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# A new species of the genus *Penicillium* isolated from the soil of the Chaco dry forest in Argentina

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**Abstract:** Studies related to the diversity of species of genus *Penicillium* present in Argentina soils focus on evaluating the functionality and importance of fungi in ecosystems, but little attention has been focused on the search for new species. The Chaco dry forest in Argentina is a semiarid region belonging to the subregion of Neotropical dry forests, characterized by the presence of the plant of the genus *Schinopsis* Engl. *Penicillium* is a genus that belongs to the phylum Ascomycota, species of this are ubiquitous and present in a wide range of environmental conditions. The aim of this work is to describe a new species of *Penicillium*, *Penicillium schinopsum* sp. nov. This species separates phylogenetically into a new clade that made identification to the species level feasible and allows the assignment to a possible new section and series. The strain is a novel species of genus *Penicillium* ser. and sect. *Schinopsiorum* sect. nov., we propose the name *Penicillium schinopsum* sp. nov. This new proposal could be part of the subgenus *Aspergilloides* and it is phylogenetically related to sections *Aspergilloides*, *Sclerotiorum*, *Charlesia,* and *Eremophila*. The morphology and growth of the colony support phylogenetic separation. The main morphological characteristic that it showed was the fast growth rates of the colonies on all culture media tested except on CYA at 37 ºC, the green colour of the colony, the monoverticillate conidiophore with a long stipe, smooth-walled globose conidia and absence of sclerotia. We considered it necessary to continue advancing in the characterization to assess its biotechnological potential.

**Keywords**: Fungi, Taxonomy, Neotropical Dry Forest, Soil.

**Resumen:** Los estudios relacionados con la diversidad de especies del género *Penicillium* presentes en suelos de Argentina se centran en evaluar la funcionalidad e importancia de los hongos en los ecosistemas, pero se ha dado poca atención en la búsqueda de nuevas especies. El bosque seco chaqueño en Argentina es una región semiárida perteneciente a la subregión de los Bosques Secos Neotropicales, caracterizada por la presencia de plantas del género *Schinopsis* Engl. *Penicillium* es un género que pertenece al filo Ascomycota, las especies son ubicuas y están en un amplio rango de condiciones ambientales. El objetivo del trabajo es describir una nueva espécie: *Penicillium schinopsum sp. nov.* Ésta se separa filogenéticamente en un nuevo clado que hizo factible la identificación a nivel de especie y la asignación de una posible nueva sección y serie. La cepa es una especie nueva del género *Penicillium*, ser., sect. *Schinopsiorum* sect. nov. Esta especie podría formar parte del subgénero *Aspergilloides* y está relacionada filogenéticamente con las secciones *Aspergilloides*, *Sclerotiorum*, *Charlesia* y *Eremophila*. La morfología y el crecimiento de la colonia apoyan la separación filogenética. Las principales características morfológicas que mostraron fueron las rápidas tasas de crecimiento de las colonias en todos los medios de cultivo probados excepto en CYA (37 ºC), el color verde de la colonia, el conidióforo monoverticilado con un estípite largo, conidios globosos de paredes lisas y ausencia de esclerocios. Consideramos necesario seguir avanzando en la caracterización para evaluar su potencial biotecnológico.

**Palabras claves**: Hongos, Taxonomía, Neotropical Dry Forest, Soil.

## INTRODUCTION

*Penicillium* is a genus of fungi that belongs to the phylum Ascomycota. The species of this genus are ubiquitous and present in a wide range of environmental conditions. The ability to grow in diverse substrates such as vegetation, soil, house samples, and food enables its wide distribution. The isolates of this genus have been obtained from a wide variety of soils such as forest, desert, agricultural, and saline soils (Visagie *et al.*, 2014 a,b; Houbraken *et al.,* 2020). The Chaco dry forest in Argentina is a semiarid region belonging to the subregion of Neotropical dry forests, characterized by the presence of the *Schinopsis* Engl. "Quebrachos", closed canopy, subtropical climate with a long dry season and the presence of a period of rainfall (Merlos *et al.*, 2018). Research has been focused on the fragmentation and deforestation of this tree species due to the expansion of the agricultural frontier (Bonino & Araujo, 2005; Gasparri & Grau, 2009; Vallejos *et al.*, 2015). However, while diversity studies are mainly focused on amphibians, birds, insects, mammals, plants, and reptiles, studies on soil fungal communities are scarce (Godeas, 1972; Kacoliris *et al.*, 2006; Montecchia *et al.*, 2011; Banda *et al.*, 2016; Diodato & Fuster, 2016; Merlos *et al.*, 2018). Even though the *Penicillium* species of soils in Neotropical forests are numerous, only the high diversity of Caatinga and Atlantic forests is known (Cruz *et al.*, 2013; Barbosa do Nascimento *et al.*, 2020). Few studies have been carried out to evaluate fungal species in the Chaco dry forest in Argentina (Godeas, 1972; Montecchia *et al.* 2011), therefore the aim of this work is to describe a new species of *Penicillium*, *Penicillium schinopsum* sp. nov. and to promote future work in this area.

## MATERIALS AND METHODS

### Isolates and morphology

The soil samples were obtained from the Chaco dry forest (26°93'11'' S; 61°62'49'' W) and washed according to Cabello & Arambarri (2002). The soil particles were placed into Petri dishes containing Potato Dextrose Agar with (PDA 2%) amended with chloramphenicol to suppress bacterial growth. For macroscopic and morphological identification, *Penicillium* colonies were subcultured in Petri dishes with PDA, Czapek´s Agar (Cz), Yeast Extract Sucrose Agar (YES), Oatmeal Agar (OA), Czapek Yeast Autolysate Agar (CYA), Czapek Yeast Autolysate agar with 5% NaCl (CYAS), Malt Extract Agar (MEA), and Synthetic Nutrient-poor Agar (SNA) (Raper & Thom, 1968; Samson & Frisvad, 2004; Visagie *et al.*, 2014b). All Petri dishes were incubated for 7 days at 25 °C, with additional CYA plates incubated at 30 and 37 °C. Mounts were made from 7 days old colony grown on MEA, according to the description shown in Visagie *et al.* (2014b). Observations of microscope characteristics were made using binocular optical microscope Olympus CX31. Colony and morphological structures photographs were captured using a KODAK digital camera (Easyhare Z-712). Also, the structures of the fungal isolates were examined by scanning electron microscope (JSM-6390LV). The cultures were preserved and maintained on CyA agar and stored for short term at 4 °C and for the long-term at -80 °C in 15% glycerol. The type species, metabolically inactive as holotype, was deposited in the culture collection of the Instituto Spegazzini, UNLP, La Plata, Argentina (LPSC (type specie) and LPS (holotype).

### DNA extractions, PCR, DNA sequencing and phylogenetic analysis

The species identified morphologically was cultured as monosporic isolated in Petri dishes with 2% PDA for 7 days at 25 °C under 12-h light/dark conditions. The DNA was extracted using the cetyl trimethyl ammonium bromide (CTAB) protocol described by Stenglein and Balatti (2006). The DNA quality was examined by electrophoresis in 0.8% (w/v) agarose gels containing Gel Red TM (Biotium) at 80 V in 1X Trisborate-EDTA buffer for 3 h at room temperature. The DNA was visualized under UV light. DNA concentrations were calculated using a fluorometer (Qubit TM-Invitrogen). The $Bt_2a$/ $Bt_2b$ (Partial *β-tubulin* gene; Glass & Donaldson, 1995), ITS1/ITS4 (Internal Transcriber spacer; White *et al.*, 1990), CMD5/CMD6 (Calmoduline gene; Hong *et al.*, 2006), and 5F/7CR (RNA polymerase II second largest subunit; Liu *et al.*, 1999) were amplified through polymerase chain reaction (PCR) (XP Termal Cycler). Those fragments amplified by PCR were analyzed by electrophoresis agarose gels (1.5% w/v) containing Gel Red TM (Biotium) in 1 X Trisborate-EDTA buffer, at 80 V for 1 h at room temperature. The fragments were purified by *AccuPrep*® Gel Purification Kit (Bioneer Corporation). DNA sequencing was carried out using Big Dye Terminator version 3.1 Cycle Sequencing Ready Reaction Kit (Applied Biosystems) in an Applied Biosystems Sequencer

(ABI/Hitachi Genetic Analyzer 3130). The sequences were compared with the NCBI database using BLAST (Altschul *et al.*, 1990).

To determine the phylogenetic relationship of our isolate, a combined of ITS-*BenA*-*CaM*-*RPB*2 using representative species from 20 sections was built to distinguish among other species of *Penicillium* belonging to sections *Alfrediorum*, *Aspergilloides*, *Charlesia*, *Cinnamopurpurea*, *Citrina*, *Crypta*, *Eremophila*, *Exilicaulis*, *Gracilenta*, *Griseola*, *Inusitata*, *Lanata-Divaricata*, *Lasseniorum*, *Ochrosalmonea*, *Paradoxa*, *Ramigena*, *Scleriotiorum*, *Stolkia*, *Torulomyces* and *Thysanophora* (Table 1, Fig. 1). The species *Aspergillus glaucus* CBS 516.65 and *Hamigera avellanea* CBS 295.48 were selected as outgroups. The sequence alignments and the maximum-likelihood (ML) and Bayesian-inference (BI) phylogenetic analyses were performed as described by Valenzuela-Lopez *et al.* (2018).

## RESULTS

### Taxonomy
### Morphological analysis

***Penicillium schinopsum*** L.B. Silvestro, Rodriguez-Andrade, Pelizza, Stchigel, Merlos, and M.V. Moreno sp. nov.

The ex-type strain is LPSc1424$^{T}$. Holotype LPS 49247 (dried specimen in metabolically inactive state). Index Fungorum number: IF558048.
*Etymology*. From Latin *Schinopsidis*, of main species of tree native *Schinopsis* sp. from Chaco Dry Forest.
*Type*. Argentina, Chaco Province, "Tres Estacas" (26°55'27'' S; 61°37'36' W) in Charata (district Chaco - Argentina), from soil samples, isolated by CSM, January 2013.
*Description*. The fungus colonies showed pale green coloration with concentric rings on all culture media after 7 days of incubation (Fig. 2). Colonies on all culture media after 7 days of incubation (Fig. 1) tended to be pale green (26D4) with concentric rings. The species showed good growth on MEA, YES, SNA, OA, Czapek, APG, CyAS, CREA at 25 °C, CYA at 25 °C and CYA at 30 °C and did not grow on CYA at 37 °C. The colony diameter was on APG: 34–42 mm, CYA at 25 °C: 41–46 mm, CYA at 30 °C: 30-33 mm, CyAS: 28–30 mm, CREA: 28–31 mm, Czapek: 34–41 mm, MEA: 42–45 mm, SNA: 30–32 mm, OA: 34–36 mm and YES: 40–42 mm. Colonies morphology, on all culture media, showed circular margin, entire, white floccose mycelia without production of sclerotia and exudates. Sporulation is abundant, pale green towards the centre (26D4). Colonies on YES produced conidia greenish grey towards the edges (25E2) and turning white towards the centre. The bottom view under CYA 30 °C, OA, and CYAS was white in colour; on APG, CYA 25 °C, MEA, YES pale and yellowish, and on CZAPEK reddish. Under CREA medium a yellow halo was formed around the colonies which revealed a good capacity to acid production (Fig. 1). Conidiophores were monoverticillate, smooth, unbranched, vesiculated with vesicules (3–6 $\mu$m), stipes (20–100 $\mu$m), phialides ampulliform 6–8 (7,5–10 $\mu$m) and globose smooth walled conidia (2–3 $\mu$m, n= 50) (Fig. 3 and Fig. 4).

### DNA sequencing and phylogenetic analysis

The sequences generated were deposited in the NCBI/GeneBank database under the accession number: ITS (MN627761), *BenA* (MN627762), *CaM* (MN627760), and *RPB*2 (MN627763).

Based on a megablast search of NCBIs GenBank nucleotide database, the closest hit using the ITS sequence is with the ex-type strain of *Penicillium wisconsinense* (CBS 128279, GenBank NR153225; Identities = 494/515 (96 %), gaps 12/515 (2 %)), using the *BenA* sequence is with the strain of *Penicillium griseolum* (DTO 216-D2, GenBank MF974920; Identities= 237/293 (81 %), gaps 23/293 (7 %)), using the *CaM* sequence is with the strain of *Penicillium magnielliptisporum* (CMV007I1, GenBank MK451665; Identities= 397/398 (99 %), gaps 1/398 (0 %)), and using *RPB*2 sequence is with *Penicillium fortuitum* (DTO 313-A3, GenBank MN969206; Identities= 853/1004 (85 %), gaps 4/1004 (0 %)).

We carried out individual and combined analyses with ITS, *BenA*, *CaM* and *RPB*2 *loci* to resolve the taxonomical position of our strain with species of *Penicillium* sections *Alfrediorum*, *Aspergilloides*, *Charlesia*, *Cinnamopurpurea*, *Citrina*, *Crypta*, *Eremophila*, *Exilicaulis*, *Gracilenta*, *Griseola*, *Inusitata*, *Lanata-Divaricata*, *Lasseniorum*, *Ochrosalmonea*, *Paradoxa*, *Ramigena*, *Scleriotiorum*, *Stolkia*, *Torulomyces,* and *Thysanophora*, including type strains of the accepted species (TREEBASE ID: 27313). A concatenated dataset obtained contained 109 sequences with a total of 2,598 characters including gaps (606 of them for ITS, 461 for *BenA*, 642 for *CaM* and 889 for *RPB*2), of

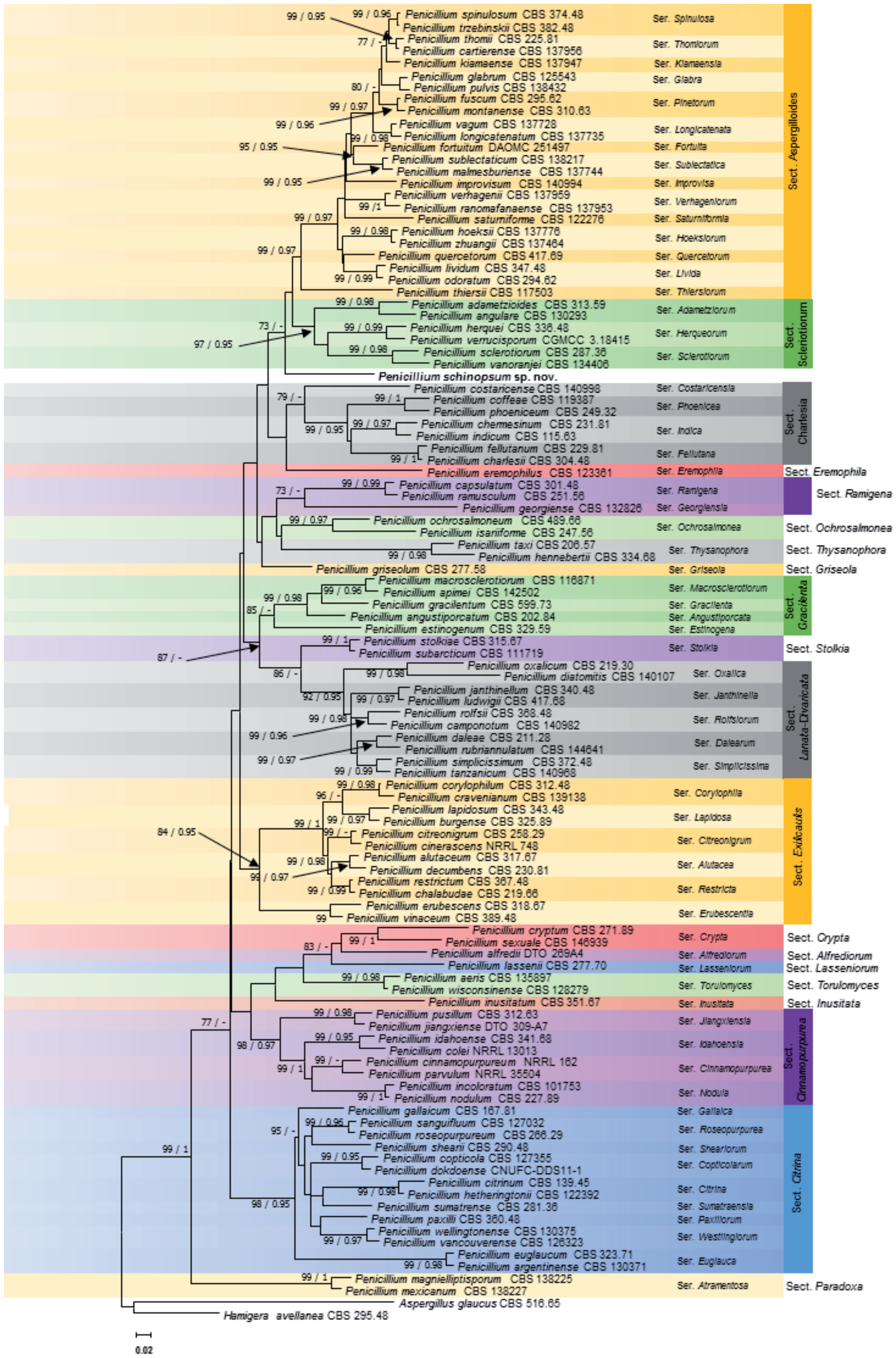

Fig. 1. ML phylogenetic tree of *Penicillium* sections *Alfrediorum*, *Aspergilloides*, *Charlesia*, *Cinnamopurpurea*, *Citrina*, *Crypta*, *Eremophila*, *Exilicaulis*, *Gracilenta*, *Griseola*, *Inusitata*, *Lanata-Divaricata*, *Lasseniorum*, *Ochrosalmonea*, *Paradoxa*, *Ramigena*, *Scleriotiorum*, *Stolkia*, *Torulomyces* and *Thysanophora* and two species *Aspergillus glaucus* CBS 516.65 and *Hamigera avellanea* CBS 295.48 (outgroups) inferred from the combined ITS, *BenA*, *CaM* and *RPB*2 loci. Support in nodes is indicated above thick branches and is represented by bootstrap values (ML analysis) of 70 % and higher and/or posterior probabilities (BI analysis) of 0.95 and higher. Alignment length 2,598 bp.

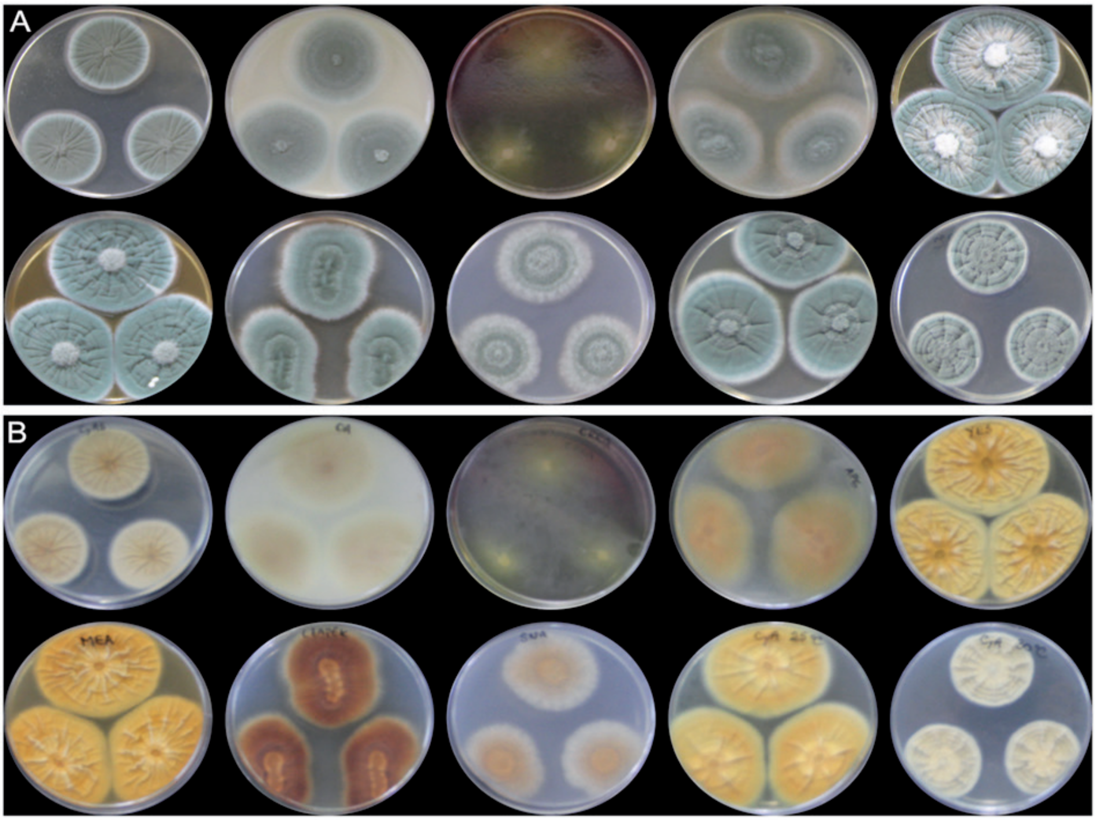


Fig. 2. *Penicillium schinopsum*. A. Top view of the colonies, left to right, CYAS, OA, CREA, APG, YES, MEA, CZAPEK, SNA, CYA 25 °C and CYA 30 °C. B. Bottom view of colony, left to right: CYAS, OA, CREA, APG, YES, MEA, CZAPEK, SNA, CYA 25 °C and CYA 30 °C.

which 1402 were parsimony informative (237 for ITS, 309 for *BenA*, 423 for *CaM* and 433 for *RPB*2). The sequence datasets did not show conflict in the tree topologies for the 70 % reciprocal bootstrap trees, which allowed to combine the four genes for the multi-locus analysis. The ML analysis showed a similar tree topology and was congruent with that obtained in the Bayesian analysis. Phylogenetic analysis resolved 21 main clades, 19 of them define all sections of subgenus *Aspergilloides: Aspergilloides* (99/0.97), *Scleriotiorum* (97/0.95), *Charlesia*, *Eremophila*, *Ramigena* (73/-), *Ochrosalmonea* (99/0.97), *Thysanophora* (99/0.98), *Griseola*, *Gracilenta* (85/-), *Stolkia* (99/1), *Lanata-Divaricata* (92/0.95), *Exicaulis* (84/0.95), *Crypta* (99/1), *Alfrediorum*, *Lasseniorum*, *Torulomyces* (99/0.98), *Inusitata*, *Cinnamopurpurea* (98/0.97), and *Citrina* (98/0.95), moreover, a well-defined clade belonged to the section of subgenus *Penicillium*: *Paradoxa* (99/1). Within these sections, 63 series have been classified and these are observed in different subclades. Finally, one clade includes *Penicillium schinopsum* sp. nov. does not belong to any series or section and phylogenetically is related to sections *Aspergilloides*, *Sclerotiorum*, *Charlesia,* and *Eremophila* (Fig. 1).

## DISCUSSION

Studies related to the diversity of fungi present in Argentina soils focus on evaluating the functionality and importance of fungi in ecosystems, but little attention has been focused on the search for new species. The discovery and characterization of species on different substrates offer the possibility to use these species as potential agents of biocontrol of pathogens, bioremediation, biotransformation, and production of enzymes. Soils have been the source of many new species of interest to the scientific community. The identification of new species of *Penicillium* from soils in Argentina is scarce.

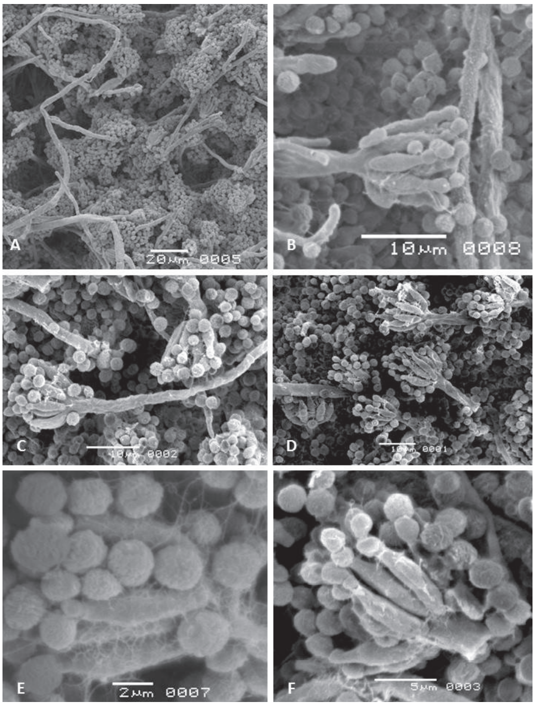


Fig. 3. *Penicillium schinopsum*. A-D, F. Conidiophores. E. Conidia. Scales: A-D, F= 2,5 $\mu$m; E= 1$\mu$m.

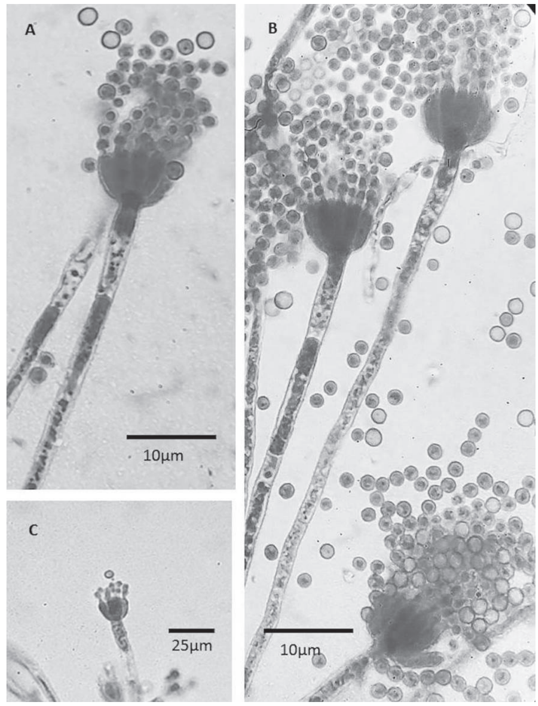


Fig. 4. Detail of the conidiophores and conidia of *Penicillium schinopsum*. Conidiophore and conidia. Scales: A–B= 10 $\mu$m; C= 25$\mu$m.

There is only one record in the Tierra del Fuego Province that mentions two new species of the genus (Ramírez, 1985); therefore, it is crucial to consider that the dry forest of Chaco is a good place to find species that have not been described yet. Our work shows that *Penicillium schinopsum* separates into a branch that allows assigning it to a new series and a new section, different from those characterized in Houbraken *et al.* (2020) using the same markers (ITS, *BenA*, *CaM,* and *RPB*2) that made feasible identification to the specie level and phylogenetic classification. Furthermore, the morphology and growth of the colony support phylogenetic separation and could belong to a new section and series (*Schinopsiorum*). This new proposal could be part of the subgenus *Aspergilloides* and it is phylogenetically related to sections *Aspergilloides*, *Sclerotiorum*, *Charlesia* and *Eremophila*. *Penicillum schinopsum* sp. nov. have morphological differences compared to the species in the sect. *Aspergilloides*, *Sclerotiorum*, *Charlesia* and *Eremophila*. The main characteristic in culture that allowed to distinguished new section and series was fast growth rates of the colonies on all culture media tested except on CYA at 37 °C, and the green color of the colony. The morphological characteristics that define the species and section are the monoverticillate conidiophore with a smooth long stipe, smooth-walled globose conidia and absence of sclerotia. The species in sections *Charlesia* grow restricted on Czapek yeast agar; in section *Aspergilloides* rate of growing is moderately to fast on CYA and/or MEA; in section *Sclerotiorum* colonies grow is restricted or moderated (and strains have vivid orange to red colony colours, with colorful sclerotia); and in section *Eremophila* (which include xerophilic species) the asexual morph is not known and colonies do not grow on high water activity media (Rivera & Seifert, 2011; Houbraken *et al.,* 2014; Houbraken *et al.,* 2020; Sun *et al.,* 2021). The morphological similarities among all sections of subgenus *Aspergilloides* are the monoverticillate conidiophore with a vesiculate apex or swelling (Houbraken *et al.*, 2020). The proposal of a new series and section was informally introduced here and it is important to be considered in the next works. For this, we considered it necessary to continue advancing in the phylogenetic and physiological characterization to assess its biotechnological, taxonomic and biochemical potential.

Table 1. *Penicillium* EMBL/GenBank codes used in this study

| Species name | Section | Serie | Strain no. | GenBank accession nr. ITS | BenA | CaM | rpb2 |
|---|---|---|---|---|---|---|---|
| Penicillium schinopsum sp. nov. | - | - | LPSc1424 (T) | MN627761 | MN627762 | MN627760 | MN627763 |
| Penicillium alfredii | Alfrediorum | Alfrediorum | DTO 269A4 (T) | KJ775684 | KJ775177 | KJ775411 | KJ834520 |
| Penicillium fortuitum | Aspergilloides | Fortuita | DTO 313-A3 = DAOMC 251497 (T) | MF803942 | MF803836 | MF803932 | MN969206 |
| Penicillium glabrum | Aspergilloides | Glabra | CBS 125543 = IBT 22658 = IMI 91944 (T) | GU981567 | GU981619 | KM089152 | JF417447 |
| Penicillium pulvis | Aspergilloides | Glabra | CBS 138432 = DTO 180-B7 (T) | KM189632 | KM088876 | KM089263 | KM089650 |
| Penicillium hoeksii | Aspergilloides | Hoeksiorum | CBS 137776 = DTO 192-H4 (T) | KM189707 | KM088954 | KM089341 | KM089728 |
| Penicillium zhuangii | Aspergilloides | Hoeksiorum | CBS 137464 = NRRL 62806 = AS 3.15341 (T) | KF769435 | KF769411 | KF769422 | MN969145 |
| Penicillium improvisum | Aspergilloides | Improvisa | DAOMC 250547 = CBS 140994 = DTO 410-D9 = KAS 2386 = W 156 (T) | KT887867 | KT887828 | KT887789 | MN969169 |
| Penicillium kiamaense | Aspergilloides | Kiamaensia | CBS 137947 = FRR 6087 = DTO 056-I6 (T) | KM189506 | KM088743 | KM089128 | KM089515 |
| Penicillium lividum | Aspergilloides | Livida | CBS 347.48 = ATCC 10102 = CCRC 31286 = DSM1180 = IFO 6102 = IMI 039736 = NRRL 754 = QM 1930 = VKMF-303 (T) | KM189582 | KM088825 | KM089211 | KM089598 |
| Penicillium odoratum | Aspergilloides | Livida | CBS 294.62 = CBS 296.62 = ATCC 14769 = DSM2419 = IFO 7741 = IMI 094208ii = NRRL 3007 = WSF2000 (T) | KC411730 | KJ834478 | KM089363 | JN406583 |
| Penicillium longicatenatum | Aspergilloides | Longicatenata | CBS 137735 = DTO 180-D9 = CV 2847 = DAOM 241119 (T) | KM189636 | KM088880 | KM089267 | KM089654 |
| Penicillium vagum | Aspergilloides | Longicatenata | CBS 137728 = DTO 180-G3 = CV 25 = DAOM 241357 (T) | KM189642 | KM088886 | KM089273 | KM089660 |
| Penicillium fuscum | Aspergilloides | Pinetorum | CBS 295.62 = ATCC 14770 = CCRC 31517 = DSM2438 = IFO 7743 = IMI 094209 = MUCL 31196 = NRRL 3008 = WSF15c (T) | AF033411 | GQ367513 | GQ367539 | JN121483 |
| Penicillium montanense | Aspergilloides | Pinetorum | CBS 310.63 = ATCC 14941 = FRR 3407 = IFO 7740 = IHEM 4375 = IMI 099468 = MUCL 31326 = NRRL 3407 (T) | KM189551 | KM088789 | KM089174 | KM089561 |
| Penicillium quercetorum | Aspergilloides | Quercetorum | CBS 417.69 = NRRL 3758 = ATCC 48727 = CCRC 31668 = FRR 516 = IFO 31749 = IMI 140342 = MUCL 31203 = VKMF-1074 (T) | KM189556 | KM088795 | KM089180 | KM089567 |
| Penicillium saturniforme | Aspergilloides | Saturniformia | CBS 122276 = AS 3.6886 (T) | EU644081 | EU644080 | EU644062 | JN121439 |
| Penicillium spinulosum | Aspergilloides | Spinulosa | CBS 374.48 = ATCC 10498 = FRR 1750 = IMI 024316 = LSHBAd 29 = MUCL 13910 = MUCL 13911 = NCTC 591 = NRRL 1750 = QM 7654 (T) | AF033410 | KJ834493 | GQ367524 | JN406558 |
| Penicillium trzebinskii | Aspergilloides | Spinulosa | CBS 382.48 = ATCC 10507 = FRR 731 = IFO 6110 = IMI 039749 = MUCL 29102 = NRRL 731 = QM 7678 (T) | KM189784 | KM089034 | KM089421 | KM089808 |
| Penicillium sublectaticum | Aspergilloides | Sublectatica | CBS 138217= DTO 244-G2 (T) | KM189761 | KM089010 | KM089397 | KM089784 |
| Penicillium malmesburiense | Aspergilloides | Sublectatica | CBS 137744 = DTO 182-H5 = CV 1180 = DAOM 241144 (T) | KM189676 | KM088921 | KM089308 | KM089695 |
| Penicillium thiersii | Aspergilloides | Thiersiorum | CBS 117503 = IBT 27050 = NRRL 28162 (T) | AF125936 | KJ834497 | AY741726 | JN121434 |
| Penicillium thomii | Aspergilloides | Thomiorum | CBS 225.81 = IMI 189694 = NRRL 2077 (T) | KM189560 | KM088799 | KM089184 | KM089571 |
| Penicillium cartierense | Aspergilloides | Thomiorum | CBS 137956 = DTO 092-H9 (T) | KM189564 | KM088804 | KM089189 | KM089576 |
| Penicillium verhagenii | Aspergilloides | Verhageniorum | CBS 137959 = DTO 193-A1 (T) | KM189708 | KM088955 | KM089342 | KM089729 |
| Penicillium ranomafanaense | Aspergilloides | Verhageniorum | CBS 137953 = DTO 085-A5 (T) | KM189541 | KM088779 | KM089164 | KM089551 |

| Species name | Section | Serie | Strain no. | GenBank accession nr. | | | |
|---|---|---|---|---|---|---|---|
| Penicillium costaricense | Charlesia | Costaricensia | DAOMC 250520 = CBS 140998 = DTO 410-E3 = KAS 2597 = 01-RGTHC-294 (T) | MN431396 | KT887834 | KT887795 | MN969173 |
| Penicillium fellutanum | Charlesia | Fellutana | CBS 229.81 = CBS 326.48 = ATCC 10443 = FRR 746 = IFO 5761 = IMI 039734 = IMI 039734iii = NRRL 746 = QM 7554 (T) | AF033399 | KJ834450 | AY741753 | JN121460 |
| Penicillium charlesii | Charlesia | Fellutana | CBS 304.48 = ATCC 8730 = CBS 342.51 = CECT 2277 = FRR 778 = IMI 040232 = LSHBBB127 = LSHBP 146 = NRRL 1887 = NRRL 778 = QM 6338 = QM 6838 (T) | AF033400 | JX091508 | AY741727 | JN121486 |
| Penicillium chermesinum | Charlesia | Indica | CBS 231.81 = FRR 2048 = IFO 31745 = IMI 191730 = NRRL 2048 (T) | AY742693 | KJ834441 | AY741728 | MN969111 |
| Penicillium indicum | Charlesia | Indica | CBS H-7476 (isotype). Ex-type: CBS 115.63 = NRRL 3387 = ATCC 18324 = FRR 3387 = IFO 31744 = IMI 166620 (T) | AY742699 | EU427263 | AY741744 | JN406640 |
| Penicillium coffeae | Charlesia | Phoenicea | CBS 119387 = IBT 27866 = NRRL 35363 (T) | AY742702 | KJ834443 | AY741747 | JN121436 |
| Penicillium phoeniceum | Charlesia | Phoenicea | CBS 249.32 = ATCC 10481 = IJFM 5122 = IMI 040585 = NRRL 2070 = QM 7608 = VKMF-321 (T) | KC411711 | KJ834483 | AY741729 | JN406597 |
| Penicillium cinnamopurpureum | Cinnamopurpurea | Cinnamopurpurea | CBS 429.65 = CBS 847.68 = NRRL 162 = ATCC 18489 = CSIR 936 = FAT 362 = IAM 7016 = IFO 6032 = NHL 6359 = QM 7888 (T) | EF626950 | EF626948 | EF626949 | JN406533 |
| Penicillium parvulum | Cinnamopurpurea | Cinnamopurpurea | CBS 132825 = NRRL 35504 (T) | EF422845 | EF506218 | EF506225 | MN969131 |
| Penicillium idahoense | Cinnamopurpurea | Idahoensia | CBS 341.68 = NRRL 5274 = ATCC 22055 = FRR 881 = IMI 148393 (T) | KC411747 | EF626953 | EF626954 | JN121499 |
| Penicillium colei | Cinnamopurpurea | Idahoensia | NRRL 13013 = IBT 29696 (T) | KF932958 | KF932926 | KF932942 | KF932996 |
| Penicillium pusillum | Cinnamopurpurea | Jiangxiensia | CBS 312.63 = FRR 1541 = IMI 089286 = LSHBB147 = NRRL 2498 (T) | EF626951 | KF932925 | KF932941 | KF932995 |
| Penicillium jiangxiense | Cinnamopurpurea | Jiangxiensia | AS 3.6521 = DTO 309-A7 (T) | KJ890411 | KJ890409 | KJ890407 | MN969122 |
| Penicillium incoloratum | Cinnamopurpurea | Nodula | CBS 101753 = AS 3.4672 (T) | KJ834508 | KJ834457 | KJ866984 | JN406651 |
| Penicillium nodulum | Cinnamopurpurea | Nodula | CBS 227.89 (T) | KC411703 | KJ834475 | KJ867003 | JN406603 |
| Penicillium citrinum | Citrina | Citrina | CBS 139.45 = DTO 022-F3 = ATCC 1109 = ATCC 36382 = CECT 2269 = FRR 1841 = IMI 091961 = IMI 092196 = LSHBAd 95 = LSHBP 25 = LSHBP 6 = MUCL 29781 = NRRL 1841 = NRRL 1842 (T) | AF033422 | GU944545 | MN969245 | JF417416 |
| Penicillium hetheringtonii | Citrina | Citrina | CBS 122392 = DTO 005-H9 = IBT 29057 (T) | GU944558 | GU944538 | MN969263 | JN606606 |
| Penicillium copticola | Citrina | Copticolarum | CBS 127355 = IBT 30771 (T) | JN617685 | JN606817 | JN606553 | JN606599 |
| Penicillium dokdoense | Citrina | Copticolarum | CNUFC-DDS11-1 (T) | MG906868 | MH243037 | MH243031 | - |
| Penicillium euglaucum | Citrina | Euglauca | CBS 323.71 = IBT 30767 (T) | JN617699 | JN606856 | JN606564 | JN606594 |
| Penicillium argentinense | Citrina | Euglauca | CBS 130371 = IBT 30761 (T) | JN831361 | JN606815 | JN606549 | MN969105 |
| Penicillium gallaicum | Citrina | Gallaica | CBS 167.81 = ATCC 42232 = IJFM 5597 (T) | JN617690 | JN606837 | JN606548 | JN606609 |
| Penicillium paxilli | Citrina | Paxillorum | CBS 360.48 = ATCC 10480 = FRR 2008 = IMI 040226 = NRRL 2008 = QM 725 (T) | GU944577 | JN606844 | JN606566 | JN606610 |
| Penicillium sanguifluum | Citrina | Roseopurpurea | CBS 127032 = IBT 29041 = DTO 020-B7 (T) | JN617681 | JN606819 | JN606555 | MN969135 |
| Penicillium roseopurpureum | Citrina | Roseopurpurea | CBS 226.29 = ATCC 10492 = ATHUM2895 = FRR 2064 = IMI 040573 = MUCL 28654 = MUCL 29237 = NRRL 2064 = NRRL 2064A (T) | GU944605 | JN606838 | JN606556 | JN606613 |
| Penicillium shearii | Citrina | Sheariorum | CBS 290.48 = ATCC 10410 = IFO 6088 = IMI 039739 = IMI 039739iv = NRRL 715 = QM 1870 (T) | GU944606 | JN606840 | EU644068 | JN121482 |
| Penicillium sumatraense | Citrina | Sumatraensia | CBS 281.36. Ex-type: CBS 281.36 = DTO 022-F1 = NRRL 779 = FRR 779 (T) | GU944578 | JN606639 | MN969301 | EF198541 |
| Penicillium wellingtonense | Citrina | Westlingiorum | CBS 130375 = DTO 076-C6 = IBT 23557 = DTO 76C6 (T) | JN617713 | JN606670 | MN969311 | JN606616 |

| Species name | Section | Serie | Strain no. | GenBank accession nr. | | | |
|---|---|---|---|---|---|---|---|
| Penicillium vancouverense | Citrina | Westlingiorum | CBS 126323 = DTO 082-B8 = IBT 20700 (T) | JN617675 | JN606663 | MN969307 | MN969143 |
| Penicillium cryptum | Crypta | Crypta | CBS 271.89 = DTO 122C9 = ATCC 60138 = IMI 296794 = NRRL 13460 (T) | KF303647 | KF303608 | KF303628 | JN121478 |
| Penicillium sexuale | Crypta | Crypta | FMR 17380 = CBS 146939 (T) | LR655195 | LR655199 | LR655203 | LR655207 |
| Penicillium eremophilum | Eremophila | Eremophila | IMI 313774 = CBS 123361 = ATCC 62925 (T) | GU733341 | KY709170 | KY611931 | KY611970 |
| Penicillium alutaceum | Exilicaulis | Alutacea | CBS 317.67 = ATCC 18542 = FRR 1158 = IFO 31728 = IMI 136243 (T) | AF033454 | KJ834430 | KP016768 | JN121489 |
| Penicillium decumbens | Exilicaulis | Alutacea | CBS 230.81 = FRR 741 = IMI 190875 = MUCL 29107 = NRRL 741 (T) | AY157490 | KJ834446 | KP016782 | JN406601 |
| Penicillium citreonigrum | Exilicaulis | Citreonigra | CBS 258.29 = ATCC 48736 = FRR 761 = IMI 092209 = LSHBP 20 = LSHBP 98 = MUCL 28648 = MUCL 29062 = MUCL 29116 = NRRL 761 (T) | AF033456 | EF198621 | EF198628 | JN121474 |
| Penicillium cinerascens | Exilicaulis | Citreonigra | DTO 189-A9 = NRRL 748 = ATCC 48693 = BIOURGE 90 = FRR 748 = IMI 92234 = QM 7555 = Thom 4733.34 (T) | AF033455 | JX141041 | JX157405 | MN969112 |
| Penicillium corylophilum | Exilicaulis | Corylophila | CBS 312.48 = TCC9784 = ATHUM2890 = CECT 2270 = FRR 802 = IMI 039754 = MUCL 28671 = MUCL 29073 = MUCL 29131 = NRRL 802 = QM 7510 (T) | AF033450 | JX141042 | KP016780 | KP064631 |
| Penicillium cravenianum | Exilicaulis | Corylophila | CBS 139138 = DAOMC 241082 = DTO 180-I5 = CV 92 (T) | JX140900 | JX141076 | JX157418 | KP064636 |
| Penicillium erubescens | Exilicaulis | Erubescentia | CBS 318.67 = ATCC 18544 = CSIR 1040 = FRR 814 = IFO 31734 = IMI 136204 = NRRL 6223 (T) | AF033464 | HQ646566 | EU427281 | JN121490 |
| Penicillium vinaceum | Exilicaulis | Erubescentia | CBS 389.48 = ATCC 10514 = FRR 739 = IMI 029189 = NRRL 739 = QM 6746 (T) | AF033461 | HQ646575 | HQ646586 | JN406555 |
| Penicillium lapidosum | Exilicaulis | Lapidosa | CBS 343.48 = ATCC 10462 = CCT4477 = IFO 6100 = IMI 039743 = NRRL 718 = QM 1928 (T) | MN431392 | KJ834465 | FJ530984 | JN121500 |
| Penicillium burgense | Exilicaulis | Lapidosa | CBS 325.89 (T) | KC411736 | KJ834437 | KP016772 | JN406572 |
| Penicillium restrictum | Exilicaulis | Restricta | CBS 367.48 = ATCC 11257 = FRR 1748 = IMI 040228 = NRRL 1748 = QM 1962 (T) | AF033457 | KJ834486 | KP016803 | JN121506 |
| Penicillium chalabudae | Exilicaulis | Restricta | CBS 219.66 = ATCC 18322 = ATCC 18329 = FRR 3393 = VKM F-1037 (T) | KP016811 | KP016748 | KP016767 | KP064572 |
| Penicillium angustiporcatum | Gracilenta | Angustiporcata | CBS 202.84 (T) | KC411690 | KJ834431 | MN969235 | JN406617 |
| Penicillium estinogenum | Gracilenta | Estinogena | CBS 329.59 = DTO 360-C8 = ATCC 18310 = CCRC 31557 = FAT1196 = FRR 3428 = IFO 6230 = IMI 068241 = QM 8149 = VKMF-274 (T) | MN431388 | MN969381 | MN969255 | - |
| Penicillium gracilentum | Gracilenta | Gracilenta | CBS 599.73 = ATCC 28047 = ATCC 48258 = FRR 1557 = IMI 216900 = NHL 6452 = DTO 095-D8 (T) | KC411768 | KJ834453 | MN969260 | JN121537 |
| Penicillium macrosclerotiorum | Gracilenta | Macrosclerotiorum | CBS 116871 = AS 3.6581 (T) | KJ834511 | KJ834469 | DQ911123 | JN121432 |
| Penicillium apimei | Gracilenta | Macrosclerotiorum | CBS 142502 = URM 7591 (T) | MF278310 | LT854641 | LT882717 | LT854650 |
| Penicillium griseolum | Griseola | Griseola | CBS 277.58 = ATCC 18239 = FRR 2671 = IFO 8175 = IMI 071626 = LSHBB323 = NRRL 2671 = QM 7523 (T) | EF422848 | EF506213 | EF506232 | JN121480 |
| Penicillium inusitatum | Inusitata | Inusitata | CBS 351.67 = ATCC 18622 = CSIR 1096 = FRR 1163 = IMI 136214 = NRRL 5810 (T) | AF033431 | KJ834458 | MN969265 | JN121503 |
| Penicillium daleae | Lanata-Divaricata | Dalearum | CBS 211.28 = DTO 105-F2 = ATCC 10435 = DSM 2449 = FRR 2025 = IFO 6087 = IFO 9072 = IMI 034910 = MUCL 29234 = NRRL 2025(T) | GU981583 | GU981649 | MN969251 | KF296427 |
| Penicillium rubriannulatum | Lanata-Divaricata | Dalearum | CGMCC 3.18804 = NN072456 = CBS 144641 (T) | KY495029 | KY495138 | MN969336 | KY495080 |
| Penicillium janthinellum | Lanata-Divaricata | Janthinella | CBS 340.48 = DTO 095-C3 = ATCC 10455 = IMI 040238 = NRRL 2016 = QM 6865 (T) | GU981585 | GU981625 | MN969268 | JN121497 |
| Penicillium ludwigii | Lanata-Divaricata | Janthinella | CBS 417.68 = DTO 094- D8 = DTO 264-I9 = FRR 559 (T) | KF296409 | KF296468 | MN969273 | KF296435 |
| Penicillium oxalicum | Lanata-Divaricata | Oxalica | CBS 219.30 = ATCC 1126 = FRR 787 = IMI 192332 = MUCL 29047 = NRRL 787 = QM 7606 (T) | AF033438 | KF296462 | MN969283 | JN121456 |

| Species name | Section | Serie | Strain no. | GenBank accession nr. | | | |
|---|---|---|---|---|---|---|---|
| Penicillium diatomitis | Lanata-Divaricata | Oxalica | CCF 3904 = MH 53 = CBS 140107 = IBT 30728 (T) | FJ430748 | HE651133 | LT970912 | LT797560 |
| Penicillium rolfsii | Lanata-Divaricata | Rolfsiorum | CBS 368.48 = DTO 106-H8 = ATCC 10491 = FRR 1078 = IFO 7735 = IMI 040029 = MUCL 29229 = NRRL 1078 = QM 1961 (T) | JN617705 | GU981667 | MN969294 | KF296455 |
| Penicillium camponotum | Lanata-Divaricata | Rolfsiorum | DAOMC 250557 = CBS 140982 = NBBR-2-1 = W 471 = KAS 2177 (T) | KT887855 | KT887816 | KT887777 | MN969179 |
| Penicillium simplicissimum | Lanata-Divaricata | Simplicissima | CBS 372.48 = DTO 014-H2 = ATCC 10495 = FRR 902 = IFO 5762 = IMI 039816 = QM 1939 (T) | GU981588 | GU981632 | MN969297 | JN121507 |
| Penicillium tanzanicum | Lanata-Divaricata | Simplicissima | DAOMC 250514 = CBS 140968 = DTO 410-D3 = 50.118 = KAS 1946 (T) | KT887841 | KT887802 | KT887763 | MN969183 |
| Penicillium lassenii | Lasseniorum | Lasseniorum | CBS 277.70 = DTO 95D6 = NRRL 5272 = ATCC 22054 = FRR 858 = IMI 148395 (T) | KF303648 | KF303607 | KF303629 | JN121481 |
| Penicillium ochrosalmoneum | Ochrosalmonea | Ochrosalmonea | CBS 489.66 = ATCC 18338 = CSIR 145 = IMI 116248ii = NRRL 35499 (T) | EF626961 | EF506212 | EF506237 | JN121524 |
| Penicillium isariiforme | Ochrosalmonea | Ochrosalmonea | CBS 247.56 = ATCC 18425 = CCRC 31699 = IFO 6393 = IHEM 4376 = IMI 060371 = LSHBBB308 = MUCL 31191 = MUCL 31323 = NRRL 2638 = QM 1897 (T) | AF454077 | KJ834459 | MN969266 | JN121470 |
| Penicillium magnielliptisporum | Paradoxa | Atramentosa | CBS 138225 = DTO 128-H8 (T) | KJ775686 | KJ775179 | KJ775413 | MN969124 |
| Penicillium mexicanum | Paradoxa | Atramentosa | CBS 138227 = DTO 270-F1 (T) | KJ775685 | KJ775178 | KJ775412 | MN969127 |
| Penicillium georgiense | Ramigena | Georgiensia | CBS 132826 = NRRL 35509 = DTO 194-D3 (T) | EF422852 | EF506223 | EF506239 | KM089734 |
| Penicillium capsulatum | Ramigena | Ramigena | CBS 301.48 = ATCC 10420 = DSM2210 = FRR 2056 = IJFM 5120 = IMI 040576 = NRRL 2056 = QM 4869 = VKMF-445 (T) | AF033429 | MN969375 | KP735539 | JN406582 |
| Penicillium ramusculum | Ramigena | Ramigena | CBS 251.56 = ATCC 12292 = FRR 3459 = IMI 063546 = IMUR478 = LSHBBB324 = NRRL 3459 = QM 7057 (T) | EF433765 | EU427269 | EU427278 | JN121472 |
| Penicillium adametzioides | Sclerotiorum | Adametziorum | CBS 313.59 = ATCC 18306 = FAT1302 = IFO 6055 = IMI 068227 = NRRL 3405 = QM 7312 (T) | JN686433 | JN799642 | JN686387 | JN406578 |
| Penicillium angulare | Sclerotiorum | Adametziorum | CBS 130293 = IBT 27051 = NRRL 28157 (T) | AF125937 | KC773779 | KC773804 | JN406554 |
| Penicillium herquei | Sclerotiorum | Herqueorum | CBS 336.48 = NRRL 1040 = ATCC 10118 = BIOURGE 452 = FRR 1040 = IFO 31747 = IMI 28809 = MUCL 29213 = NCTC 1721 = QM 1926 = Thom 4640.447 (T) | JN626101 | JN625970 | JN626013 | JN121494 |
| Penicillium verrucisporum | Sclerotiorum | Herqueorum | CGMCC 3.18415 (T) | KX885069 | KX885049 | KX885059 | KX885040 |
| Penicillium sclerotiorum | Sclerotiorum | Sclerotiorum | CBS 287.36 = ATCC 10494 = IFO 6105 = IMI 040569 = NRRL 2074 = QM 1938 = VKMF-353 (T) | JN626132 | JN626001 | JN626044 | JN406585 |
| Penicillium vanoranjei | Sclerotiorum | Sclerotiorum | CBS 134406 (T) | KC695696 | KC695686 | KC695691 | - |
| Penicillium stolkiae | Stolkia | Stolkia | CBS 315.67 = ATCC 18546 = CSIR 1041 = FRR 534 = IMI 136210 = NRRL 5816 (T) | AF033444 | JN617717 | AF481135 | JN121488 |
| Penicillium subarcticum | Stolkia | Stolkia | CBS 111719 = NRRL 31108 = UAMH 3897 (T) | AF481120 | JN617716 | AF481141 | MN969139 |
| Penicillium taxi | Thysanophora | Thysanophora | CBS 206.57 = ATCC 18484 = BBA 7480 = MUCL 11402 = QM 8153 (T) | KJ834517 | KJ834495 | MN969302 | JN121454 |
| Penicillium hennebertii | Thysanophora | Thysanophora | CBS 334.68 = ATCC 18741 = IMI 137644 = MUCL 21216 = VKMF-2999 (T) | KJ834507 | KJ834454 | MN969262 | JN121493 |
| Penicillium aeris | Torulomyces | Torulomyces | CBS 135897 = DTO 207D4 (T) | KF303654 | KF303614 | KF303627 | KF303681 |
| Penicillium wisconsinense | Torulomyces | Torulomyces | CBS 128279 = DTO 198-H7 = WSF 3132 (T) | KF303670 | KF303624 | KF303641 | KF303706 |
| Aspergillus glaucus | - | - | CBS 516.65 = NRRL 116 = ATCC 16469 = IMI 211383 = LCP 64.1859 = Thom 5629.C = WB 116 (T) | EF652052 | EF651887 | EF651989 | EF651934 |
| Hamigera avellanea | - | - | CBS 295.48 = ATCC 10414 = CECT 2265 = DSM 2208 = IMI 040230 = NRRL 1938 (T) | AF454075 | EU021664 | EU021682 | EU021627 |

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REFERENCES

Altschul, S.F., W. Gish, W. Miller, E.W. Myers & D.P. Lipman. 1990. Basic local alignment search tool. *Journal of Molecular Evolution* 215: 403–410.

Banda, R., K., A. Delgado-Salinas, K.G. Dexter, R. Linares-Palomino, A. Oliveira-Filho, D. Prado, M. Pullan, C. Quintana, R. Riina, M.G.M. Rodríguez, J. Weintritt, P. Acevedo-Rodríguez, J. Adarve, E. Álvarez, B.A. Aranguren, J.C. Arteaga, G. Aymard, A. Castaño, N. Ceballos-Mago, Á. Cogollo, H. Cuadros, F. Delgado, W. Devia, H. Dueñas, L. Fajardo, Á. Fernández, M.Á. Fernández, J. Franklin, E.H. Freid, L.A. Galetti, R. Gonto, M.R. González-, R. Graveson, E.H. Helmer, Á. Idárraga, R. López, H. Marcano-Vega, O.G. Martínez, H.M. Maturo, M. McDonald, K. McLaren, O. Melo, F. Mijares, V. Mogni, D. Molina, N.D. Moreno, J.M. Nassar, D.M. Neves, L.J. Oakley, M. Oatham, A.R. Olvera-Luna, F.F. Pezzini, O.J. Dominguez, M.E. Ríos, O. Rivera, N. Rodríguez, A. Rojas, T. Särkinen, R. Sánchez, M. Smith, C. Vargas, B. Villanueva & R.T. Pennington. 2016. Plant diversity patterns in neotropical dry forests and their conservation implications. *Science* 353: 1383–1387.

Barbosa do Nascimento, R., J.D. Pereira Bezerra, A.C. da Silva Santos, R.F. Ribeiro Melo, J. Houbraken, NT. Oliveira & C.M. de Souza-Motta. 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 Botánica Brasilica* 34: 409–429.

Bonino, E. & P. Araujo. 2005. Structural differences between a primary and a secondary forest in the Argentine Dry Chaco and management implications. *Forest Ecology and Management* 206: 407–412.

Cabello, M. & A.M. Arambarri. 2002. Diversity in soil fungi from undisturbed and disturbed *Celtis tala* and *Scutia buxifolia* forests in the eastern Buenos Aires Province (Argentina). *Microbiologial Research* 157: 115–125.

Cruz, R., C. Santos, J. Silva de Lima, K. Aparecida Moreira & C.M. de Souza-Motta. 2013. Diversity of *Penicillium* in soil of Caatinga and Atlantic Forest areas of Pernambuco, Brazil: an ecological approach. *Nova Hedwigia* 97: 543–556.

Diodato, L. & A. Fuster. 2016. Composition of insect assemblage canopy of subtropical dry forests of Semiarid Chaco, Argentina. *Caldasia* 38: 197-210.

Gasparri, I.N. & H.R. Grau. 2009. Deforestation and fragmentation of Chaco dry forest in NW Argentina (1972–2007). *Forest Ecology Management* 258: 913-921.

Glass, N.L. & G.C. Donaldson. 1995. Development of premier sets designed for use with the PCR to amplify conserved genes from filamentous Ascomycetes. *Applied and Environmental Microbiology* 61: 323–1330.

Godeas, A.M. 1972. Micoflora del suelo de la Argentina. I. Algunas formas ascospóricas de la Región chaqueña. *Micopathología. et Mycología Applicata* 46:189–204.

Hong, S.B., H.S. Cho, H.D. Shin, J.C. Frisvad & R.A. Samson. 2006. Novel *Neosartorya* species isolated from soil in Korea. *International Journal of Systematic and Evolutionary Microbiology* 56: 477–486.

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

Houbraken, J., S. Kocsubé, C.M. Visagie, N. Yilmaz, X.C. Wang, M. Meijer, B. Kraak, V. Hubka, K. Bensch, R.A. Samson & J.C. Frisvad 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., C.M. Visagie, M. Meijer, J.C. Frisvad, P.E. Busby, J.I. Pitt, K.A. Seifert, G. Louis-Seize, R. Demirel, N. Yilmaz, K. Jacobs, M. Christensen & R.A. Samson. 2014. A taxonomic and phylogenetic revision of *Penicillium* section *Aspergilloides*. *Studies in Mycology* 78: 373–451.

Kacoliris, F.P., I. Berkunsky, & J. Williams. 2006. Herpetofauna of the Argentinean Impenetrable Great Chaco. *Phyllomedusa* 5: 149–157.

Liu, Y.J., S. Whelen & B.D. Hall. 1999. Phylogenetic relationships among ascomycetes: evidence from an RNA polymerse II subunit. *Molecular Biology and Evolution* 16: 1799–1808.

Merlos, C.S., S.A. Pelizza & M.V. Moreno. 2018. Neotropical seasonally dry forests: response of soil fungal communities to anthropogenic actions. *International Journal of Biodiversity Science* 2: 198–202.

Montecchia, M.S., O.S. Correa, M.A. Soria, S.D. Frey, A.F. García & J.L. Garland. 2011. Multivariate approach to characterizing soil microbial communities in pristine and agricultural sites in Northwest Argentina. *Applied Soil Ecology* 47: 176–183.

Ramírez, C. 1985. Two new species of *Penicillium* from the Tierra del Fuego (Argentina and Chile). *Mycopathologia* 91: 92–100.

Raper, T. & C. Thom. 1968. *A Manual of the Penicillia. Hafner Publishing Company*. New York and London, 875 pp.

Rivera, K.G. & K.A. Seifert. 2011. A taxonomic and phylogenetic revision of the *Penicillium sclerotiorum* complex. *Studies in Mycology* 70: 139–58.

Rodríguez-Andrade, E., A.M., Stchigel & J.F. Cano-Lira. 2021. New Xerophilic Species of *Penicillium* from Soil. *Journal of Fungi* 7: 2–16.

Samson, R. & J.C. Frisvad. 2004. *Penicillium* subgenus *Penicillium*: new taxonomic schemes and mycotoxins and other extrolites. Ceentraalbureau voor Schimmel cultures, Utrecht, The Netherlands. *Studies in Mycology* 49: 1–251.

Stenglein, S.A. & P.A. Balatti. 2006. Genetic diversity of *Phaeoisariopsis griseola* in Argentina as revealed by virulence and molecular markers. *Physiological and Molecular Plant Pathology* 68: 158–167.

Sun, B.D., C.M. Visagie, A.J. Chen & J. Houbraken. 2021. A taxonomic review of *Penicillium* section *C harlesia*. *Mycological Progress* 20: 1383–1397

Valenzuela-Lopez, N., J.F. Cano-Lira, J. Guarro, D.A. Sutton, N. Wiederhold, P.W. Crous & A.M. Stchigel. 2018. Coelomycetous *Dothideomycetes* with emphasis on the families *Cucurbitariaceae* and *Didymellaceae*. *Studies in Mycology* 90: 1–69.

Vallejos, M., J.N. Volante, M.J. Mosciaro, L. Vale, L.A. Bustamante & J. Paruelo. 2015. Transformation dinamics of the natural cover in the Dry Chaco ecoregion: a plot level geo-database from 1976 to 2012. *Journal of Arid Environments* 123: 8–11.

Visagie, C.M., Y. Hirooka, J.B. Tanney, E. Whitfield, K. Mwange, M. Meijer, A.S. Amend, K.A. Seifert & R.A. Samson. 2014a. *Aspergillus*, *Penicillium* and *Talaromyces* isolated from house dust samples collected around the world. *Studies in Mycology* 78: 63–139.

Visagie, C.M., J. Houbraken, J.C. Frisvad, S.B. Hong, C.H.W. Klaassen, G. Perrone, K.A. Seifert, J. Varga, T. Yaguchi & R.A. Samson. 2014b. Identification and nomenclature of the genus *Penicillium*. *Studies in Mycology* 78: 343–371.

White, T.J., T. Bruns, S. Lee & J. Taylor. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In: M.A Innis, D.H. Gelfand, T.J. Shinsky & T.J. White (eds.), *PCR protocols: a guide to methods and applications* pp. 315–322, Academic Press Inc, New York.

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