

## Fungus flora of paddy fields in Korea.

### — III. Ascomycetes —

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## 韓國 논 土壤中の 菌類에 관한 研究

### — III. 子囊菌類 —

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### ABSTRACT

Soil microfungi of the paddy fields in Korea were isolated by the dilution plate method from soil samples of two selected sites. It was concluded that 14 species among 30 species identified were undescribed fungi in Korea. Among them, 7 species of Ascomycetous fungi were described in this paper as new to Korea. Species of the genus *Talaromyces* were found to be dominant in paddy field soils and they consisted of *Talaromyces flavus* var. *flavus*, *T. panasenkoi*, *T. stipitatus* and *T. trachyspermus*. Special attention was paid on the predominant occurrence of *Westerdykella multispora* which produced globose to subglobose pseudothecia containing 32 spored asci with multiseptate, cylindrical ascospores. A cellulose decomposing ascomycete, *Chaetomium globosum*, was also found which produce black, ostiolate perithecia furnished with numerous, wavy to undulate terminal hairs. They contain evanescent, clubshaped, 8 spored asci with lemon-shaped, olive brown ascospores. Another ascomycete, *Emericellopsis terricola* with *Acremonium anamorph*, was isolated from two sites.

### INTRODUCTION

The authors(1981a, 1981b) investigated a comparative study of the soil microfungi isolated on dilution plate from the rice paddy fields of two selected sites in Seoul, Korea. It was also evaluated that the vertical distribution and seasonal variation of fungal flora from

soil samples.

In a previous paper, soil microfungi of paddy fields in Korea was examined to represent that, among 85 isolates, 30 species in 13 genera were identified. Among 30 species, it was found that 14 species was new to Korea. Therefore, six species of Deuteromycetous fungi and a zygomycete *Zygorhynchus moelleri* were reported new to Korea.

## MATERIALS AND METHODS

In a previous paper, it was reported by the authors that detailed sampling method and the dilution plate method. Soil sampling was carried out by pushing a sterile stainless sampler vertically into the soil. Three parts of soil samples at three different depths were collected from the slit of soil sampler aseptically in clean laboratory. Each soil sample was subjected to the dilution plate method and the isolation of fungi was performed on malt extract-yeast extract agar plate.

The morphological characteristics of fungus on Czapek agar, malt extract agar and potato sucrose agar media were observed and described to identify the each fungus.

## RESULTS

From our serial examination on the microfungus flora of rice paddy fields from the soil samples of Yukkog-dong and Shinwon-dong around Seoul. In a previous paper, it was found that 14 species of soil fungi among 85 isolates could be identified as new to Korea. Among them, Ascomycetous fungi, seven species in four genera, *Chaetomium globosum*, *Emericellopsis terricola*, *Talaromyces flavus* var. *flavus*, *T. stipitatus*, *T. trachyspermus*, *T. pan-assenkoi* and *Westerdykella multisporea*, were reported in this paper for the first time in Korea.

### *Chaetomium globosum* Kunze

Fries, Syst. Mycol. 3 : 255(1829); Seth, Nova Hedwigia 37 : 73(1970); Udagawa, J. Gen. Appl. Microbil. Tokyo, 6 : 223 (1960) & Kinruizukan, p. 482 (1978).

Syn. *Chaetomium chartarum* Ehrenb. (1818); *C. fieberi* Corda (1837); *C. elasticae* Korrd.

(1907); *C. setosum* Bain. (1910); *Chaetomium japonicum* Saito et Okazaki (1939).

Colonies on Czapek agar growing well, surface lanose or lawn like mucor, mycelial structures thick, whitish gray or whitish beige; reverse grayish brown or dark brown.

Colonies on malt extract agar growing rapidly, with abundant granules of ascospores or whitish mycelial structures on surface, grayish green colored granules, central areas pale violet; exudate uncolored; reverse dark gray or black.

Colonies on potato sucrose agar growing rapidly, with abundant granules of dark green or dark gray ascospores, some areas of surface white mycelial felt, exudate abundant, colorless; reverse gray or dark gray.

Perithecia usually black, scattered, opaque, globose to subglobose, covered with loose hairs, ostiolate. Terminal hairs light olive-brown, long, undulate to loosely coiled. Lateral hairs olive-brown, straight to slightly undulate. Asci club-shaped, 8-spored. Ascospores pale brown to dark brown, lemon-shaped or broadly ovoidal,  $8\sim 10.5 \times 7\sim 8.5 \mu\text{m}$ , apiculate at both ends.

Habitat: Paddy field soils. Yukkog-dong in Buchun, Oct. 25, 1980, Au-Y2-100-3-4; Shinwondong in Seoul, April 25, 1980, Sp-S2-100-3-1, Jan. 25, 1981, W-S1-100-4-1, K.H. Min.

Note: This fungus was usually isolated from animal dungs. However, it was also isolated from the soil samples of the two paddy fields in Korea.

### *Emericellopsis terricola* van Beyma

van Beyma, Antonie van Leeuw. 6 : 263 (1940); Gams, Cephalosp. Schimmelpilze p. 30 (1971); Udagawa, Trans. Mycol. Soc. Japan, 4 : 94 (1963); Udagawa, Kinruizukan, p. 424

(1977).

St. anam.: *Acremonium* sp.

Colonies on Czapek agar growing restrictly, lanose surface, with gray or grayish black granules on whitish pink or pale beige mycelial structures, thin mycelial felt, central areas wrinkled irregularly; no exudate; reverse pale pink or dark gray.

Colonies on malt extract agar growing restrictly, 4cm diameter in 2 weeks, submerged mycelial structure, central areas conspicuously or irregularly wrinkled, mycelia colored with pink at the central areas, with whitish mycelial structures at marginal areas, somewhat submerged; no exudate; reverse pale beige to dull brown.

Colonies on potato sucrose agar growing well, velvety or lanose, with abundant dark gray granules after the maturation of ascomata, whitish mycelial structures, somewhat submerged ascomata or mycelial felt, at the central areas wrinkled conspicuously, but poor or thin mycelial structures; no exudate, reverse dark gray or dull brown.

Cleistothecia scattered, in small groups, black, globose to subglobose, 50~170 $\mu$ m in diameter, smooth-walled. Asci 8-spored, globose to subglobose. Ascospores light olive or olive colored, ellipsoidal, usually 8 $\times$ 5.5~6.0 $\mu$ m.

Conidiophores lacking. Phialides erect, long, but various length in some strains. Conidia phialidic, hyaline, ellipsoidal or pyriform, 5-10 $\times$ 2~4.5 $\mu$ m, smooth walled.

Habitat: Paddy field soil. Yukkog-dong in Buchun, July 25, 1980, Su-Y2-100-2-1, K.H. Min; Shinwon-dong, Jan. 25, 1981, W-S2-100-4-A, K.S. Chun.

Note: This fungus was usually isolated from soil, but it was isolated from soil of paddy field. This fungus is recorded here for the first time in Korea.

*Talaromyces flavus* (Klocker) Stolk & Samson, var. *flavus*

Klocker, Hedwigia 41 : 80 (1902); Benjamin, Mycologia 47 : 684 (1955); Chattopadhyay & Das Gupta, Trans. Br. Mycol. Soc. 42 : 72 (1959); Stolk & Samson, Studies in Mycology 2 : 10 (1972); Udagawa, J. Agr. Sci. Tokyo Nogyo Daigaku 5 : 14 (1959) & Kinruizukan, p. 406 (1978); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 472 (1979); Ito et al., IFO Res. Comm. 10 : 20 (1981).

St. anam.: *Penicillium dangeardii* Pitt (1979).  
Syn. *Penicillium vermiculatum* Dangarde (1907); *P. liani* Kamyschko (1962).

Colonies on Czapek agar growing moderately, with abundant granules of pale yellow and pale pink ascomata, whitish poor mycelial structures; exudate more or less pale pink; reverse pale beige to pale brown or pale pink.

Colonies on malt extract agar growing rapidly, with abundant pale yellow ascomata and somewhat whitish poor mycelial structures; no exudate; reverse pale brown to pinkish brown, sometimes dark red.

Colonies on potato sucrose agar growing well, with abundant granules of pale pink ascomata, lanose with abundant whitish mycelial structures; no exudate; reverse pale brown or honey to dark red colored.

Cleistothecia pale yellow, pinkish or purple red in some strains, sometimes whitish, about 150~600 $\mu$ m in diameter, almost globose or subglobose, usually confluent but discrete at the margin, with well developed networks of yellow pigmented hyphae. Initials club-shaped, about 200 $\times$ 3~4 $\mu$ m in size, around which antheridia coiled several times. Asci mostly 8-spored, ellipsoidal or subglobose, 8~9 $\times$ 8~9 $\mu$ m. Ascospores yellow or yellowish pink, usually

ellipsoidal, in some strains red pigment, usually 3.5 to 4.0 $\mu$ m or slightly smaller.

Conidiophores arising directly from the substratum. Metulae 2~6 in verticil, sometimes lacking. Phialides 2 to 6 in whorls, 9 $\times$ 2 $\mu$ m, smooth-walled. Conidia brownish green, subglobose to ellipsoidal, 2~3 $\times$ 2.5 $\mu$ m. thick and smooth-walled.

Habitat: Paddy field soils. Yukkog-dong in Buchun, Kyunggi-do, October 25, 1980, Au-Y3-10-4 & Au-Y3-100-1-4-1. January 25, 1981. W-Y3-10-1-A, K.H. Min.

Notes: Our fungus fits fundamentally with the original description with the exception of changing color of ascemata with age. This species is recorded here for the first time in Korea.

*Talaromyces stipitatus* (Thom) C.R.Benjamin

Benjamin, Mycol. 47 : 684(1955); Stolk & Samson, Studies in Mycology 2 : 29 (1972); Udagawa, Kinurizukan, p. 409 (1979); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 479(1979).

St. anam.: *Penicillium emmonsii* Pitt(1979).

Syn. *Penicillium stipitatum* Thom apud Emmons (1935).

Colonies on Czapek agar growing well, with abundant yellow ascemata on mycelial structures, becoming pale yellow or gray yellow in age, weak mycelial felt on surface; no exudate; reverse uncolored or grayish yellow.

Colonies on malt agar growing broadly, loosely dispersed, not furrowed, plane surface, with uniform layer of cleistothecia over the colony giving pale yellow, lanose like mycelium; reverse uncolor or grayish yellow.

Colonies on potato sucrose agar growing rapidly, velvety or lanose surface, greenish yellow or pale yellow, with abundant ascem-

ata and poor mycelial structures: reverse at first yellow becoming to honey colored in age.

Cleistothecia usually yellow or pale yellow, greenish yellow in some strain, globose or subglobose, surrounded by loosely radiating hyphae. Asci 8-spored, ellipsoidal or subglobose, 4~6.5 $\times$ 4~7.5 $\mu$ m. Ascospores yellow, flattened ellipsoidal, with a single equatorial ridge, usually 2.2 $\times$ 4.0 $\mu$ m, smooth-walled.

Conidiophores arising from aerial hyphae. Metulae usually in small verticils of about 2 to 3. Phialides about 2 to 6 in verticil, 15 $\times$ 2~3 $\mu$ m. Conidia ovoidal to ellipsoidal or pyriform, 3~7 $\times$ 3 $\mu$ m. pale green, smooth-walled.

Habitat: Paddy field soils; Yukkog-dong in Buchun, Oct. 25, 1980, Au-Y3-10-1, K.S. Chun, Shinwon-dong, April 25, 1980, Sp-S2-10-3, July 25, 1980, Su-S1-10-5-1, K.H. Min.

Note: This fungus is very close to the original description morphologically, but in some strains the colonies of this fungus showed various colorization with age. This isolate is described as the first record in Korea.

*Talaromyces trachyspermus* (Shear) Stolk & Samson

Shear, Science, N.Y. 11, 16 : 138 (1902); Benjamin, Mycol. 47 : 683 (1955); Stolk & Samson, Studies in Mycology 2 : 32 (1972); Udagawa, J. Agr. Sci. Tokyo Nogyo Daigaku 5 : 15 (1959) & Kinruizkan, p. 413(1979); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 497 (1979); Ito et al., IFO Res. Comm. 10 : 20 (1981).

Syn. *Arachnotus trachyspermus* Shear, *Talaromyces spiculispurus* (Lehman) C.R. Benjamin

St. anam: *Penicillium lehmanii* Pitt (1979).

Syn. *Penicillium spiculispurum* Lehman(1920)

Colonies on Czapek agar growing well, very

thin, with abundant ascomata with the pale brown or beige colored and very poor mycelial structures; no exudate; reverse pale beige colored.

Colonies on malt extract agar growing rapidly, lanose, poorly forming mycelial structure, pale beige or pale yellow ascomata formed after maturation, weak granules of ascomata structures; exudates abundant, pale beige or colorless; reverse pale brown or beige colored.

Colonies on potato sucrose agar growing rapidly, lanose or of submerged mycelial structures, but pale beige or pale yellow ascomata formed after maturation; no exudate; reverse whitish beige or brownish beige colored.

Cleistothecia creamish to yellowish in age, globose, mostly confluent, consisting of a network of interwoven hyphae, usually encrusted with granules,  $1.5\sim 3.0\mu\text{m}$  in diameter. Asci globose to ovoidal,  $7.0\times 6.5\mu\text{m}$ . Ascospore ellipsoidal,  $3.0\times 2.5\mu\text{m}$ . with spines about  $0.5\mu\text{m}$ .

Conidiophores borne from aerial hyphae. Metulae with small verticils of 2 to 3, sometimes lacking. Phialides about 3 to 5 in a verticil. Conidia ellipsoidal or ovoidal,  $3\sim 3.5\times 2\sim 2.7\mu\text{m}$ , smooth-walled.

Habitat: Paddy field soil. Shinwon-dong in Seoul, July 25, 1981, Su-S1-10-1-3, K.H.Min.

Note: *T. trachyspermus* can easily be distinguished from other *Talaromyces* species by the disposition of the asci and the spinulose ascospores. This is the first described record in Korea.

#### *Talaromyces panasenkoi* Pitt

Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 482 (1979); Panasenko, *Mycologia* 56 : 59 (1964); Stolk & Samson. *Studies in Mycology* 2 : 34 (1972); Udagawa, *Kinruizukan*, p. 414 (1978) & *Trans. Mycol. Soc. Japan* 7 : 94 (1966).

Syn. *Talaromyces ucrainicus* (Panasenko) Udagawa (1966)

St. anam.: *Penicillium panasenkoi* Pitt (1979).

Syn. *Penicillium ucrainicum* Panasenko (1964).

Colonies on Czapek agar growing very restrictly, a few small colonies white, lanose surface, only with mycelial structures; exudate abundant, uncolored; reverse pale grayish brown or dull brown.

Colonies on malt extract agar growing well, lanose, of white mycelial structure, with thin weak mycelia sometimes submerged at the marginal areas and abundant yellow ascomata; exudate abundant, uncolored; reverse pale brown or pale grayish brown.

Colonies on potato sucrose agar growing moderately, at the marginal areas with abundant or white thin mycelial felt, but at central areas abundant yellow ascomata produced; exudate abundant, uncolored or pale yellow; reverse dull brown.

Cleistothecia at first white, becoming to yellow after maturations, of confluent structures, consisting of network of loosely interwoven yellow hyphae, encrusted with yellow granules. Asci 6 to 8-spored, globose to subglobose,  $6\sim 7\times 6.5\mu\text{m}$ . Ascospores ellipsoidal, somewhat jagged, irregular, with longitudinal ridges,  $2\sim 3.5\times 2.5\mu\text{m}$  in size.

Conidiophores arising from aerial hyphae. Metulae in small verticils of 2 to 3. Phialides about 2 to 4 in verticils. Conidia ellipsoidal or ovoidal,  $2.5\sim 2.0\mu\text{m}$ , smooth-walled.

Habitat: Paddy field soil. Yukkog-dong in Buchun, July 25, 1980, Su-Y2-10-3-1, K.H.Min.

Note: Although ascospore ornamentation of this fungus is quite different from those of *T. trachyspermus* and *T. intermedius*, they have been regarded as being closely related. This species is first described from Korean soil and

fit with the original description.

*Westerdykella multispora* (Saito et Minoura)  
Ceij et Milko.

Ceij & Milko, *Ceska Mykol.* 18 : 84 (1964);  
Udagawa, *Trans. Mycol. Soc. Japan* 4 : 97  
(1963); Cain, *Can. J. Botany* 39 : 1646 (1961);  
Thompson & Backus, *Mycol.* 58 : 654 (1966);  
von Arx & Storm, *Personnia* 4 : 413 (1967);  
Udagawa, *Kinruizukan* p. 680 (1977).

Syn. *Anixiopsis multispora* Saito et Minoura;  
*Pseudourotium multispora* (Saito & Minoura) St-  
olk; *Preussia multispora* (Saito et Minoura)  
Cain; *Pycnidiophora multispora* (Saito et Mino-  
ura) Thompson et Backus (1966).

Colonies on Czapek agar growing moderat-  
ely, with black granules of ascospores over the  
surface and deeply submerged in substrate,  
hyaline mycelial structures submerged; reverse  
pale violet or pale purple.

Colonies on malt extract agar growing well,  
typically lanose surface, composed of abun-  
dant mycelial structures, orange or pale orange  
colored only on surface, with submerged black  
granules of ascospores; reverse gray or grayish  
black.

Colonies on potato sucrose agar growing ra-  
pidly, lanose, mixed of pale orange mycelial  
structures and black granules of ascospores,  
raised remarkably in central areas; reverse at  
first pale brown but becoming grayish black.

Pseudothecia scattered, superficial or subm-  
erged, globose or subglobose, black colored.  
Asci 32-spored, ovoidal or broad fusiform, 13

~17×10~11μm. Ascospore pale olive, cylind-  
rical, 4~5×2~3μm, smooth-walled.

Habitat: Paddy field soil; Shinwon-dong, Ap-  
ril 25, 1980, July 25, 1980, and Jan. 25, 1981,  
Sp-S3-10-5, Su-S1-100-3-1 & W-S3-100-1-a,  
respectively K.H. Min; Yukkog-dong, April 25,  
1980, Sp-Y1-100-5-2, K.H. Min.

Note: This fungus was isolated from paddy  
field soils and is described as the first record  
in Korea in this paper.

## DISCUSSION

As reported in previous paper (1981a, 1981  
b), it was found that the dominant fungi in  
paddy fields in Korea were composed of the  
genus *Aspergillus*, *Penicillium* and their teleo-  
morphic state *Eupenicillium* and *Talaromyces*.

Ito et al.<sup>7)</sup> also reported *Talaromyces flavus*  
var. *flavus* and *T. trachyspermus* as dominant  
ascomycetes from the paddy field soils in Ja-  
pan in addition to 3 Deuteromycetes; *Paecilomyces variotii*, *Penicillium funiculosum* and *P. piceum*. These 5 species were common to those in the Korean paddy field soils. It is known that all of the fungi reported in this paper are also distributed in the soils of the Japanese paddy fields (personal communication by Yokoyama).

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## 摘 要

한국의 두장소의 논토양에서 회석평판법에 의하여 토양균을 분리하였다. 동정된 30종중 14종은 한국에서 미기록종이며 이중 7종은 자낭균류에 속하는 것으로 본 논문에 서술하였다.

*Talaromyces*의 種중에서는 *Talaromyces flavus* var. *flavus*, *T. panasenkoi*, *T. stipitatus* 그리고 *T. trachys-*

*permus*가 가장 우세하게 분포되어 있다. 또 특이한 것은 *Westerdykella multispora*가 현저하게 주목된다. *Westerdykella multispora*는 많은 격막이 있는 원통형 자낭포자가 32개 포함된 자낭을 가지고 있는 球形 또는 亞球形의 pseudothecia를 형성한다. *Chaetomium globosum*은 cellulose를 분해하는 ascomycetes의 종류로 많은 파상 頂毛와 ostiole을 가지고 있는 검은 자낭각을 형성한다. 이 자낭각은 배몬형태의 올리브색을 띤 갈색자낭포자 8개를 포함하고 있는 곤봉모양을 하고 있으며 소실성의 자낭을 형성한다. 또 다른 Ascomycete로써 *Acremonium anamorph*를 가지고 있는 *Emericellopsis terricola*도 2곳의 채취장소에서 분리할 수 있었다.

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**Plate 1.2** A: *Chaetomium globosum*, perthecium ( $\times 150$ ), B: *C. globosum*, ascospores, C: *Emericellopsis terricola*, cleistothecium and ascospores, D: *Talaromyces flavus* var. *flavus*, cleistothecium and ascospores, E: *T. stipitatus*, cleistothecium and ascospores, F: *T. panasenkoi*, cleistothecium and ascospores, G: *T. trachyspermus*, cleistothecium and ascospore, H: *Westerdykella multispora*, cleistothecium and ascospores ( $\times 600$ ).

Plate 1

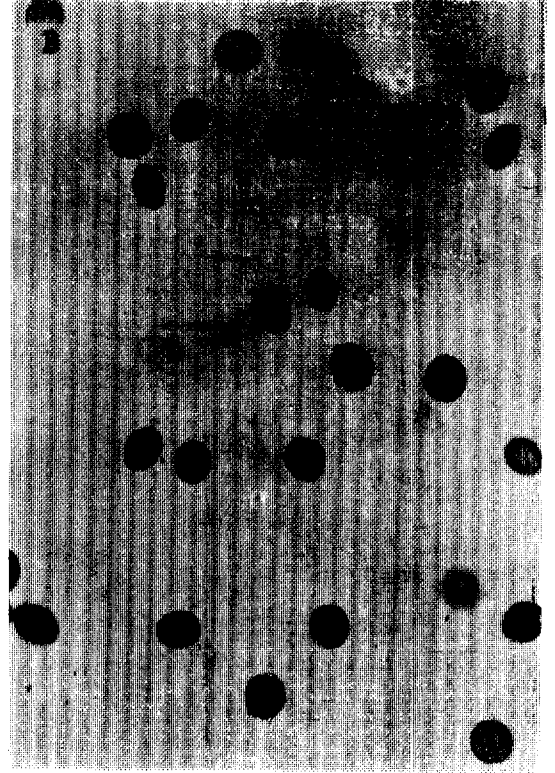




Plate 2

