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SUMMARY

Nine species of ***Penicillium*** *have been isolated from soil in the Rio Trombetas drainage. Four of the records are new to Brazil. Distribution patterns are discussed. Other records for* ***Penicillium*** *in Brazil are reviewed.*

Penicillium is a dominant genus of soil fungi in temperate climates (Domsch et al., 1980). The Brazilian distribution of **Penicillium** species or of genera with a **Penicillium** anamorph is known from work in Amapá (Batista et al., 1967b), Amazonas (Batista & Maia, 1955a), Maranhão (Batista et al., 1965), Pernambuco (Batista & Maia, 1957; Batista et al., 1967a), and São Paulo (Picci & Verona, 1956; Raper & Thom, 1949).

Soil fungi were a focus of the 1980 Rio Trombetas expedition of the Projeto Flora Amazônica. Soil samples were collected in 117 localities of the Rio Trombetas, Rio Cachorro, and Rio Mapuera. A soil corer was pressed into the top soil layer to a depth of approximately eight centimeters. The soil cores were placed into fine-weave cloth bags, air dried **in situ**, individually tagged, and transported to Manaus. The samples were divided: half of them was retained by Dr. Wai Yin Mok, Departamento de Patologia Tropical, INPA, who screened them for pathogenic yeasts (Mok et al., 1984); and the other half was shipped to the US Forest Service Laboratory, Southwest Pacific Experiment Station laboratory in Riverside, California, which had a permit for soil importation. Pure culture isolation of soil fungi was done in two ways. Most of the isolates were derived from a dilution series from 10 grams of soil in 90 mls of sterilized 0.2% water agar solution, which was mixed in a sanitized electric (Waring) blender for 1 minute. Several dilutions of up to 10% were made from this initial solution. The dilution series was plated onto four agars: Martin's IIA Agar (10 grams dextrose, 2 grams

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bactopeptone, 0.5 grams KH_2PO_4, 0.5 grams $MgSO_4$, 20 grams agar, and 1 liter distilled water); 10% Aged Pond Water Agar; V-8 Juice Agar; and BBL YPSS Agar. All plates were made in duplicate. A solution containing penicillium-G and streptomycin sulfate for control of bacteria was used. The YPSS culture plates were incubated at 50°C and the other three agars were incubated at 25°C.

The second isolation method was to heat shock a soil slurry in a test tube at 60°C for 90 minutes. Warcup plates were made using Difco Yeast Carbon Base which incorporated this slurry with alphacellulose added as a carbon source. The same penicillium-G and streptomycin solution was used for bacterial control.

Plates from the incubation series were selected for a countable range of 10-50 colonies. Five isolates were picked from a grid superimposed over the petri plate; unusual appearing fungi were also subcultured. Each strain was assigned a number that was different from all the other strains that we isolated. The isolates selected were transferred to sodium caseinate agar and glucose-peptone agar and incubated for 10 days; subcultures were placed in agar-slants in screwcap tubes and stored at 5°C. Cultures were identified in the Botany laboratory of the Natural History Museum in Los Angeles, California, utilizing the procedures and taxonomy outlined by Pitt (1979b).

The anamorph **Penicillium** was isolated 349 times from the following Pará sites collected by P. H. Dunn. The data are presented in the order of: site number; date of collection; and site information. Site numbers are reffered to by "=Nº" where the data are the same. Parentheses indicate a different site or habitat within the same general locality.

Nº 1; 16 June 1980; Oriximiná, Highway 162 near junction with road to Óbidos; cultivated area. Nº 2; =Nº 1 (secondary growth). Nº 3; =Nº 1 (primary forest). Nº 4; 16 June 1980; Oriximiná, near junction of Highway 163 and 162; cultivated. Nº 5; =Nº 4 (secondary growth). Nº 6; =Nº 4 (primary forest). Nº 7; 16 June 1980; Oriximiná, along Highway 163; (primary forest). Nº 8; 16 June 1980; Rio Trombetas, 7 kilometers south of Cachoeira Porteira; shale outcropping in primary forest. Nº 9; 17 June 1980; Rio Trombetas east bank, 10 kilometers south of Cachoeira Porteira; primary forest, terra firme. Nº 10; 18 June 1980; Cachoeira Porteira Road, Kilometer 6; primary or old secondary forest. Nº 11; =Nº 10 (Kilometer 5). Nº 12; =Nº 10 (Kilometer 4). Nº 13; =Nº 10; 19 June 1980; (Kilometer 15). Nº 14; =Nº 13 (low area near river). Nº 15; 19 June 1980; Cachoeira Porteira Road, Kilometer 13; primary forest. Nº 16; =Nº 15. Nº 17; 21 June 1980; Cachoeira Porteira Road, Kilometer 27; primary forest. Nº 18; =Nº 17 (Kilometer 25). Nº 19; 22 June 1980; Rio Cachorro; Porto da Serra; primary forest. Nº 20; =Nº 19 (cultivated plot). Nº 21; 22 June 1980; Rio Mapuera; one hour by motorized canoe upriver from Cachoeira Porteira on north bank; in flood area. Nº 22; =Nº 21 (terra firme, primary forest). Nº 23; =Nº 20 (river island). Nº 24; =Nº 20. Nº 25; 23 June 1980; Rio Trombetas west bank, above Cachoeira Porteira; primary forest. Nº 26; 23 June 1980; Rio Trombetas, 4 kilometers north on west bank. Nº 27; =Nº 26. Nº 28; 26 June 1980; Rio Mapuera, near Cachoeira Vience, south shore; terra firme, primary forest. Nº 29; =Nº 28 (hilltop palm growth). Nº 30; =Nº 28 (north shore, beach). Nº 31; =Nº 28

(midslope with palm understory). Nº 32; =Nº 28 (hilltop palm growth). Nº 33; =Nº 28 (hilltop primary forest). Nº 34; 27 June 1984; Rio Mapuera, Ilha Vience, north side; low terra firme, palms. Nº 35; =Nº 34 (hilltop palm growth). Nº 36; =Nº 34 (southside in low terra firme with palms). Nº 37; 27 June 1980; Rio Mapuera, Ilha Maracajã, beach floodplain. Nº 38; =Nº 37 (inland, higher elevation with shrubby growth and palms). Nº 49; 30 June 1980; Rio Mapuera rapids, limestone scrub area, north side, non-flooding area dominated by bamboo. Nº 110, 18 July 1980; Lago do Erepecu, basalt dike island, north shore.

A representative culture for each species was prepared as herbarium specimens by slow dessication of the agar colony. Each specimen was accessioned into Herbarium LAM; duplicates were distributed to various herbaria.

Nine species of **Penicillium**, four new for Brazil, were isolated from 45 sites in this study. In order to detect any ecological patterns, the isolation site data were examined for fungal distribution patterns. The results do not seem to indicate a strong correlation with habitat. Site Nº 2 (secondary forest) was the most diverse, containing 7 out of 9 **Penicillium** species. Site Nº 12, which contained 6 out of 9 species is a primary or old secondary forest. Sites 19, 27, 31, and 49 (the first three, primary forest) each contained one species only: **P. dodgei**. **Penicillium dodgei** was the most widely distributed species, being found in 77% of the sites. The highest level of co-occurrence of other species with **P. dodgei** was with **P. citrinum** (54% of sites where **dodgei** occurred) and with **P. indonesiae** (46% of **dodgei** sites). Three distinctly different sites (Nºs. 7, 14, and 38) had the same 5 species: **citrinum, dodgei, indonesiae, lapidosum,** and **verruculosum**. Several sites shared the same species composition (Table 1).

Table 1. Collection sites sharing the same species composition.

PENICILLIA	SITES
dodgei	19, 27, 31, 49
dodgei citrinum	13, 30
dodgei citrinum indonesiae	3, 28, 29
dodgei dangeardii lapidosum	9, 21
dodgei indonesiae lapidosum	8, 24
dodgei citrinum indonesiae lapidosum verruculosum	7, 14, 38

The following is an annotated listing of **Penicillium** from Brazil. The new records are marked with an asterisk.

P. brevicompactum Dierckx
São Paulo (Picci & Verona, 1956).

P. **capsulatum** Raper & Fennel
Maranhão (Batista et al., 1965; Batista et al., 1967a).

P. chrysogenum Thom
Maranhão (Batista et al., 1965; Batista et al., 1967a), also as **Penicillium notatum** Westling; São Paulo (Guida, 1955) as **P. notatum** Westling.

P. citrinum Thom
Amapá (Batista et al., 1967b) also as **Penicillium steckii**; Maranhão (Batista et al., 1965) as **P. steckii**, and (Batista et al., 1967a); NE Brazil (Pitt, 1979b); Pará LAM 300406 (PHID1306J) Trombetas sites 1-7, 12-16, 25, 28-30, 34-38; 110; Pernambuco, Recife (Pitt, 1979a) described as the new species **Penicillium botryosum** Batista & Maia (1957), also (Raper & Thom, 1949); São Paulo (Picci & Verona, 1956).

P. commune Thom
Maranhão (Batista et al., 1965).

P. **cyaneum** (Bainier & Sartory) Biourge
Maranhão (Batista et al., 1965)

P. dangeardii Pitt
Brazil "various soils" (Raper & Thom, 1949), and Maranhão (Batista et al., 1967a) as **Penicillium vermiculatum** Dangeard; Pará (LAM300407) (PHD594E) Trombetas sites 2, 9-10, 12, 15, 18, 21-23, 25, 32-34, 36; São Paulo (Pitt, 1979a), (Raper & Thom, 1949). The teleomorph is **Talaromyces flavus** (Klocker) Stolk & Sampson.

P. dodgei Pitt
Pará (LAM300408) (PHD1757C) Trombetas sites 1-9, 11-15, 18-35, 37-38, 49; São Paulo (Pitt, 1979a), as **Penicillium brefeldianum** B. Dodge (Raper & Thom, 1949). The teleomorph is **Eupenicillium brefeldianum** (B. Dodge) Stolk & Scott.

P. **egyptiacum** van Beyma
Maranhão (Batista et al., 1965) mispelled "**egyptiarum**". The teleomorph is **Eupenicillium egyptiacum** (Van Beyma) Stolk & Scott.

P. funiculosum Thom
Maranhão (Batista et al., 1965; Batista et al., 1967a), also as **Penicillium varians G.**

Smith; NE Brazil (Ramos & Upadhyay, 1966).

P. glabrum (Wehmer) Westling
Amapá (Batista et al., 1967b) as **Penicillium frequentans** Westling; Maranhão (Batista et al., 1965) as **P. frequentans**; NE Brazil (Pitt, 1979b); São Paulo (Picci & Verona, 1956) as **P. frequentans**.

P. griseofulvum Dierckx
NE Brazil (Ramos & Upadhyay, 1966).

P. herquei Bain & Sartory
Maranhão (Batista et al., 1965).

P. implicatum Biourge
Maranhão (Batista et al., 1965).

P. indonesiae Pitt
Pará (LAM300409) (PH2352A) Trombetas sites 2-3, 5, 7-8, 10-11, 14-17, 23-24, 26, 28-29, 35-38; Maranhão (Batista et al., 1967a) with **Carpenteles javanicum** (van Beyma) Shear as a synonym; Pernambuco, Recife (Pitt, 1979a) as **Penicillium javanicum** van Beyma (Raper & Thom, 1949). The teleomorph is **Eupenicillium javanicum** (van Beyma) Stolk & Scott.

P. janczewskii Zaleski
NE Brazil (Ramos & Upadhyay, 1966) as **Penicillium nigricans** Bainier ex Thom.

P. janthinellum Biourge
Amapá (Batista et al., 1967b); São Paulo (Picci & Verona, 1956).

P. kloeckeri Pitt
São Paulo (Pitt, 1979a) as **Penicillium wortmanii** Klöcker (Raper & Thom, 1949). The teleomorph is **Talaromyces wortmanii** (Klöcker) C. R. Benjamin.

P. lapidosum Raper & Fennel (*)
Pará (LAM300410) (PHD792B) Trombetas sites 2, 5-10, 12, 14, 20-24, 26, 32, 34, 38. The teleomorph is **Eupenicillium lapidosum** Scott & Stolk.

P. lehmanii Pitt (*)
Pará (LAM300411) (PHD1663B) Trombetas sites 2, 5, 22-23, 25, 26, 37. The teleomorph is **Talaromyces trachyspermus** (Shear) Stolk & Sampson.

P. namyslowskii Zaleski
Maranhão (Batista et al., 1965). Pitt (1979) placed this species in the genus **Geosmithia**.

P. novae-zeelandiae van Beyma
Maranhão (Batista et al., 1965).

P. oxalicum Currie & Thom
Maranhão (Batista et al., 1965).

P. paxilli Bainier
Amazonas, Manaus (Batista & Maia, 1955a).

P. purpurogenum Stoll
Maranhão (Batista et al., 1965); NE Brazil (Ramos & Upadhyay, 1966) as **Penicillium rubrum** Stoll.

P. raistrickii G. Smith
Maranhão (Batista et al., 1965) missepelled as "**vaistrickii**", (Batista et al., 1967a).

P. restrictum Gilman & Abbott
São Paulo (Picci & Verona, 1956).

P. rugulosum Thom
Maranhão (Batista et al., 1965) as **Penicillium tardum** Thom.

P. sclerotiorum van Beyma
Maranhão (Batista et al., 1965).

P. shearii Stolk & Scott
Pernambuco, Recife (Pitt, 1979a) as **Penicillium asperum** (Shear) Raper & Thom (1949). The teleomorph is **Eupenicillium shearii** Stolk & Scott.

P. simplicissimum (Oudemans) Thom
Amapá (Batista et al., 1976b); Maranhão (Batista et al., 1965); Pará (Batista & Maia 1955a) from Óbidos as **Penicillium pulvillorum** Turfitt, (Batista et al., 1967a); Pernambuco, Recife (Pitt, 1979a) described as the new species **Penicillium brasilianum** Batista in Batista & Maia (1957).

P. spinulosum Thom
Pará (LAM300412) (PHD1500E) Trombetas site 20; São Paulo (Picci & Verona, 1956).

P. sublateritium Biourge
Pernambuco, Recife (Batista & Maia, 1955a) described as the new species **Penicillium ramusculum** Batista & Maia.

P. thomii Maire
Maranhão (Batista et al., 1965).

P. variabile Sopp
Maranhão (Batista et al., 1965); NE Brazil (Ramos & Upadhyay, 1966).

P. velutinum van Beyma(*)

Pará (LAM300413) (PHD1327F) Trombetas sites 1-2, 4-6, 11-12, 16, 110.

P. verruculosum Peyronel(*)

Pará (LAM300414) (PHD2345A) Trombetas sites 7, 11-12, 14, 17, 20, 35-38.

P. vinaceum Gilman & Abbott

Maranhão (Batista et al., 1965; Batista et al., 1967a).

P. waksmanii Zaleski

Maranhão (Batista et al., 1965); Pernambuco, Recife (Batista et al., 1960).

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