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Hyphomycetes from Korean Soil. I. The Genus *Penicillium* with a Teleomorphic State *Eupenicillium javanicum*.

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韓國 土壤中의 絲狀菌에 關한 硏究. I. *Penicillium*屬과 子囊菌 *Eupenicillium javanicum*에 관하여

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ABSTRACT

A mycological survey was carried out with the soil samples collected in Korea from September, 1978 to December, 1979. Special attention was paid to the fungus genus *Penicillium*. One hundred twenty three isolates, as a result, were obtained from the Korean soils. Among these, sixteen species were identified and described in this paper. Almost all of the fungi reported here are new to Korea. One of them is an ascomycete fungus, *Eupenicillium javanicum* van Beyma which produces abundant pale yellowish cleistothecia of 120~150μ in diameter. Ascospores of this fungus were found lenticular with an equatorial furrow as indicated in the previous descriptions.

INTRODUCTION

Species of the genus *Penicillium* are one of the commonest microorganisms on decaying organic matters and widely distributed in the world. From a long time age, the penicillia were so important for the human benefits that its taxanomic studies were gradually developed according to their necessities.

Although the studies on genus *Aspergillus* in Korea were recorded by B.H. Lee & S.J. Kim (1968) and Y.N. Lee *et al.* (1976), other myclolgical investigations have not been performed in the field of the Hyphomycete genera from Korea.

Attempts were made to indentify the isolates from the soils obtained from various places in Korea from 1978 to 1979. During the investigation of Hyphomycetes, many species of the genus *Penicillium* have been found from the Korean soils.

In this paper, sixteen species of the genus *Penicillium* will be reported and most of these

fungi are described here for the first time in Korea.

MATERIALS and METHODS

In this investigation, soils were collected from various places in Korea and isolated by the dilution plate method. The medium used for isolating the fungi from soils contained 5g of peptone, 2g yeast extract, 20g sucrose, 0.5g $MgSO_4 \cdot 7H_2O$, 1g K_2HPO_4, 100mg chloramphenicol, 20g agar and 1000m*l* distilled water.

The isolates were inoculated on Czapek agar, malt extract agar and potato sucrose agar slants for identification. Identification was made mainly on the basis of the morphological and growth characters. Most of the representative strains reported here have been deposited in the Institute for Fermentation Osaka.

RESULTS

Penicillium brevi-compactum Dierchx

Dierchx, Soc. Sci. Brux. **25** : 88(1901); Biourge, Monogr., La Cellule **33**(1) : 155(1923); Thom, The Penicillia, p. 295(1930); Abe, J. Gen. Appl. Microbiol. **2** : 103(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 191 (1957); Raper & Thom, A manual of Penicillia, p. 407(1968).

Colonies on Czapek agar growing restrictedly, heavily sporulating, surface velvety or lanose, basal felt raised in central area, slightly wrinkled, furrowed, with narrow marginal zonation, conidial areas white to cream, then becoming to grayish blue-green in age; reverse olive green.

Colonies on malt extract agar growing restrictedly, surface radially furrowed, raised in central area, conidial area pale blue-green; reverse cream or colorless.

Colonies on potato sucrose agar growing poorly, surface velvety, overgrown by sparse aerial growth, close basal felt, conidial area white when young, but grayish green in age; reverse colorless.

Penicilli not divaricate and compact, with 2 or 3 branches closely appressed, bearing cluster of metulae and phialides. Conidiophores variable in length, septate and with heavy walls, smooth or rough-walled. Branches 14μ long, 4μ wide. Metulae in groups of 3 or 4, $8 \times 4\mu$, enlarging upward. Phialides commonly $8 \times 3.5 \sim 4.0\mu$, more or less inflated at basal part. Conidia globose to subglobose, mostly $3 \times 3\mu$, with smooth or slightly roughed wall.

Habitat: Soils; Cheonhodong, Kangnamku, March 30, 1979, T.Y. Ahn, SUB 14 and Shinlimdong, Kwanaku, Seoul, March 6, 1979, T.Y. Ahn, SUB 90.

Note: Conidia of the present fungus are mostly globose as compared with the original description. However, this fungus fits very well with the description in other morphological and cultural characteristics. This is the first record of the occurence of this fungus in Korea.

Penicillium charlesii Smith var. ***rapidum*** Abe

Abe, J. Gen. Appl. Microbiol. **2** : 73(1956); Smith, Trans. Brit. Mycol. Soc. **46** : 332(1963).

Colonies on Czapek agar growing rapidly, wrinkled and sometimes raised in central area, basal felt very thin and closely textured, with the appearance of abundant conidia in pale green; exudate lacking; reverse green.

Colonies on malt agar growing rapidly, consisting of a thin mycelial felt, surface plane and velvety, sometimes raised in central area, pale blue green when young, becoming to blue green in age; exudate fairly abundant, colorless; reverse green or grayish green-brown.

Colonies on potato sucrose agar growing rapidly, mostly thin, sometimes raised, in central area, surface grayish green, overgrown by plane conidial structures; exudate limited; reverse whitish gray or uncolored.

Penicilli monoverticillate but not arranged as a definite apical verticil of metulae or branches. Conidiophores mostly branched, occasionally rebranched, arising from creeping of interwoven aerial hyphae, 50×3μ or more longer, smooth-walled. Metulae sometimes in groups of 2 or 3, 16—22×3μ. Phialides in compact clusters, commonly parallel. Conidia hyaline, globose to subglobose, mostly 2—3×2—3μ, smooth walled.

Habitat: Soil; Shinlimdong, Kwanaku, Seoul, March 16, 1979, T.Y. Ahn, SUB 15.

Note: This is the first described record from Korean soil. The present isolate fits well in many respects with the description given by Abe except the nearly smooth conidia. It was found, rough-walled conidia were sometimes produced, suggesting changeable nature of conidial surface at different growth conditions. Smith(1963) treated this fungus as synonymous with *P. charlesii* and stated that Abe's reason for the erection of the variety, because of the rather more rapid growth than that of the type, was too trivial to be taken seriously. According to Abe (personal communication), this fungus should be renamed as *P. charlesii-globosum* Abe on the basis of its globose shape of the conidia while *P. charlessii* have elliptical conidia.

Penicillium chrysogenum Thom

Thom, U.S. Dept. Agr., Bur. Anim. Ind., Bull. **118** : 58(1910); Westling, Arkiv f. Botanik **11** : 54 & 107(1911); Biourge, Monogr., La Cellule **33**(1) : 170(1923); Thom, The Penicillia, p. 261(1930); Abe, J. Gen. Appl. Microbiol. **2** : 91(1945); Abe, The Penicillia-Atlas of Microorganisms, p. 161(1957); Raper & Thom, A Manual of Penicillia, p. 359(1968).

Colonies on Czapek agar growing rapidly, consisting of thin basal felt, surface usually velvety, radially furrowed, heavily sporulating throughout, conidial areas yellow green to grayish green; reverse commonly bright yellow.

Colonies on malt agar growing well, velvety or sometimes more or less floccose, never furrowed, conidial areas yellowish green; reverse usually dull yellow.

Colonies on potato sucrose agar growing rapidly, velvety or granular, conidial areas showing yellowish green but becoming grayish green; reverse usually dull yellow.

Penicilli asymmetrical, smooth-walled, irregulary branched, consisting of a verticil of metulae, Conidiophores arising from the substratum, variable in length, 3.0μ wide. Metulae commonly 10×2.5μ. Phialides in verticils of 4-6, mostly 10×2.5μ. Conidia typically elliptical, smooth walled, 3.5×2.8μ.

Habitat: Soils; Seongryu cave, Kusanri, Ulchin, Kyungbuk, June 5, 1978, K.H. Min SUB Al and March 9, 1980, K.H. Min, SUB 126.

Note: This isolates agree well with original description in many characteristics and with many strains of IFO such as IFO 4626.

Penicillium citrinum Thom

Thom, U.S. Dept. Agr., Bur. Anim. Ind., Bull. 118 : 61(1910); Thom, The Penicillia, p. 256(1930); Abe, J. Gen. Appl. Microbiol. 2 : 85(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 149(1957); Raper & Thom, A Manual of Penicillia, p. 345(1968).

Syn. *P. aurifluum* Biourge(1923).

Colonies on Czapek agar growing restrictly, radiately wrinkled, central area pale yellow, with zonations at marginal area, generally

velvety, sometimes floccose, with close-textured basal felt, conidial areas blue green in age; exudate abundant, in pale yellow droplets; reverse commonly yellow or sometimes colorless.

Colonies on malt extract agar growing restrictly, with zonations at marginal area, velvety or becoming to floccose, heavily sporulating, conidial areas grayish blue green in age; reverse dull yellow or amber.

Colonies on potato sucrose agar growing restrictly, with zonation at marginal area, usually velvety, conidial areas pale olive gray; reverse conspicuously amber or yellow color.

Penicilli asymmetric, not divaricate, consisting of a terminal cluster of 4-6 metulae, each bearing a cluster of parallel phialides and conidial chains. Conidiophores short, arising from aerial hyphae, smooth walled, varible in length, 2.5μ wide. Metulae measuring 12.5×2.5μ. Phialides 7.5×2.5μ. Conidia globose to subglobose, smooth-walled, mostly 2.5μ in diameter.

Habitat: Soil; Seongryu cave, Kusanri, Ulchin, Kyungbuk, March 9, 1980, K.H. Min, SUB 124.

Note: The present fungus fits very well with the original description and is also very similar to the strains IFO 6026 and 6352 in morphological characteristics. This species is recorded here for the first time in Korea.

Penicillium cyclopium Westling

Westling, Arkiv f. Botanik **11** : 55 & 92(1911); Thom, The Penicillia, p. 384(1930); Abe, J. Gen. Appl. Microbiol. **2** : 110(1956); Abe, The Penicillia-Atlas of Microorgansims, p. 219 (1957); Raper & Thom, A Manual of *Penicillium*, p. 493(1968).

Colonies on Czapek agar growing rapidly, sometimes furrowed, radiately wrinkled, central area more or less arising, with zonations at marginal area, fasciculate or floccose, heavily sporulating, conidial areas light green to deeper; reverse colorless when young, becoming to orange-brown in age.

Colonies on malt extract agar growing moderately, plane to more or less granular or floccose, heavily sporulating, with zonations, at the margin more or less radiately wrinkled, green shade at conidial areas; reverse ochraceous or umber.

Colonies on potato sucrose agar growing well, floccose or fasciculate, heavily sporulating, more or less wrinkled, conidial areas greenish gray; reverse ochraceous color.

Penicilli comparatively large, bearing one or two branches, consisting of verticils of metulae and phialides. Conidiophores borne on substratum, usually rough walled, variable in length, 3.0μ wide. Branches commonly 20μ long, 3.0μ wide. Metulae in groups of 3 to 4, measuring 20×3.0μ. Phialides consisting of a verticil of 3~5, measuring 10×2.5μ. Conidia usually globose or subglobose, smooth, 2~3μ in diameter.

Habitat: Soils; Seongryu cave, Kusanri, Ulchin, Kyungbuk, June 5, 1978, K.H. Min, SUB A3 and March 9, 1980, K.H. Min, SUB 125.

Note: This species is first described from Korean soils. The present isolates fit with the description given by Raper & Thom(1968) and the strain IFO 5847.

Penicillium decumbens Thom

Thom, U.S. Dept. Agr., Bur. Anim. Ind., Bull. **118** : 71(1910); Biourge, Monogr., La Cellule 33(1) : 287(1923); Thom, The Penicillia, p. 197(1930); Abe, J. Gen. Appl. Microbiol. **2** : 69(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 109(1957); Raper & Thom, A Manual of Penicillia, p. 209(1968).

Colonies on Czapek agar growing slowly,

usually velvety, or sometimes floccose, developing white mycelium in central area, heavily sporulating, conidial area grayish green; reverse colorless.

Colonies on malt extract agar growing moderately, heavily sporulating, velvety or lanose, central portion white mycelial, conidial areas pale blue; reverse usually colorless.

Colonies on potato sucrose agar growing moderately, velvety or more or less lanose, conidial areas commonly pale blue; reverse colorless.

Penicilli strictly monoverticillate, small, typically borne on lateral branches from tailing aerial hyphae. Conidiophores variable but measuring 40~80×2.5μ, smooth walled. Phialides usually consisting of very compact clusters of 8~13 in number, 9×2.5μ. Conidia elliptical to subglobose, 2~2.5μ in diameter, smooth walled.

Habitat: Soil; Seongryu cave, Ulchin, Kyungbuk, March 9, 1980, K.H. Min, SUB 127.

Note: This isolate is very similar to the original description and the strain IFO 6093. This is the first described record in Korea.

Penicillium frequentans Westling

Westling, Arkiv f. Botanik **11** : 58 & 133 (1911); Biourge, Monograph, La Cellule **33**(1) : 292(1923); Thom, The Penicillia, p. 216(1930); Abe, J. Gen. Appl. Microbiol. **2** : 55(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 69(1957); Raper & Thom, A Manual of Penicillia, p. 172(1968).

Colonies on Czapek agar growing rapidly, conspicuously zonating, central area usually more or less raised, radiately wrinkled, with thin marginal area with storm gray colored, closely woven felt of hyphae from the surface, conidial areas grayish green in age, velvety and heavily sporulating; reverse commonly in yellow orange shade to dull purplish brown.

Colonies on malt extract agar spreading moderately, surface plane and velvety, central area more or less raised, forming zonation at marginal area, heavily sporulating; reverse dull brown.

Colonies on potato sucrose agar growing moderately, velvety or plane, central area sometimes raised, usually slightly zonating at marginal portion, grayish green; reverse dull purplish brown in age.

Penicilli usually monoverticillate, sometimes branched. Conidiophores arising mostly from the substratum, commonly short, up to 170μ long 3.0μ wide, with finely roughened wall. Phialides with 6~7 groups in the verticil, mostly 9~10μ long, 3.0μ wide. Conidia globose to subglobose, thin-walled, mostly smooth to more or less echinulate, 3.0μ in diameter.

Habitat: Soil: Shinlimdong, Kwanaku, Seoul, March 16, 1979, T.Y. Ahn, SUB 89.

Note: This fungus is very close to the original description with the exception of echinulate conidia. However, Westling suggested that *P. glabrum* with somewhat echinulate conidia should also be regarded as a typical *P. frequentans*. This isolate is described as the first record in Korea.

Penicillium implicatum Biourge

Biourge, Monogr., La Cellule **33**(1) : 278(1923); Thom, The Penicillia, p. 210(1930); Abe, J. Gen. Appl. Microbiol. **2** : 67(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 101 (1957); Raper & Thom, A Manual of Penicillia, p. 201(1968).

Colonies on Czapek agar spreading very restrictedly, with thin and white narrow marginal area, surface velvety, heavily sporulating, raising in colony center, pale green or sometimes orange-brown, forming the crusts of conidia in age, with small droplets, yellow or red brown in color; reverse dark orange to

deep red brown.

Colonies on malt extract agar, growing moderately, radiately pale green shade from the center, often with zonations at the margin with thin area, surface velvety and heavily sporulating, blue green, somewhat whitish in center; reverse honey or dark red brown.

Colonies on potato sucrose agar, spreading moderately, radiately wrinkled, thin and narrow at the marginal area, somewthat raising in center, surface velvety sometimes lanose, blue green, heavily sporulating, with crusts of conidia in age, reverse dark red brown or honey,

Penicilli commonly strictly monoverticillate but with an occasional branch bearing a verticil of phialides. Conidiophores short, mostly 80μ long 3.0μ wide, smooth-walled. Phialides compact, in several groups in a verticil, 8.6×2.9μ. Conidia globose, 2.9μ in diameter, or elliptical, 3.5×2.9μ, thick walled, smooth or rough.

Habitat: Soils; Jaedong, Chongroku, Seoul, March 4, 1979, A.R. Kim, SUB 71 and 106.

Note: The above description was given based on our strains in good condition. These two strains are basically the same as the description of the species in many respects but differ in having larger phialides. This is the first described record of this fungus in Korea.

Penicillium janthinellum Biourge

Biourge, Monogr., La Cellule **33**(1) : 258(1923); Thom, The Penicillia, p. 238(1930); Abe, J. Gen. Appl. Microbiol. **2** : 76(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 125 (1957); Raper & Thom, A Manual of Penicilla, p. 299(1968).

Colonies on Czapek agar growing moderately, thin at margin, surface raised, radially furrowed, irregularly wrinkled in central area, floccose of fine hyphae, at first white, but commonly becoming colored to grayish green or pale gray; reverse uncolor or pale purple-brown.

Colonies on malt extract agar growing broadly, generally thin, consisting of looser texture, and lawn-like, floccose or coarsely lanose, at first white or cream to pale gray-green, vegetative mycelium pale orange; reverse pale purple.

Colonies on potato sucrose agar spreading moderately, usually consisting of loose texture, surface floccose or coarsely lanose, sometimes sparsely, pale grayish green in color; exudate not produced; reverse pale purplish orange.

Penicilli asymmetric and irregular, strongly divaricate, becoming tangled in age, not tending to form columnar. Conidiophores smooth or finely rough-walled, 3.0μ wide, in short branches arising from the aerial hyphae, with verticils consisting of 2 or 3 metulae and phialides. Branches very variable in size, but commonly 20×3μ. Metulae mostly 11×2.5μ. Phialides enlarged at the base, narrowed to a conidium-bearing apical tube, usually 10×2.0μ. Conidia more or less elliptical or subglobose, smooth but sometimes rough-walled.

Habitat: Soils; Seongryu cave, Ulchin, Kyungbuk, June 6, 1978, SUB A4, Kosuri, Daikangmyun, Danyang, Chungbuk, Jan. 15, 1979, K.H. Min, SUB 3 and 10 and Jikdongri, Pochunkun, Kyunggido, June 9, 1979, K.H. Min, SUB 84, 99, 103 and 110.

Note; These isolates agree with the original description except the smooth conidial wall. This is the first record of this species with description in Korea.

Penicillium notatum Westling

Westling, Arkiv f. Botanik **11** : 55 & 95(1911); Biourge, Monogr., La Cellule **33**(1) : 179 (1923); Thom, The Penicillia, p. 264(1930); Abe, J. Gen. Appl. Microbiol. **2** : 94(1956);

Abe, The Penicillia-Atlas of Microorganisms, p. 167(1957); Raper & Thom, A Manual of Penicillia, p. 367(1968).

Colonies on Czapek agar spreading broadly, surface typically velvety marginal area commonly white, to yellow, sometimes zonating, central area yellow, raised, with conspicuously radial furrows, heavily sporulating, conidial areas grayish green to blue-green, exudate abundantly produced; reverse becoming pale greenish brown, sometimes light grayish green in age.

Colonies on malt extract agar growing rapidly, comparatively thin, surface plane, not radially furrowed, velvety, commonly azonating, marginal area consisting of white mycelium, conidial areas pale-green; reverse appearing pale brownish yellow.

Colonies on potato sucrose agar spreading moderately, strictly velevty, heavily sporulating throughout, usually pale blue-green in conidial areas; reverse at first uncolor becoming pale greenish yellow.

Penicilli asymmetrica, biverticillate, sometimes bearing one or more fertile branches but appearing simple terminal verticils of metulae with clusters of phialides. Conidiophores arising from the basal felt, smooth-walled. Branches variable in size, mostly 10-18×3.0μ. Metulae commonly in groups of 3, variable in length, mostly 10×3.0μ. Phialides usually borne in verticils of 4-6, mostly 8×3.0μ. Conidia globose to subglobose, mostly 3.5×3.2μ, sometimes 2.5-3.0×4.0μ, smooth-walled.

Habitat: Soils; Seongryu cave, Ulchin, Kyungbuk, June 5, 1978, K.H. Min, SUB A5, Shinlimdong, Kwanaku, March 16, 1979, T. Y. Ahn, SUB 20, and Chunhodong, Kangnamku, Seoul, March 6, 1979, T.Y. Ahn, SUB 29, and 45.

Note: The present isolates fits with the original description in many respects. This species is new to Korea. Samson *et al.* (1977) placed their fungus in synonymy with *P. chrysogenum* Thom.

Penicillium oxalicum Currie & Thom

Currie & Thom, J. Biol. Chem. **22**: 289(1915); Thom, The Penicillia, p. 247(1930); Abe, J. Gen. Appl. Microbiol. **2**: 95(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 171 (1957); Raper & Thom, A Manual of Penicillia, p. 378(1968).

Colonies on Czapek agar growing broadly, strictly velvety, surface generally plane developing irregular furrows, heavily sporulating, conidial area dull to dark green when matured; no exudate producing; reverse colorless or brownish orange.

Colonies on malt extract agar spreading rapidly, surface commonly velvety, heavily sporulating by the conidia formation when matured, conidial area becoming dull green color; no exudation; reverse colorless or pale yellowish brown.

Colonies on patato sucrose agar growing broadly, typically velvety, developing reddish brown margin about 1~2mm wide, conidial area dull green shades in age; reverse colorless or yellowish orange.

Penicilli asymmetrical and biverticillate, consisting of 2 or more metulae bearing phialides, or irregularly branced, often closely appressed. Conidiophores typically arising from the substratum, variable in length, smooth-walled or finely rough-walled. Branches absent or sometimes single, 10×3.0μ. Metulae commonly in groups of 2 or 3, mostly 14×3.0μ. Phialides in terminal clusters of 6-8, 8-10×3.0μ. Conidia typically elliptical, smooth-walled, usually, 5.0×3.7μ.

Habitat: Soils; Seongryu cave, Ulchin, Kyungbuk, June 5, 1978, K.H. Min, SUB A6,

Shinlimdong, Kwanaku, Seoul, March 16, 1979, K.H. Min, SUB 66 and Jaedong, Chongroku Seoul, Sept. 5, 1979, K.H. Min, SUB 38.

Note: The present fungus is quite similar to the original description although conidial size is more smaller than that given in the original and of IFO 5748. This is the first record of this species in Korea.

Penicillium pseudo-casei Abe apud G. Smith

Abe, J. Gen. Appl. Microbiol. **2** : 102(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 187(1957); Smith, Trans. Brit. Mycol. Soc. **46** : 335(1963).

Colonies on Czapek agar growing rather rapidly, consisting of a comparatively tight basal felt, typically velvety, bearing a white margin, conidial area greenish; exudate limited, colorless; odor moldy; reverse colorless or pale yellow.

Colonies on malt extract agar growing well, closely textured, typically velvety, with plane and hard basal felt bearing crowded conidial structures; area darkgreen or blue green; exudate limited; reverse pale brown, appearing tinged with orange brown at margin.

Colonies on potato sucrose agar growing moderately, closely textured, surface velvety, conidial area green, then becoming to dark green; odor more or less moldy; reverse colorless with surrounding agar uncolored.

Penicilli asymmetrical, typically rebranched below the level of metulae, with main axes and branches terminating in verticils of 3 to 5 metulae. Conidiophores arising primarily from the substratum or from the basal felt, typically rough-walled, variable in length, usually up to 190μ long, 3.0μ wide. Branches variable in size, commonly 18-21×3.0μ. Metulae usually 10-12×3.0μ. Phialides in fairly or loosely compact verticils of 3 to 6, 8-10×3.0μ. Conidia typically elliptical or ovate with echinulate or verruculose walls, sometimes smooth-walled.

Habitat: Soils; Sampungri, Yunpungmyun, Geisankun, Chungbuk, March 4, 1979, K.H. Min, SUB 2 and 36.

Note: This fungus is new to Korea. These collections generally fit in morphological characteristics with the original description and strains IFO 6235 and 7747, excepting the color of the conidial area. Smith(1963) validated Abe's species(*nomen nudum*) by giving the Latin diagnosis. Pitt (1979) treated this fungus as a synonym of *P. crustosum* Thom.

Penicillium purpurogenum Stoll var. ***rubri-sclerotium*** Thom

Thom, Mycologia **7** : 142(1915); Thom, The Penicillia, p. 479(1930); Abe, J. Gen. Appl. Microbiol. **2** : 125(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 291(1957); Raper & Thom, A Manual of Penicillia, p. 636(1968).

Colonies on Czapek agar spreading rapidly, appearing velvety or lanose, sometimes more or less flocculent, somewhat restricted, with pale blue green shade in age, heavily sporulating; exudate usually limited; reverse becoming pale brown to dark brown.

Colonies on malt extract agar growing moderately, at first lanose to flocculent, becoming velvety in age, thin, producing abundant conidial structures throughout the colony development, conidial areas pale green; exudate usually limited; reverse grayish brown.

Colonies on potato sucrose agar spreading broadly, thin plane, heavily sporulating, at first lanose, velvety in age, forming abundant conidial structures all over the colony or in localized areas, conidial areas pale green; exudate not producing; reverse grayish brown to dark brown.

Penicilli typically biverticillate and asymmetrical, commonly consisting of compact clus-

ters of somewhat divergent phialides. Conidiophores erecting from the basal felt or from submerged hyphae of thin colony margin, smooth or rough-walled, variable in lengths, about 2.0μ in diameter. Metulae in groups of 4 to 5, measuring 7.5×2.0μ. Phialides comparatively long compared with metulae, 10×2.0μ. Conidia typically rough-walled, sometimes smooth-walled, elliptical tosubglobose, 2.5×2.0μ.

Habitat: Soil; Jaedong, Chongroku, Seoul, A.R. Kim, Sept. 5, 1979. SUB 46 and 92.

Note: These strains produced abundantly sclerotia with dark red color in above three media. This species is new record in Korea. According to Stolk(1972), this variety is a synomy of *P. funiculosum* Thom.

Penicillium purpurrescen(Sopp) Raper & Thom

Raper & Thom, A Manual of Penicillia, p. 177(1968); Sopp, Monogr., p. 117(1912); Thom, The Penicillia, p. 178(1930); Abe, J. Gen. Appl. Microbiol. **2**: 52(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 57(1957).

Syn. *Citromyces purpurrescens* Sopp(1912)

Colonies on Czapek agar spreading broadly, radiately wrinkled, deeply branched in center area, with close basal felt of coarse hyphae, velvety with slightly lanose surface, conidial area dark blue green; exudate fairly abundant, pale orange or pale yellowish brown; reverse reddish brown or brownish drab.

Colonies on malt extract agar growing rapidly, commonly velvety, dark olive green or olive green; reverse pale purplish brown or pale brown color,

Colonies on potato sucrose agar growing moderately, usually velvety but more or less lanose, conidial area greenish to grayish green; reverse becoming to pale brown color.

Penicilli strictly monoverticillate, comparatively large, with phialides in a compact cluster, forming loose to compact columns of conidial chains. Conidiophores arising mostly from the substratum, rarely branched, smooth-walled to definetely rough-walled, measuring 80~120×2.5~3.0μ, smooth or finely rough-walled. Phialides in groups of 6 to 9, crowded in a verticil, measuring 11~12×2.5μ. Conidia mostly globose to subglobose, 4.0~5.5μ, with heavy and conspicuously roughened walls, dark green.

Habitat: Soil; Shinlimdong, Kwanaku, Seoul, March 16, 1979, T.Y. Ahn, SUB 117.

Note: This fungus was isolated as a component of the soil microflora and is new to Korea. Our isolate agrees well with the description given by Raper & Thom(1968) and the strains IFO 5685 and 6033. According to Abe (personal communication), both *P. montanense* Christensen & Buckus and *P. striatisporum* Stolk are considered to be synomymous with this species.

Penicillium stoloniferum Thom

Thom, U.S. Dept. Agr., Bur. Anim. Ind., Bull. **118**: 68(1910); Thom, The Penicillia, p. 292(1930); Abe, J. Gen. Appl. Microbiol. **2**: 103(1956); Abe, The Penicillia-Atlas of Microorganisms, p. 195(1957); Raper & Thom, A Manual of Penicillia, p. 412(1968).

Colonies on Czapek agar growing very restrictedly, becoming strongly wrinkled, central area usually raised conspicuously, typically consisting of close-textured mycelial felt, velvety to lanose, sometimes more or less floccose, with narrow zonation when matured, forming abundant conidial structures, yellow-green when young, but becoming to gray in age; reverse dull yellow to greenish gray.

Colonies on malt extract agar spreading rapidly, plane, velvety or lanose, consisting

of closed-textured mycelial felt, zonated at marginal area, radiately wrinkled in central area, conidial area pale blue; exudate limited; reverse colorless.

Colonies on potato sucrose agar growing moderately, at first lanose, but becoming velvety, producing conidial structures abundantly, heavily sporulating, conidial area pale gray to pale blue gray; exudate limited; reverse at first colorless, but becoming pale greenish yellow.

Penicilli symmetric divaricate, typically branched, short and compact with appressed branches, metulae and phialides numerous and closely crowded. Conidiophores variable in length, usually ranging up to 200μ long, 4μ wide, arising from the substratum or from aerial hyphae, smooth or somewhat rough-walled. Branches usually 10×3.5μ. Metulae parallel or slightly divergent, commonly 2-3. 10×3.0μ. Phialides in compact clusters of 4-5, comparatively short, generally 10×2.5μ. Conidia elliptical or subglobose, sometimes globose, finely rough-walled, usually 3.0×2.5μ.

Habitat: Soils; Shinlimdong, Kwanaku, March 16, 1979, T.Y. Ahn, SUB 18, 24, 84, 86, 94, 104 and Chunhodong, Kangnamku, Seoul, March 6, 1979, T.Y. Ahn, SUB 28 and 116.

Note: The above description was given based on our strains which possessing typical morphological characteristics. These isolates were the first record of this species in Korea and it seems that the fungus is widely distributed in Korean soils.

Eupenicillium javanicum (Beyma) Stolk & Scott

van Beyma, Verhand. Kon. Akad. Wetensch. Amsterdam. Afd. Nat. (Tweed Sectie) **26** : 16 (1929); Loakwood *et al.*, Zentbl. f. Bakt. etc. (II) **90** : 412(1934); Shear, Mycologia **26** : 107 (1934); Emmons, Mycologia **27** : 145(1935); Stolk & Scott, Persoonia **4** : 398(1967); Raper & Thom, A Manual of Penicillia, p. 135(1968); Pitt, The genus *Penicillium* p. 114 (1979).

Syn. *Carpenteles javanicum*(van Beyma) Shear(1934).

St. anam. *Penicillium indonesiae* Pitt(1979).

Syn. *Penicillium javanicum* Saito & Minoura (1948).

Colonies on Czapek agar spreading moderately, brownish, central area more or less raised, radially furrowed, marginal portion comparatively thin, white mycelial; exudate abundant, pale brown; reverse gray brown or deep brown in age.

Colonies on malt extract agar growing broadly, loosely colonies dispersed, not furrowed, surface plane, blue green, producing uniform layer of cleistothecia over the colony giving pale yellowish appearance; reverse brownish orange or yellowish brown.

Colonies on potato sucrose agar spreading slowly, composed of small granules of brownish cleistothecia, consisting of remarkably submerged white mycelium, pale green shade in age at conidial area; reverse pale purple brown.

Penicilli strictly monoverticillate or fragmentary, few in number. Conidiophores arising from aerial hyphae, commonly 200×2.0μ, but up to 400μ in length, with smooth or finely rough-walled. Phialides in groups of 3-6, measuring 12×2.0μ. Conidia subglobose or elliptical, 2.6×2.5μ, smooth or finely rough-walled.

Cleistothecia abundantly produced, spherical to oblong, mostly 120-150μ in diameter, pale yellowish brown, usually without surrounding hyphae, consisting of parenchyma-like tissue at first, then matured to the asci developing from the center of colony within two weeks. Asci 8-spored, globose to oblong in maturation, 5-8. 7μ in diameter. Ascospores heavy walled,

faintly rough-walled, lenticular, with a equatorial furrow, 3.0μ in diameter.

Habitat: Soils; Kusanri, Ulchin, Kyungbuk, Feb. 1, 1979, K.H. Min, SUB 74 and Chungpadong, Yongsanku, Seoul, Oct. 7, 1979, K. H. Min, SUB 105.

Note: our fungus fits fundamentally with the original description, but differs in having rough-walled conidiophores. This is the first record of this fungus in Korean soils.

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摘 要

韓國土壤으로부터 1978년부터 1979년에 걸쳐서 123菌株를 分離하였다. 分離된 菌株中 *Penicillium*屬 16種이 同定되었고, 이 중에서 한 菌株만이 *Eupenicillium javanicum*인 子囊菌이었다. 이 菌의 특징은 엷은 노란색의 폐자기를 가지며 그 크기는 120μ에서 150μ 정도이며 그 內部에는 子囊을 만든다. 子囊胞子는 球形이고, 반달모양이며 적도판에 골을 形成하고 있으며 그벽은 거친 모양이다. 그 직경은 2~5μ 정도이었다. 여기서 報告되는 *Penicillium*屬의 모든 種은 韓國에서는 未記錄種들이다.

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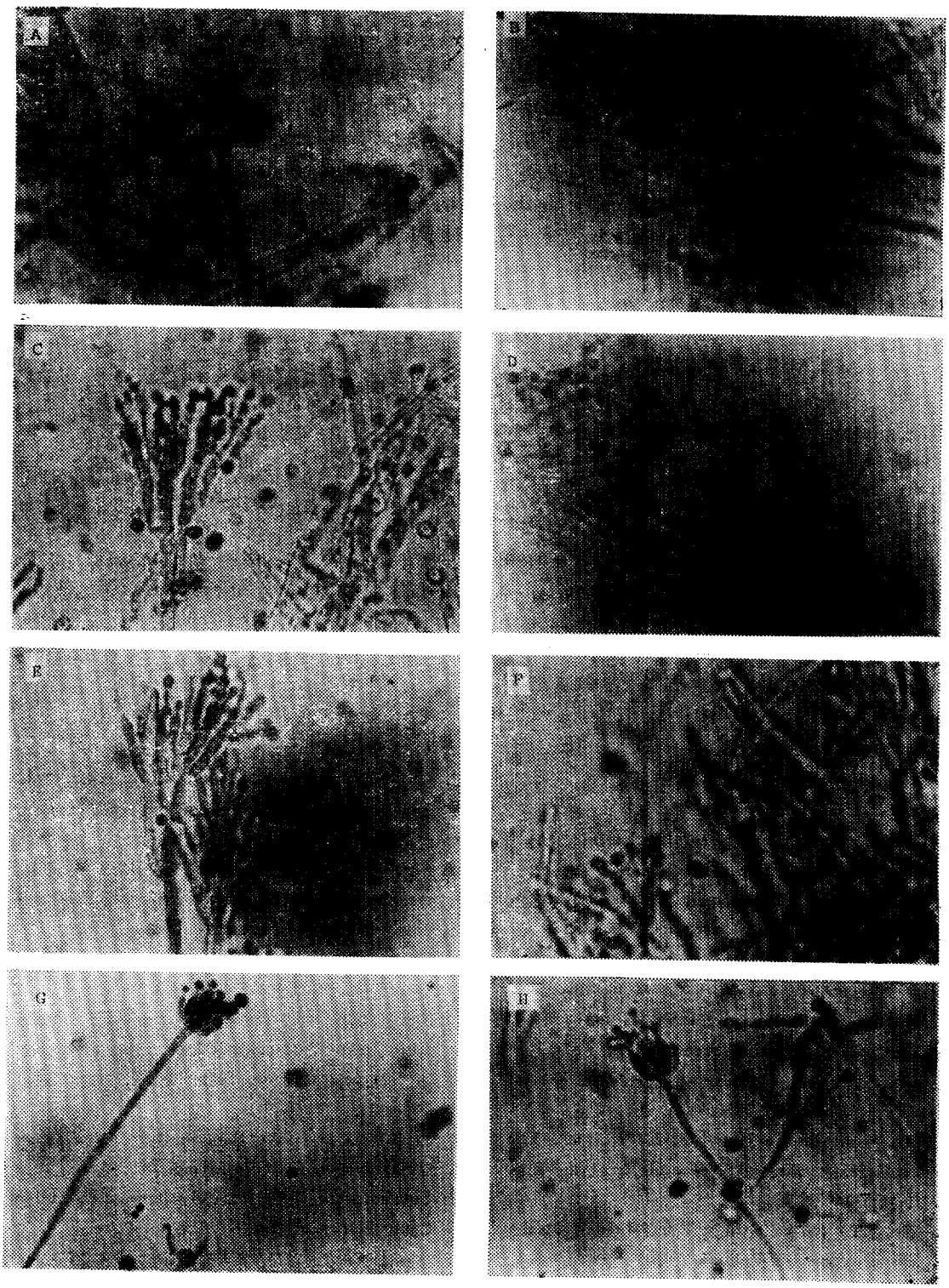

Plate I. A: *Penicillium brevi-compactum*, B: *P. charlesii* var. *rapidum*, C: *P. chrysogenum*, D: *P. citrinum*, E: *P. cyclopium*, F: *P. decumbens*, G: *P. frequentans*, H: *P. implicatum* (ca×400).

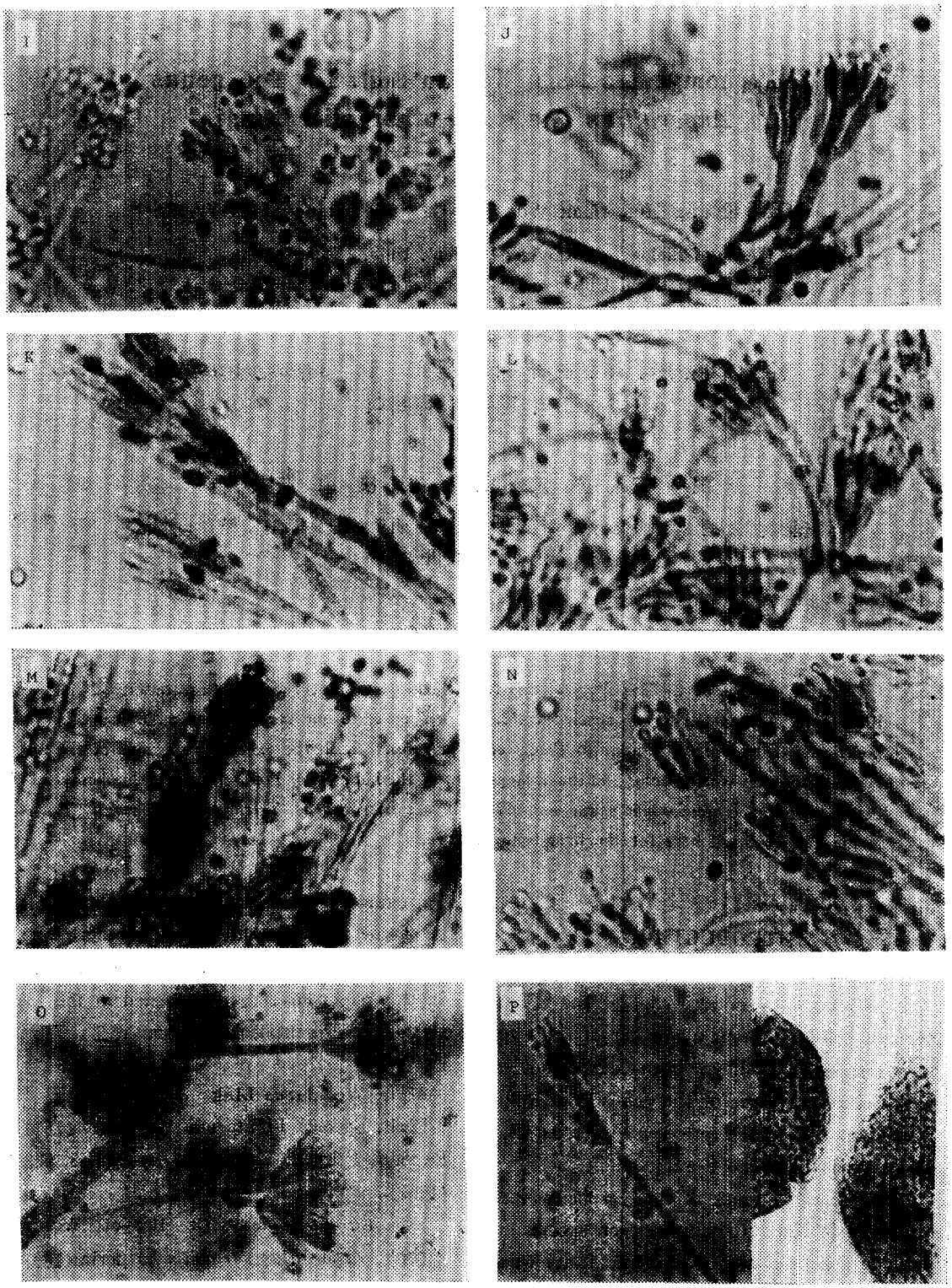

Plate Ⅱ. I. *Penicillium: janthinellum*, J: *P. notatum*, K: *P. oxaticum*, L: *P. pseuao-casei*, M: *P. purpurogenum* var. *rubri-sclerotium*, N: *P. purpurrescens*, O: *P. stoloniferum*, P: *Eupenicillium javanicum*, condial state (ca×400) and ascocarp (X100).