*Helianthus annus* L.) rhizosphere according to their capacity to hydrolyse inulin. Brazilian Journal of Microbiology 34: 273-280.

Stamatakis A. 2014. RAxML Version 8: A tool for Phylogenetic Analysis and Post-Analysis of Large Phylogenies. Bioinformatics 30: 1312- 1313.

Sulzbacher MA, Grebenc T, Bevilacqua CB, *et al*. 2018. Co-invasion of ectomycorrhizal fungi in the Brazilian Pampa biome. Applied Soil Ecology 130: 194-201.

Sun BD, Chen AJ, Houbraken J, *et al*. 2020. New section and species in Talaromyces. MycoKeys 68: 75. doi: 10.3897/mycokeys.68.52092

Takahashi JP, Schoenlein-Crusius IH, Gruppi VT, Moreira CG. 2012. Geofungos no Córrego do Sapateiro, Parque Municipal do Ibirapuera, São Paulo, SP, Brasil. Hoehnea 39: 287-295.

Tamura K, Stecher G, Peterson D, Filipski A, Kumar S. 2013. MEGA6: molecular evolutionary genetics analysis version 6.0. Molecular Biology and Evolution 30: 2725-2729.

Tauk-Tornisielo SM, Garlipp A, Ruegger M, Attili DS, Malagutti E. 2005. Soilborne filamentous fungi in Brazil. Journal of Basic Microbiology: An International Journal on Biochemistry, Physiology, Genetics, Morphology, and Ecology of Microorganisms 45: 72-82.

Tauk-Tornisielo SM, Vallejo MC, Govone JS. 2009. Biomasses and xylanase production by strains of *Penicillium* isolated from Brazilian Atlantic forest. Arquivos do Instituto Biológico 76: 359-364.

Taylor DL, Sinsabaugh RL. 2015. The soil fungi: Occurrence, phylogeny, and ecology. In: Paul EA. Soil microbiology, ecology and biochemistry (4th edn). Cambridge, Massachusetts, Academic Press. pp. 77-109.

Tijith KG, Houbraken J, Mathew J, Jisha MS. 2019. *Penicillium setosum*, a new species from Withaniasomnifera (L.) Dunal. Mycology 10: 49-60.

Varga J, Frisvad JC, Samson RA. 2011. Two new aflatoxin producing species, and an overview of *Aspergillus* section *Flavi*. Studies in Mycology 69: 57–80.

Varga J, Kocsubé S, Tóth B, *et al*. 2007. *Aspergillus brasiliensis* sp. nov., a biseriate black *Aspergillus* species with world-wide distribution. International Journal of Systematic and Evolutionary Microbiology 57: 1925-1932.

Vieira FGN, Christ D, Graciano L, *et al*. 2019. Experimental design for optimization of β-xylosidase production by *A. fumigatus* isolated from the Atlantic Forest (Brazil). Journal of Advances in Biology & Biotechnology 21: 1-16.

Visagie CM, Houbraken J, Rodriques C, *et al*. 2013. Five new *Penicillium* species in section *Sclerotiora*: a tribute to the Dutch Royal family. Persoonia 31: 42-62.

Visagie CM, Houbraken J, Seifert KA, *et al*. 2015. Four new *Penicillium* species isolated from the fynbos biome in South Africa, including a multigene phylogeny of section *Lanata-Divaricata*. Mycol Progress 14: 1-23.

Visagie CM, Renaud JB, Burgess KMN, *et al*. 2016. Fifteen new species of *Penicillium*. Persoonia 36: 247-280.

Visagie CM, Varga J, Houbraken J, *et al*. 2014. Ochratoxin production and taxonomy of the yellow aspergilli (*Aspergillus* section *Circumdati*). Studies in Mycology 78: 1-61.

Wei S, Xu X, Wang L. 2021. Four new species of *Talaromyces* section *Talaromyces* discovered in China. Mycologia 113: 492-508.

Wellbaum C, Schoenlein-Crusius IH, Santos VB. 1999. Fungos filamentosos em folhas do ambiente terrestre e aquático da Ilha dos Eucaliptos, Represa do Guarapiranga, São Paulo, SP. Brazilian Journal of Botany 22: 69-74.

Wilson OJ, Mayle FE, Walters RJ, Lingner DV, Vibrans AC. 2021. Floristic change in Brazil's Southern Atlantic forest biodiversity hotspot: From the last glacial maximum to the late 21st century. Quaternary Science Reviews 264: 107005. doi: 1016/j.quascirev.2021.107005

Xu Y, Feng X, Jia J, *et al*. 2018. A novel β-glucuronidase from *Talaromyces pinophilus* Li-93 precisely hydrolyzes glycyrrhizin into glycyrrhetinic acid 3-O-mono-β-d-glucuronide. Applied and Environmental Microbiology 84: e00755–18. doi: 10.1128/AEM.00755-18

Yang Y, Dou Y, Huang Y, An S. 2017. Links between soil fungal diversity and plant and soil properties on the loess plateau. Frontiers in Microbiology 8: 2198.

Yilmaz N, Visagie CM, Houbraken J. 2014. Polyphasic taxonomy of the genus *Talaromyces*. Studies in Mycology 78: 175-342.

Zhai MM, Li J, Jiang CX, *et al*. 2016. The bioactive secondary metabolites from *Talaromyces* species. Natural Products and Bioprospecting 6: 1-24.

Žifčáková L, Vetrovský T, Howe A, Baldrian, P. 2016. Microbial activity in forest soil reflects the changes in ecosystem properties between summer and winter. Environmental Microbiology 18: 288-301.

Zwiener VP, Lima RAF, Sánchez-Tapia A, *et al*. 2020. Tree diversity in the Brazilian Atlantic Forest: biases and general patterns using different sources of information. In: Marques MCM, Grelle CEV. (eds) The Atlantic Forest: history, biodiversity, threats and opportunities of the megadiverse forest. Switzerland, Springer International Publishing.