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Fungus flora of paddy fields in Korea.

Ⅱ. Fungal flora of paddy fields.

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韓國 논 土壤中의 菌類에 關한 硏究

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ABSTRACT

The soil microfungal flora of the paddy fields in Korea was investigated at four different seasons. The fungi were isolated by the dilution plate method from soil samples of two selected sites around Seoul. A total of 85 isolates was obtained as pure cultures and 30 species in 13 genera were identified and 11 isolates were unidentified. Among these, 6 species of Deuteromycetous fungi, *Penicillium* spp., were found to be dominant in paddy field soils. *Penicillium funiculosum*, *P. piceum*, *P. roqueforti* and *P. verruculosum* were described as new to Korea. *P. piceum* has remarkable characteristics of the typical columnar head simiar to a compact spruce-like evergreen tree. *P. requeforti* has penicilli variable in pattern with compactly branched metulae and appressed or divergent phialides. Stipes mostly thick, with walls granular. *Cladosporium cladosporioides* and *Paecilomyces variotii* were also described. In addition, *Zygorhynchus moelleri*, a remarkably dominant Zygomycete in Korean paddy soils, produces subglobose sporangia with oval columella and dark colored zygospores of about 35μm in diameter.

INTRODUCTION

The investigation of fungal flora isolated from paddy field soils was made by Dutta and Ghosh[3]. During investigation, they isolated a total number of 165 fungi representing 51 genera from 22 soil samples. The identified fungi, which were considered as dominant, were mainly *Aspergillus* spp., *Pniciellium* spp., *Talaromyces* spp., *Cephalosporium curtipes* and *Curvularia lunata.*

It was reported by Goos[6] that 64 species of the soil fungi from Honduras were isolated and identified; 6 Phycomycetes; 10 Ascomycetes; 1 Basidiomycetes; 47 Fungi Imperfect. In this work, it was found that *Talaromyces* spp., *Aspergillus* spp. and *Penicillium* spp. were also dominant species.

In a previous work[11], the authors have inv-

estigated the fungal population of rice paddy field in Seoul, Korea. The plots each in research stations were selected for the seasonal variation and distribution of fungal propagules, also for the population of *Talaromyces* spp.

In the present work, the fungal flora of paddy fields at the two sites around Seoul was investigated by the dilution plate method from soil samples during four seasons. Among 85 isolates, six species of Deuteromycetous fungi and one additional species of Zygomycetous fungus, *Zyggorhynchus moelleri*, were described for the first time in Korea.

MATERIALS AND METHODS

In a previous paper[11], two sampling sites, Yukkog-dong and Shinwon-dong, respectively around Seoul, Korea, were selected by the present authors for isolating the soil microfungi of paddy fields. Soil sampling was made by pushing a sterile stainless sampler vertically into the soil. Three parts of the soil samples at three different depths were obtained through a slit of the sampler aseptically in the laboratory clean room.

Soil samples were applied to the dilution plate method and the fungi were isolated on malt extract-yeast extract agar plates. For monosporic cultures, only one colony among the colonies of similar cultural appearance on a plate was taken on to a slant culture, in order to avoid in making duplicate isolates for one species. However, it was inevitable to free from overlapped isolates as cited in the habitat in the descriptions for the respective species.

RESULTS

The result of the investigation of the fungal flora of two paddy fields around Seoul was shown in Table 1.

As mentioned in Materials and Methods, usually monospore cultures along with monopropagule cultures were made after four or five days, incubation by picking up the colonies as many as possible, but avoiding to culture duplicate strains for each species as few as possible.

However, it can not be avoided the duplicate strains because monosporic colony was selected randomly from culture plates.

Fungi isolated and identified were, as shown in Table 1, 30 species in 13 genera and unidentified were 11 strains among 82 isolates.

Fungi Imperfecti was consited of 21 species in 7 genera. *Aspergillus* was 4 species; *A. flavus*, *A. fumigatus*, *A. niger*, *A. oryzae*. *Cladosporium cladosporioides*, *Fusarium oxysporium* and *Paecilomyces variotii* were also found in these paddy fields. Ten species of *Penicillium* genus were *P. brevicompactum*, *P. decumbens*, *P. frequantans*, *P. funiculosum*, *P. implicatum*, *P. oxalicum*, *P. piceum*, *P. roqueforti*, *P. verruculosum*, *Phoma* sp. and *Trichoderma aureoviride*, *T. harzianum*, and *T. koningii* were identified.

Ascomycetous fungi were identified as 8 species in 5 genera. *Chaetomium globosum*, *Emericellopsis terricola*, *Eupenicillium javanicum* and *Westerdykella multispora* were isolated. Four species of *Talaromyces* were *Talaromyces flavus* var. *flavus*, *T. stipitatus*, *T. trachyspermus*, *T. panasenkoi*.

It was also found that zygomycetous fungus identified was single species; *Zogorhynchus moelleri*.

Unidentified isolates were 11 strains in the present work.

Goos[6] and Christensen *et al.*[2] described *Aspergillus* spp. and *Penicillium* spp. based on the fungi isolated from soils of Honduras or forests in Wisconsin, respectively. Isolation of this fungus from Honduras soils supports the previously stated opinion(Goos, 1963) that they are widespread in tropical soils.

The occurrence of *Talaromyces* in soil has

Table 1. Fungi identified from soil samples of Seoul prefecture.

Fungus	Isolates
Aspergillus flavus	Sp-Y2-100-1-1.
A. fumigatus	W-Y1-10-4-1.
A. niger	Au-S1-10-5-4, Sp-Y1-100-5-3.
A. oryzae	Sp-S2-100-2-1.
Chaetomium globosum	Au-Y2-100-3-4, Sp-S2-100-3-1, W-S1-100-4-1.
Cladosporium cladosporioides	Au-Y1-10-5-2, Au-Y3-10-1-2-5, Au-Y3-10-5-6 Au-S1-10-3-3, Au-S1-100-1-5, Su-Y1-10-1-1.
Emericellopsis terricola	Su-Y2-100-2-1, W-S2-100-4-A.
Eupenicillium javanicum	Su-Y1-10-5-1, Su-S2-100-2-1.
Fusarium oxysporium	Au-S2-100-3-2, Sp-Y3-10-2-1.
Paecilomyces varioti	Su-S1-10-1-4.
Penicillium brevi-compactum	Au-Y1-10-1-4.
P. decumbens	Au-S2-10-1-6.
P. frequentans	Sp-S3-100-3-2.
P. funiculosum	Sp-Y2-10-5-2, Su-S3-10-3-1, Su-Y2-10-1-1, Su-S1-10-3-1, Su-S1-10-1-5.
P. implicatum	Su-Y2-10-5-4-1.
P. janthinellum	Au-S2-100-4-3.
P. oxalicum	Sp-Y2-10-5-1, Su-Y1-10-5-2, Su-Y2-100-1-1, Su-Y2-10-3-2, Su-S1-10-4-1, Su-S3-10-5-1, W-Y3-10-3-1, W-Y2-10-3-1, W-S3-100-4-1.
P. piceum	Sp-Y1-10-1, Sp-S1-100-1-1.
P. roqueforti	W-Y2-10-4-2.
P. verruculosum	Au-S2-10-2-7, Au-S3-100-2-1, Su-S2-10-1-1, Su-S2-10-2-1, Su-S1-100-3-3, Su-S2-10-1-1-2.
Phoma sp.	W-Y2-10-4-A.
Talaromyces flavus var. flavus	Au-Y3-10-4, W-Y3-10-1-A, Au-Y3-100-1-4-1.
T. stipitatus	Au-Y2-10-1-1-1, Sp-S2-10-3, Su-S1-10-5-1.
T. trachysperms	Su-S1-10-1-3.
T. ucrainicus	Su-Y1-10-3-1.
Trichoderma aureoviride	Sp-S1-10-4, Au-S1-10-1-3-2.
T. harzianum	Au-S3-100-2-4.
T. koningii	Sp-Y1-100-1, Sp-Y2-100-1, W-Y3-10-5-A.
Westerdykella multispora	Sp-S3-10-5, Sp-Y1-100-5-2, Su-S1-100-3-1, W-S3-100-1-a.
Zygorhynchus moelleri	Sp-S1-10-2, Au-Y2-10-1-3, Sp-S1-1 Sp-S1-100-1-2, W-S2-10-3-1.
Unidentified isolates	Sp-S3-10-4-2, Sp-Y1-10-5, Sp-S2-10-3, Sp-S1-10-2, Sp-Y3-10-5, Sp-S1-100-1-1, Sp-Y1-100-5-2, Su-Y2-10-5-2, Su-Y2-10-5-3, Su-Y2-10-1-2, Au-Y2-10-1-1-1.

*Assignment of isolates was as follows; Sp, Su, Au, W, mean four seasons: Y1, Y2, Y3, and S1, S2, S3, mean the upper(0~10cm), the middle(10~20cm) and the lower(20~30cm) layer of each soil of Yukkog-dong and Shinwon-dong: the next order of 10 or 100 means the dilution method: the next of that was plate number followed by isolate number.

**Isolation method was described in detail in Material and Methods.

been fully reviewed in papers by Dutta and Ghosh[3] and in recent paper by Yokoyama *et al.*[18] Dutta and Ghosh[3] isolated *Talaromyces spoculisporus* only from the soil of paddy fields. However, in the present investigation, *Talaromyces flavus* var. *flavus*, *T. stipitatus*, *T. Trachyspermus*, and *T. panasenkoi* were identified for the first time from the Korean soils.

The presence of *Emericellopsis* in soil has been described in previous investigation by Goos[6]. Species of *Emericellopsis* are distributed throughout the world. However, we recorded here *Emericellopsis terricola* for the first time in Korea.

From our serial investigation on the microfungal flora of the paddy field soils at two sites in Korea, it was found that 30 species of the fungi in 13 genera could be isolated[11]. In this paper, seven species of the soil fungi from two selected paddy fields are described as new to Korea.

Cladosporium cladosporiodes (Fresenius) de Vries

de Vries, Contribution to the knowledge of the genus *Cladosporium* Link ex Fr., p. 57 (1952); Yamamoto, Sci. Rept. Hyogo Univ. Agr. **4** : 5(1959); Minoura, Kinruizukan p. 860 (1978).

Syn. *Penicillium cladosporioides* Fres.(1863); *Cladosporium hypophyllum* Fuckel(1869); *C. exobasidii* Jaap(1907); *C. coralloides* Yamamoto (1959); *C. funiculosum* Yamamoto(1959).

Colonies on Czapek agar growing moderately, velvety or lanose surface, conspicuously wrinkled at the central area, with dull green shade or dark green on sporulation with age, but at central area pale gray or grayish, dense or thick mycelial structures; exudate colorless or pale beige; reverse blackish green or black.

Colonies on malt extract agar growing moderately, lanose or funiculose surface, central area raised conspicuously, abundant sporulation with age, becoming to the blackish brown or grayish brown or dull brown with pale green, very dense mycelial felt; reverse black or blackish-pale green.

Colonies on potato sucrose agar growing rapidly, lanose or funiculose surface, central area raised or wrinkled remarkably, abundant sporulation, becoming pale brownish-green black, dull or dark brown color in age, with thick or dense mycelial felt; reverse greenish brown black, brownish black or black.

Conidiophores macronematous and micronematous, but variable in length and in shape, pale to olive brown, smooth or verruculose, ramoconidia 0-1-septated, smooth or sometimes verruculose. Conidia in long branched chains, ellipsoidal or limoniform to cylindrical, mostly 3~7×2~4μm, pale brown, usually walls smooth but verruculose.

Habitat: Paddy field soils. Yukkog-dong in Buchun, July 25, 1980, Su-Y1-10-1-1, Oct. 25, 1980, Au-Y1-10-5-2, Au-Y3-10-1-2-5 & Au-Y3-10-5-6; Shinwon-dong, Oct. 25, 1980, Au-S1-10-3-3 & Au-S1-100-1-5, K.H. Min.

Note: This fungus was easy to isolate from air and soils. But this reported by the present authors in this paper at first in Korea.

Paecilomyces variotii Bainier

Bainier, Bull. Trimest. Soc. Mycol. Fr. **23** : 26(1907); Raper & Thom, A Manual of the Penicillia, p. 691(1949); Samson, Studies Mycol., **6** : 14(1974); Udagawa, Kinruizukan, p. 1074(1978); Ito *et al.*, IFO Res. Comm. **10** : 20(1981).

Syn. *Penicillium variotii*(Bain.) Sacc.; *P. divaricatum* Thom; *Paecilomyces aureocinnamomeus*(Biourge) Thom; *P. lecyth-*

idis Ram; *P. maximus* Ram; *P. indicus* Rai *et al.*

Colonies on Czapek agar growing rapidly, irregulanly wrinkled, abundant or thick mycelial felt, abundant sporulation with age, conidial areas dull brown or grayish brown; no exudate; reverse dark brown or brownish black.

Colonies on malt extract agar growing well, velvety surface, very abundant sporulation at old age, thin mycelial felt, Conidial areas grayish brown but at central areas dull brown; no exudate, reverse gray or dark gray.

Colonies on potato sucrose agar growing rapidly, velvety or lanose surface, very abundant sporulation at maturation, conidial areas greenish dull brown or at central areas more dull brown, thick mycelial felt; no exudate; reverse dark brown or brownish black.

Conidiophores consisting of dense whorls, bearing 2 to 5 phialides, smooth-walled, encrusted with granules. Phialides in whorls or solitary, variable in size, with cylindrical or ellipsoidal basal portion, slightly bent away from the main axis. Conidia hyaline to yellow, smooth-walled, variable in shape, usually globose to subglobose, or ellipsoidal, 3～5×2～4μm in size. Chlamydospores usually present, globose to subglobose or pyriform, thick-walled.

Habitat: Paddy field soil. Shinwon-dong, July 25, 1980, Su-S1-10-1-4, K.H. Min.

Note: This fungus has many synonyms among various genera. It is also reported here for the first time in Korea.

Penicellium funiculosum Thom

Thom, Bull. Bur. Anim. Ind. U.S. Dept. Agr. **118** : 69(1910) & The Penicillia, p. 464 (1930); Raper & Thom, A Manual of Penicillia, p. 616(1968); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 431(1979); Ito, *et al.*, IFO Res. Comm. **10** : 20(1981).

Syn. *Penicillium varians* G. Smith(1933); *P. aurantiacum* Miller *et al.*(1957); *P.rubicundum* Miller *et al.*(1957).

Colonies on Czapek agar growing restrictly, conidial areas green shade, lanose surface with matured conidia, red-orange after the maturation of conidial structures; reverse yellow honey.

Colonies on malt extract agar growing well, with abundant sporulation after the conidial development, appearing green colored, typically lanose to velvety surface; reverse usually uncolor.

Colonies on potato sucrose agar growing well, conidial areas varing in colors but with green shade in age, lanose or funiculose surface; reverse uncolor.

Conidiophores arising from funiculose hyphae, very short, variable in size, with walls smooth, simple but sometimes branched in terminal areas. Penicilli biverticillate and symmetrical, bearing a single terminal verticil of mutulae. Metulae usually 5～7 in a verticil, but variable in size. Phialides in a verticil of 5 to 7, more or less longer or shorter. Conidia subglobose to elliptical, usually 3～3.5×2.5 μm, with walls heavy, smooth or roughened.

Habitat: Paddy field soils. Yukkog-dong in Buchun, April 25 and July 25, 1980, Sp-Y2-10-5-2 and Su-Y2-10-1-1, respectively; Shinwon-dong, July 25, 1980, Su-S3-10-3-1, Su-S1-10-3-1 & Su-S1-10-1-5, K.H. Min.

Note: This fungus was isolated from the Gokunsan Island and soils of these two paddy fields by the authors. This is first record in Korea.

Penicillium piceum Raper and Fennell.

Raper & Fennell, Mycol. **40** : 533(1948);

Raper & Thom, A Manual of Penicillia p. 627 (1968); Minoura, Kinruizukan p. 1109(1977); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 456(1979); Ito, *et al.*, IFO Res. Comm. **10**: 20(1981).

Colonies on Czapek agar growing somewhat restrictly, consisting of white to yellow mycelial felt, central areas raised, bearing few conidial heads, with abundant conidial structures in loose mycelial network, velvety surface, blue green in age, poor conidial areas sparsely; exudate abundant, uncolor; reverse pale yellow-green to red brown.

Colonies on malt extract agar growing better than on Czapek agar, surface irregular tufts of funiculose encrusted hyphae, heavily sporing, yellow-green shades at the conidial areas; exudate limited in amount, fragment; reverse uncolored or pale orange colored.

Colonies potato sucrose agar growing well, surface plane, velvety in appearance, but consisting of a loose network of short aerial hyphae, heavily sporing to be dull greenish-yellow; exudate in small droplets, clear to pale yellow; reverse orange or red brown colored.

Penicilli biverticillate and symmetrical, compact. Conidiophores smooth-walled, often curved, 15~20×2.5~3.0μm. Metulae 6~12 on the vesicular apex of the conidiophores, 7~12×2~4μm. Phialides acerose, parallel, in crowded clusters of 6~8, 8~9×1.8~2.0μm. Conidia phialidic, subglobose, rough-walled, olive brown, 3~4×2~2.5μm.

Habitat: Paddy field soils. Yukkog-dong, April 25, 1980, Sp-Y1-10-1; Shinwon-dong, April 25, 1980, Sp-S1-100-1-1, K.H. Min.

Note: Morphologically, this fungus is very close to the original description. This is the first described record of this fungus in Korea.

Penicillium roqueforti Thom

Thom, U.S. Dept. Agr. Bur. Anim. Ind., Bull. **82**: 35~36(1906); *ibid.*, **118**: 34(1910); The Penicillia, 227(1930); Raper & Thom, A Manual of Penicillia, 395(1968); Minoura, Kinruizukan, p. 1113(1978); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 344(1979).

Colonies on Czapek agar growing rapidly, velvety or lanose, very poor mycelial structures thin or weak, poorly sporulating, but conidial areas dull green or viridian green; no exudate; reverse very pale green.

Colonies on malt extract agar growing moderately, velvety surface, thin mycelial felts thin or weak, with abundant sporulation with dull green or viridian green shade; no exudate; reverse beige.

Colonies on potato sucrose agar growing rapidly, typically velvety, thin mycelial structures, abundant sporulation with dull green or viridian green shade in age; no exudate; reverse green or dark green.

Penicilli variable in pattern, with compactly branching metulae and appressed or diverging phialides. Conidiophores mostly thick, 4~6μm, with walls granular, in variable lengths. Metulae usually roughened or asperulate. Phialides also variable in size. Conidia globose or subglobose, larger than those of common other species, ranging 3.5 to 5.0μm in diameter, smooth-walled.

Habitat: Paddy field soil. Yukkog-dong in Buchun, Jan. 25, 1981, W-Y2-10-4-2, K.S. Chun.

Note: This fungus was isolated from the soil of paddy field and air in Korea. The authors report this at first in this paper.

Pinicillium verruculosum Peyronel

Thom, The Penicillia, p. 474(1930); Raper & Thom, A Manual of Penicillia, p. 621(1968); Pitt, The genus *Penicillium* and its teleomorphic state *Eupenicillium* and *Talaromyces*, p. 440 (1979).

Syn. *Penicillium aculeatum* Raper & Fennell var. *apiculatum* Abe(1956); *P. proteolyticum* Kamyschoko(1961).

Colonies on Czapek agar growing moderately, surface usually velvety or sometimes more or less lanose, never furrowed, conidial areas showing at first greenish yellow but becoming pale brown or yellowish brown, dark greenish yellow in some strains; reverse at first honey but becoming pale purplish pink to dark red with the maturation.

Colonies on malt extract agar growing well, consisting of thin basal felt, surface usually velvety, not furrowed, heavily sporulating throughout, conidial areas grayish green;exudate more or less producing, with pale pinkish tint; reverse uncolored.

Colonies on potato sucrose agar growing rapidly, surface velvety, heavily sporulating, not furrowed, conidial areas dull green; exudate somewhat pale beige; reverse pale beige or pale brown.

Conidiophores various in length, smooth-walled, Penicilli typically biverticillate and symmetrical, consisting of a terminal verticil of 4 to 8 metulae, variable in length. Phialides in clusters of 6 to 7. Conidia globose or subglobose, 2.5 to 3.7μm, with conspicuously echinulate walls.

Habitat: Paddy field soils. Yukkog-dong, Jan. 25, 1981, W-Y3-10-4-1, K.H. Min; Shinwon-dong, July 25, 1980, Su-S2-10-1-1, Su-S2-10-2-1, Su-S1-100-3-3 & Su-S2-10-1-1-2, Oct. 25, 1980, Au-S2-10-2-7 & Au-S3-100-2-1, K. H. Min.

Note: The present fungus fits very well with the original description in its morphological characteristics. This species is record here for the first time in Korea.

Zygorhynchus moelleri Vuill.

Vuillemin, Bull. Sci. Mycol. Fr., **19**: 106 (1903); hesseltine *et al.*, Mycologia **51**: 173 (1959); Zycha *et al.*, Mucorales p. 50(1969).

Syn. *Mucor moelleri*(Vuill.) Lender(1908); *Zygorhynchus vuillemini* Namyslowski (1910); *Z. dangeardi* Moreau(1912); *Z. bernardi* Moreau(1913).

Colonies on Czapek agar growing rapidly, rarely composed of white mycelial structure on surface, with grayish black granules at maturation; reverse uncolor.

Colonies on malt extract agar growing rapidly, of abundant white mycelial to grayish white structures bearing gray granules; reverse colorless.

Colonies on potato sucrose agar growing well, at first composed of white mycelial structures, grayish black granules formed aften maturation, loosely network interwoven hyphae; reverse usually colorless.

Sporangiophores simple or branched, bearing one or two lateral branches. Sporangia grayish-yellow, slightly wider than long, 48×50μm in size. Wall not different. Columella oval or subglobose, depressed, wider than long, smooth-walled. Sporangiospores oval, 5×3~4μm. Zygospores smaller than other species of this genus, usually about 35μm in diameter.

Habitat: Paddy field soils. Yukkog-dong, Oct. 25, 1980, Au-Y2-10-1-3 & Au-Y2-100-1-3-3; Shinwon-dong, April 25, 1980, Sp-S1-10-2, Sp-S1-100-1-1 & Sp-S1-100-1-2, K.H. Min.

Note: This fungus was once isolated from the soil of Kosucave by the author, but is described here at first as isolates from the paddy field soil in Korea.

DISCUSSION

The result of the investigation summarized here and in a previous paper[11] provides some informations on the microfungal flora of the paddy field soils in Korea. In this work, the isolation of the soil fungi was made by picking up a single colony from the dilution plate and special attention was paid to avoid in making duplicate isolates for each species.

As described in this paper and reported previously, it is concluded that the dominant fungi in the paddy fields in Korea belong mostly to the genus *Aspergillus*, *Penicillium* and their teleomorphic states *Eupenicillium* and *Talaromyces*.

Bukkalo *et al.*[1] reported the mycological characteristics of the paddy field soils in Ukaraine. From 287 soil samples isolated, 170 species of fungi were isolated; Phycomycetes 17, Ascomycetes 10, Deuteromycetes 143. Several fungi were found to be dominant. They are *Mortierella alpina*, *Penicillium funiculosum*, *P. rugulosum*, *P. chrysogenum* and *Alternaria alternaria*.

Dutta & Ghosh[3] reported that dominant forms were found throughout the year, irrespective of the season, the age of crops, soil conidition and other environmental factors in the paddy fields. According to them, dominant fungi were *Aspergillus carneus*, *A. flavipes*, *A. foetidus*, *A. fumigatus*, *A. luchuensis*, *A. terreus*, *Penicillium lilacinum*, *P. purpurogenum*, *P. restrictum*, *P. tardum*, *P. variabile*, *Talaromyces stipiatus* and *T. luteus*.

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摘 要

한국의 논에서 나타나는 토양균류상을 서울근방 두곳 즉 역곡동과 신월동에서 4계절을 통해 채취한 토양표본을 희석평판배지법에 의해 분리했다. 총 85개 순수배양균을 분리했고, 그중 13屬, 30種을 동정했다. 동정된 30種중 6種은 불완전 균류로 한국에서 처음으로 이 논문에 기재하였다. 불완전균류중 논토양에 많이 분포되어 있는 것은 대부분이 *Penicillium* 속이다. 그중 한국에서 처음으로 나타난 종류로는 *Penicillium funiculosum*, *P. piceum*, *P. roqueforti* 그리고 *P. verruculosum* 등이었다. *P. piceum*의 경우는 가문비나무같은 상록수와 유사한 전형적인 원추형 분생자루가 현저한 특징을 나타낸다. *P. roqueforti*는 penicilli가 부정형으로, 빽빽하게 분기된 metulae와 밀착 또는 분산상의 phialide를 가지며 stipes는 두텁고 많은 입자를 가진 벽을 형성하고 있다.

그외 *Cladosporium cladosporioides*, *Paecilomyces variotii*도 분리되었으며, Zygomycete 중에서는 *Zygorhynchus moelleri*가 가장 우세하게 분포되어 있는 種으로써 卵形 Columella를 가지고 있는 아구형포자낭과 직경 약 35μm의 暗色인 접합포자를 형성한다.

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