

Soil Mycoflora in Larch Forest in Sugadaira※

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李址烈：菅平高原のカラマツ林土壌生菌類フローラについて

During 1968 to 1970 the author engaged in the study of the soil mycoflora of larch forests at Sugadaira in Nagano Prefecture, which is located in the middle of Honshu in Japan. This area is 1260 to 1600 meters above sea level, and covered with more than 1 meter of snow for three months of every winter.

The climate of the district is suited to larch trees (*Larix leptolepis* Murray), and we can see many well developed larch forests there. The present paper shows the results of the research.

Methods of Isolation and Culture

Soil Sampling: The characteristics of soils in the forest are presented in the following table.

Table 1. Characteristics of soils in the larch forest in Sugadaira

Soil horizon	Aoo		Ao		A				B			
Depth(cm.)	3	0.8	2	5	10	20	30	50	75	100		
Color	Wood brown	Buffy brown	Black		Brownish gray		Brown					
Water content(%)	20.0	15.0	35.5	50.0	47.5	42.5	45.0	42.5	40.0	30.0		
Organic matters (% of lost weight by burning)	65.0	30.0	15.0	10.0	7.5	7.5	10.0	5.0	5.0	2.5		
pH	4.85	5.15	5.15	5.11	5.29	5.13	5.58	5.72	5.98	5.79		

Soil was sampled at ten soil horizontal layers of Aoo, Ao, A horizon (at 2cm, 5cm, 10cm and 20cm depth), and B horizon (of 30cm, 50cm, 75cm and 1m depth). The sampling was carried out eight times on April 15~17, June 17~19, August 5~8, October 7~10 and December 26~28 in 1967 and on April 6~9, June 24~26 and August 28~30 in 1968.

The soil samples were taken from each soil horizon with sterile metal borers (4.5 cm in diameter, 6.7cm in length), put into vinyl sacks, and kept in a vacuum bottle with ice until they were brought to the laboratory.

Media for isolation: The media used for the isolation of soil fungi are as follows : *Potato dextrose agar* (PDA).....200g potatoes, without skin, diced and cooked for 10 minutes in 700cc distilled water, after filtering through porous cloth, added 20g dextrose, 15g agar and distilled water until the total volume become to 1 liter.

※ Contributions from the Sugadaira Biological Laboratory, No.22

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Carrot agar (CA)..... 200g diced carrots, cooked for 10 minutes in 700cc distilled water, until the total volume come to 1 lit.

Corn meal agar (MMA)..... 20g corn meal and 20g agar in 1 liter distilled water,

Malt extract agar (MEA).....25g malt extract and 15g agar in 1 liter distilled water,

Czapek's solution agar (CSA).....3g NaNO₃, 1g K₂HPO₄, 0.5g KCl, 0.5g MgSO₄·7H₂O, 0.01g FeSO₄·7H₂O, 30g sucrose and 15g agar in 1 liter distilled water.

Hemp seeds agar (HA)..... 20g crushed hemp seeds and 15g agar in 1 liter distilled water.

Waksman's medium (WA).....10g glucose, 5g peptone, 1g KH₂PO₄, 0.5g MgSO₄·7H₂O and 20g agar in 1 liter distilled water,

Synthetic mucor agar (SMA).....40g glucose, 2g asparagin, 0.5g KH₂PO₄, 0.25g MgSO₄, 0.5g thiamine chloride and 15g agar in 1 liter distilled water.

Larch leaf extract (LEA)half rotten larch leaves of 200g were cooked for 10 minutes in 700cc distilled water. After straining through a porous cloth, it was added 20g of agar and distilled water until the total volume came to 1 liter.

All the media used for isolation of soil fungi were adjusted to the same pH value of the sampled soil (5.0±).

Czapek's dextrose agar (CDA) 2g NaNO₃ 1g K₂HPO₄, 0.5g KCl, 0.5g MgSO₄·7H₂O, 0.01g FeSO₄·7H₂O, 36g glucole and 10 agar in 1 liter distilled water.

This medium was used for the comparative experiments of the fungal growth under various pH values.

Plain agar (A)..... 20g agar in 1 liter distilled water.

Methods of Isolation: The soil plates method, dilution method, direct inoculation method, baiting method and steaming method, were adopted to isolate the soil fungi.

Soil plate method : 7 to 12mg of soil sample is transferred from the collecting vinyl sack to a sterile Petri dish, and poured approximately 10cc of a medium which is once melted by warming and cooled to about 40°C, The soil grains must be dispersed throughout the medium by shaking the dish before the agar becomes to set. These plates were incubated at 5°C., 20°C and 30°C respectively. After 5 or 6 days, rapid growing species are subcultured for identification and then picked up to allow slow growing microfungi to develop easily.

Dilution method: The soil sample is diluted 100,000 times with distilled water. Then the suspension is poured into a Petri dish of the medium CSA. This method was employed for the calculation of mycoflora in the larch forest soil.

Direct inoculation method: A bit of soil sample is put on the centre of a culture plate which contains rather poor nutrition as MMA. For a few days, tiny tufts of fungi come out, but soon they withered. After then, in the majority of cases, we can find a number of species of tiny mycelium of other fungi come out successively for several weeks.

Baiting method: As a bait, boiled and crushed hemp seeds were used and the writer

succeeded to collect some aquatic Phycomycete.

The most species of fungi from the larch forest soil were isolated on the media of CA, PDA, CSA, MEA and LEA, while a few species had been isolated on certain media, viz. A, MMA, HA, SMA and WA adjusted to the pH values of the investigated soil samples.

Methods for cultures: The isolated fungi were purely cultured for identification, on several media at various temperatures respectively. For Pycomycetes, media of PDA, SMA and MEA were chiefly used, while for Ascomycetes, media of MY20 agar, Cellulose agar CSA and MEA were used. Fungi Imperfecti were cultured on media of CSA or MEA, and especially for yeasts, Yeast-malt extract medium and other media with sugars were used

Media MY20, cellulose agar and yeast malt extract were appropriate for culturing certain fungi to examine their physiological features.

MY20 agar—5g peptone, 3g yeast extract, 3g malt extract, 200g glucose, 20g agar, 1 liter distilled water.

Cellulose agar—500cc soil extract, 1g NH_4NO_3 , 0.5g $\text{MgSO}_4 \cdot \text{H}_2\text{O}$, 0.5g K_2HPO_4 , 10g cellulose powder.

Yeast malt extract medium—3g yeast extract, 3g malt extract, 5g peptone, 10g glucose, 20g agar, 1 liter distilled water.

Results

The author isolated 567 strains of microinhabitants from the larch forest soil in the hole course of the present study. Among them, he identified 112 species of true fungi, mostly molds. In the following table, all the identified species are presented with the soil horizons and the isolating conditions of the each fungi. (Table 2 on p.38~43)

The number of isolated species of fungi reduced gradually, according to the depth of the soil horizon, from A₀₀ toward the under layers (Table 3).

Table 3. Horizontal distribution of species of soil fungi in the larch forest.

Soil horizon	Depth(cm)	Number of species	% to total species
A ₀₀	3	32	28.57
A ₀	0.8	29	25.89
A	2	20	17.85
	5	22	19.64
	10	14	12.50
	20	14	12.50
B	30	16	14.32
	50	8	7.16
	75	8	7.16
	100	8	7.16

Table 2. Horizontal distribution of the fungi.

Species	Soil horizons and depth (cm.)									
	Aoo	Ao	A		B					
	3	0.8	2	5	10	20	30	50	75	100
Phycomycetes										
<i>Absidia glauca</i>	+	-	-	-	-	-	-	-	-	-
<i>A. spinosa</i>	-	+	-	-	-	-	-	-	-	-
<i>Chaetocladium Brefeldii</i>	-	-	-	-	+	-	-	-	-	-
<i>Cunninghamella elegans</i>	-	+	-	-	-	-	-	-	-	-
<i>Mortierella alpina</i>	+	+	-	-	-	+	-	-	-	-
<i>M. elongata</i>	-	+	+	-	-	-	-	-	-	-
<i>M. gracilis</i>	+	-	-	-	-	-	-	-	-	-
<i>M. horticola</i>	-	-	-	-	-	-	+	-	-	-
<i>M. isabellina</i>	-	+	-	+	-	-	-	-	-	-
<i>M. nana</i>	-	-	-	+	-	-	-	+	-	+
<i>M. ramanniana</i>	+	+	-	-	-	-	-	+	-	-
<i>M. ramanniana</i> var. <i>angulispora</i>	-	+	-	+	-	-	+	-	-	-
<i>M. humilis</i>	-	-	-	-	-	-	-	-	-	+
<i>M. Zychnae</i> var. <i>japonica</i> nov.	+	-	-	-	-	-	-	-	-	-
<i>Mucor christianiensis</i>	-	-	-	+	-	-	-	-	-	-
<i>M. circinelloides</i>	-	+	-	+	-	-	-	-	-	-
<i>M. corticolus</i>	+	-	-	-	-	-	-	-	-	-
<i>M. fragilis</i>	+	+	+	-	-	-	-	-	-	-
<i>M. hiemalis</i>	-	+	-	-	-	-	-	-	+	-
<i>M. racemosus</i>	-	-	-	-	-	-	-	+	+	-
<i>M. silvaticus</i>	-	+	-	-	-	-	-	-	-	-
<i>M. subtilissimus</i>	+	+	-	-	-	-	-	-	-	-
<i>Piptocephalis lepidula</i>	+	-	-	-	-	-	-	-	-	-
<i>Rhizopus nigricans</i>	+	-	-	-	-	-	-	-	-	-
<i>Syncephalastrum racemosum</i>	-	-	-	-	-	+	-	-	-	-
<i>Syncephalis nodosa</i>	-	+	-	-	-	-	-	-	-	-
<i>Zygorhynchus heterogenum</i>	-	-	+	-	-	-	-	-	-	-
<i>Z. moelleri</i>	-	-	-	+	-	+	-	-	-	-
Ascomycetes										
<i>Chaetomium cochliodes</i>	+	-	-	+	-	-	-	-	-	-
<i>C. funicola</i>	+	-	-	-	-	-	-	-	-	-
<i>C. globosum</i>	-	-	-	+	-	-	-	-	-	-
<i>Comiochaeta tetraspora</i>	-	-	-	-	-	+	-	-	-	-
<i>Eurotium repens</i>	-	-	-	-	+	-	-	-	-	-
<i>Gelasinospora longispora</i>	-	-	+	-	-	-	-	-	-	-
<i>Melanospora fusispora</i>	-	-	-	+	-	-	-	-	-	-
<i>Microthecium compressum</i>	-	-	-	-	-	-	+	-	-	-
<i>M. retisporum</i> var. <i>inferior</i>	-	-	-	-	-	-	+	-	-	-
<i>Myxotrichum setosus</i>	-	+	+	-	-	-	-	-	-	-
<i>Podospora</i> sp.	-	-	-	+	-	-	-	-	-	-
<i>Sordaria fimicola</i>	-	-	+	-	+	-	-	-	-	-
<i>Spathularia clavata</i>	(+)	(+)	(+)	-	-	-	-	-	-	-

Temperature at isolation & culture			Media for isolation										Methods for isolation			
5°C (1)	20°C (2)	30°C (3)	A	PDA	CA	MMA	MEA	CSA	HA	SMA	LEA	WA	SPM	DM	BM	DIM
-	+	-	-	-	+	+	-	-	-	-	-	-	+	-	-	-
-	+	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-
-	+	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-
-	+	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-
+	+	-	+	-	+	-	-	-	+	-	-	-	+	-	-	-
-	+	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-
-	+	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-
-	+	-	-	-	+	+	-	-	-	-	-	-	+	-	-	-
+	+	-	-	+	+	-	-	-	-	-	-	-	+	-	-	-
-	+	-	-	-	-	+	-	+	-	-	-	-	+	+	-	-
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-	+	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-

Species	Soil horizons and depth (cm.)									
	Aoo	Ao	A		B					
	3	0.8	2	5	10	20	30	50	75	100
<i>Talaromyces vermiculatus</i>	-	-	+	-	-	-	-	-	-	-
<i>Tielavia terricola</i>	-	-	-	-	-	+	-	-	-	-
Fungi Imperfecti										
<i>Acremoniella atra</i>	+	-	-	-	-	-	-	-	-	-
<i>Acremonium</i> sp.	-	-	+	-	-	-	-	-	-	-
<i>Aspergillus aculeatus</i>	+	-	-	-	-	+	+	-	-	-
<i>A. clavato-flavus</i>	-	-	-	-	-	-	+	-	-	-
<i>A. foetidus</i>	-	-	-	-	-	-	-	+	+	+
<i>A. foetidus</i> var. <i>pallidus</i>	-	-	-	+	-	-	-	-	-	-
<i>A. fumigatus</i>	+	+	-	-	-	+	+	-	-	-
<i>A. japonicus</i>	-	+	-	-	-	-	-	-	-	-
<i>A. niger</i>	+	-	-	-	-	-	-	+	-	+
<i>A. oryzae</i>	-	-	-	+	-	-	-	-	-	-
<i>A. terreus</i>	-	-	-	-	-	-	-	-	+	-
<i>A. versicolor</i>	-	-	-	-	-	-	-	+	-	-
<i>Aureobasidium pullulans</i>	+	-	-	-	-	-	-	-	-	-
<i>Beauveria Bassiana</i>	-	+	-	-	-	-	-	-	-	+
<i>Botryosporium longibrachiatum</i>	-	-	+	-	-	-	-	-	-	-
<i>Cladosporium herbarum</i>	-	-	-	+	-	-	-	-	-	-
<i>C. resinae</i>	-	+	-	-	-	-	-	-	-	-
<i>Diheterospora chlamydosporia</i>	-	-	-	+	-	-	-	-	-	-
<i>Fusarium</i> sp. A	+	-	-	+	+	+	-	-	-	-
<i>F.</i> sp. B	-	-	-	-	+	-	+	-	-	-
<i>Geotrichum candidum</i>	-	-	-	+	-	-	+	-	-	-
<i>Gliocladium roseum</i>	+	-	-	-	-	-	-	-	-	-
<i>Gonatobotrys simplex</i>	+	-	-	-	-	-	-	-	-	-
<i>Helminthosporium nodulosum</i>	-	+	-	-	-	-	-	-	-	-
<i>Hormodendrum pallidum</i>	-	-	-	-	-	-	+	-	-	-
<i>Humicola brevis</i>	+	-	-	-	-	-	-	-	-	-
<i>H. grisea</i>	-	-	-	-	-	+	-	-	-	-
<i>Monilia acremonium</i>	-	-	-	-	-	-	+	-	-	-
<i>M. sitophila</i>	-	+	-	-	-	-	-	-	-	-
<i>Paecilomyces varioti</i>	-	-	-	-	+	-	-	-	-	-
<i>Penicillium chrysogenum</i>	+	-	-	-	-	-	-	-	-	-
<i>P. citrinum</i>	-	-	-	-	-	-	-	-	+	-
<i>P. commune</i>	-	-	-	-	+	-	-	-	-	-
<i>P. corylophilum</i>	-	+	-	-	-	-	-	-	-	-
<i>P. cyclopium</i>	-	+	-	-	-	-	-	-	-	-
<i>P. frequentans</i>	-	-	-	+	-	-	-	-	-	-
<i>P. funiculosum</i>	-	-	+	-	-	+	-	-	-	-
<i>P. janthinellum</i>	+	-	+	+	-	-	-	+	+	+
<i>P. nigricans</i>	+	+	-	-	-	-	-	-	-	-
<i>P. notatum</i>	-	-	-	-	-	-	+	-	-	-

Temperature at isolation & culture			Media for isolation										Methods for isolation			
5°C (1)	20°C (2)	30°C (3)	A	PDA	CA	MMA	MEA	CSA	HA	SMA	LEA	WA	SPM	DM	BM	DIM
-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
-	+	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-
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-	+	-	+	-	+	-	-	+	-	-	-	-	+	+	-	-
-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	+	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-

Species	Soil horizons and depth (cm.)									
	Aoo	Ao	A			B				
	3	0.8	2	5	10	20	30	50	75	100
<i>Penicillium pallidum</i>	-	-	-	-	+	-	-	-	-	-
<i>P. raistrickii</i>	+	+	-	-	-	-	-	-	-	-
<i>P. restrictum</i>	-	+	-	-	-	-	-	-	-	-
<i>P. sclerotiorum</i>	-	-	+	-	+	-	-	-	-	-
<i>P. spinulosum</i>	-	-	-	-	-	+	-	-	-	-
<i>P. steckii</i>	-	-	-	-	-	+	-	-	-	-
<i>P. thomi</i>	+	-	-	-	+	-	-	-	-	-
<i>P. velutinum</i>	-	-	+	-	+	-	-	-	-	-
<i>P. waksmani</i>	-	-	-	-	+	-	-	-	-	-
<i>Periconia macrospinoso</i>	-	-	-	-	+	-	-	-	-	-
<i>Pestalotia guepini</i>	-	-	+	+	-	-	-	-	-	-
<i>P. versicolor</i>	-	-	+	-	-	-	+	-	-	-
<i>Phialophora biformis</i> sp. nov.	+	-	+	+	-	-	-	-	-	-
<i>P. sp.</i>	+	-	+	-	-	-	-	-	-	-
<i>Scopulariopsis acremonium</i>	+	-	-	-	-	-	-	-	-	-
<i>Stemphylum botryosum</i>	+	-	-	-	-	-	-	-	-	-
<i>Trichocladium asperum</i>	-	+	-	-	-	+	-	-	-	-
<i>Trichoderma viride</i>	-	+	+	+	+	+	+	-	+	+
<i>Tritirachum roseum</i>	+	+	-	-	-	-	-	-	-	-
<i>Verticillium albo-atrum</i>	-	-	-	-	-	-	-	+	-	-
<i>V. effusum</i>	+	-	-	-	-	-	-	-	-	-
<i>V. terrestre</i>	-	-	-	+	-	-	-	-	-	-
Dark hyphae A	-	-	-	-	-	-	+	-	-	-
Dark hyphae B	-	-	-	-	-	-	-	-	-	+
Dark hyphae C	-	-	-	-	-	-	+	-	-	-
Dark hyphae D	-	-	-	-	-	-	-	-	+	-
Yeast										
<i>Cryptococcus diffluens</i>	-	-	+	-	-	-	-	-	-	-
<i>Rhodotorula rubra</i>	-	-	+	-	-	-	-	-	-	-
Total isolates in %										
Total numbers of isolates										

1) For 2 months. 2) For 1 month. 3) For 2 weeks.

The number of fungi in each soil horizons, chosen in the investigation, were counted. As a result, the largest number of fungi per gram of dry soil was shown at Ao horizon (Table 4).

Table 4. Numbers of fungi per gram of dry soil collected in the larch forest.

Soil horizon	Depth(cm)	Number of fungi(10^3)
Aoo	3	197
Ao	0.8	307
A	2	160
	5	37
	10	30
	20	13.3
B	30	30
	50	17
	75	3.3
	100	10

Species Observed

All the fungi isolated from the larch forest are as follows. They includes a new species, a new variety and 26 species of new to Japan.

Phycomycetes

Absidia glauca Hagem

in Hagem: Norweg. Mucor. p.42, figs. 19, 20 (1908)

Colonies on PDA becoming yellowbrown. Primary axes 0.6~10cm long, straight or changed into irregular stolons, at times raised and curved toward the substratum to which their ends are attached by a tuft of rhizoids. The fertile branches isolated or in 2~4 groups. Sporangia pyriform, 40~50 μ in diam. A septum is formed, dividing the pedicel from the sporangium. Wall is diffluent and leaves a very straight collarette. Columellae rounded, mammiform, furnished with a very short button, 30 μ in diam., 38 μ in length. Spores round, 3~3.5 μ . colorless. Heterothallic.

Hab. : Aoo H orizon.

Absidia spinosa Lendner

in Lendner: Muc. Suisse, p.133; fig.46. (1908).

Colonies very dense, grayish cottony, 2cm high. Stolons curved, arched, carrying sporangia in 2~3 groups. Sporangia pear-shaped, bluish, 33 μ long, 28 μ wide. Columellae 20 μ wide, swollen, with rounded spines. Sporangiphores septate. Spores short rods, 2 μ in diam. 4~5 μ long. Zygosporos doliform, verrucose, formed by the fusion of two unequal gametangia on forked hyphae. Suspensor of the larger gametangium with circinate appendages.

Hab. : Ao Horizon

Chaetocladium Brefeldii van Tieghem et LeMonnier

Ann. Sc. Nat. 5. sér. 17: 342 (1873).

Colonies gray, about 10mm. long, fertile hyphae creep and wind. Lateral branches short, fragile, several times diverged or whorled with sterile branches. Sporangia attaching on the nodes of branches, gray, globose, 3~4 μ in diam., containing a single spore. Zygosporangium not observed.

Hab. : Parasitic on *Mucor* sp.

Cunninghamella elegans Lendner

in Lendner: Muc. Suisse, p. 159 (1908).

Colonies white, spreading. Hyphae firm 7~13 μ wide, with abundant oil-grains. Conidiophores erect, multi-branched, terminal vesicles 27~35 μ in diam., spherical, single or with 1~3 whorls attaching points. to conidiophores swollen. Terminal conidia lemon-shaped, leaving spicules after falling from vesicle, 12 μ long \times 9 μ width, very finely echinulate; lateral conidia ovate, 6 μ wide \times 10 μ in length.

Hab. : Ao Horizon

Mortierella alpina Peyronel

in Linnemann: Mortierella, p. 35 (1941).

Mycelium white, fine, sparse, cottony. Chlamydospores and swellings occur on the nutritive hyphae. Sporangio-phores simple, coarser than the hyphae, 200 μ long, tapering from 10 μ to 3 μ . Sporangia colorless, walls evanescent, 25 μ in diam., with a basal collar.

Spores 4 \times 2 μ , slightly kidney-shaped, hyaline. Zygosporangium not observed.

Hab. : Aoo, Ao Horizon in depth of 20cm.

Mortierella elongata Linnemann

in Linnemann: Mortierella, p. 43 (1941).

Substrate mycelium fragmental, aerial mycelium white, thick, up to 1.5cm high. Sporangio-phores numerous, without rhizoids, 200~350 μ long, 7~8 μ in diam. at the base tapering to 1.5~3 μ towards the tip, slightly branched. Sporangia with a few spores, 15~25 μ in diam. Spores 3.5~7 \times 13 μ , very irregularly formed, with central oil-droplets.

Hab. : Ao Horizon, in depth of 2cm.

Mortierella gracilis Linnemann

in Linnemann: Mortierella, p. 38 (1941).

Substrate mycelium fragmental to zonate, aerial mycelium low, thick, with rhizoidal branching at the tips. Sporangio-phores few, 200~350 μ long, 5~8 μ at the base tapering to 3 μ towards the tip, arising from aerial hyphae, without rhizoids. Sporangia globose, 18~21 μ in diam. Spores very small, 2.5~3 μ , globose.

Hab. : on dung of rabbits at Aoo Horizon

Mortierella horticola Linnemann

in Linnemann: Mortierella, p. 21 (1941).

Substrate mycelium formed a rosette, aerial mycelium white, rather sparse. Sporangio-phores very delicate, usually unbranched. $50\sim 170\mu$ long, $3.5\sim 4\mu$ in diam. at the base, tapering to $1.5\sim 2\mu$. Stylospores globose $8\sim 11\mu$ in diam., with a finely spinulose membrane.

Hab. : 30cm depth.

Mortierella humilis Linnemann

in Linnemann: Mortierella, p. 23 (1941).

Colony formed a rosette. Aerial mycelium white, cottony, reaching 1cm in height. Stylosporophores arise from the aerial mycelium, erect, simple or branched. Branches irregular, $55\sim 90\mu$ long, $2\sim 4\mu$ wide at base. Stylospores globose with a finely echinulate wall, $10\sim 15\mu$ in diam. Chlamydo-spores globose, $5.5\sim 6.5\mu$ in diam.

Hab. : 1m. depth.

Mortierella isabellina (Oudemans) zycha

in Linnemann: Mortierella, p. 18 (1941).

Colonies zonate, at first white, then pearl-gray, finally isabelline. Hyphae creeping, branching in forks. Sporangio-phores cylindrical, slightly attenuated at the tip, $120\sim 200\mu$ high, hyaline. Sporangia globose, $15\sim 24\mu$ in diam. with a hyaline wall. Spores angular, hyaline when single, pale yellowish~white in mass, $2\sim 3\mu$ in diam. Chlamydo-spores submerged, globose or elliptic, smooth, hyaline, with a thin membrane.

Hab. : Ao Horizon, Horizon in depth of 5cm.

Mortierella nana Linnemann

in Linnemann: Mortierella, p. 16 (1941).

Substrate mycelium thick, somewhat zonate, aerial mycelium white, 5mm high. Sporangio-phores irregularly distributed on substrate mycelia, or occurred as small perpendicular branches of aerial mycelia, 30μ broad at the base, tapering to $1.5\sim 2.5\mu$ towards the tip., branching monopodially. Sporangia one-spored, walls diffluent. Spores globose, smooth, $4\sim 5.5\mu$ in diam.

Hab. : 5cm., 50cm., 1m. depth

Mortierella ramanniana (Moeller) Linnemann

in Linnemann: Mortierella, p. 19 (1941).

Colonies short, velvety, carmine-red-brown. The edge of colony white, becoming gray when aged. Sporangio-phores unbranched, $150\sim 190\mu$ long, $5\sim 6\mu$ in diam. Sporangia spherical, $20\sim 35\mu$ in diam., flesh-rose to copper-red. Wall diffluent, smooth. Spores globose, rarely oval, $2\sim 3\mu$ in diam., colorless. Columellae spherical, $8\sim 10\mu$ in diam. chlamydo-spores numerous, globose or ovoid, $10\sim 12\mu$ in diam. giant-cells present. Mycelium and sporangio-phores rather septate.

Hab. : Aoo, Horizon, Horizon in depth of 50cm.

Mortierella ramanniana var. *angulispora* (Naumov) Linnemann

in Linnemann: Mortierella, p. 19 (1941),

Colonies on SAM gray, about 1mm high, sporangiophores sympodially branched, 3.7~4 μ in diam. Columellae globose, 8~11 μ in diam. Spores angular, 2.8~3.5 μ in diam.

Hab. : Ao Horizon, Horizon in depth of 5cm. and 30cm.

Mortierella zychae var. *japonica* var. nov. * (Plate I)

Colonies on MEA lobed, 3cm in width, zonate with stripes 0.7cm broad.; aerial mycelia abundant, with rhizoids, matted, thick, white forming numerous white mass of gemmae. Hyphae 5.9 μ in diam. sparsely septate. Sporangiophores 150~350 μ long, 9.8 μ in diam. at basal portion, tapering upwards 4.9 μ at the upper portion, unbranched or cymose. Sporangia globose to ellipsoid, 29.4 \times 27.4 μ , smooth, without columella, membrane thin, diffluent. Spores. ellipsoid, 6.8 \times 9.8 μ ; gemmae globose to ovoid or ellipsoid, 14.7 μ in diam. Masses of 5—150 gemmae formed on both aerial and submerged hyphae. Stylospores and zygo spores unknown.

Hab. : isolated for the first time, by baiting method with hemp seeds from a soil sample at Aoo Horizon under the wood of *Quercus serrata* Thunb. The sampling station is located at a distance of thirty meters from the larch forest. Type culture, No.313, preserved in the author's collection.

Mucor christianiensis Hagem

Ann. Mycol. 8: 265~86 (1910).

Colonies on PDA thick, gray, mat-like. Sporangiophores scattered, 1.5~2cm high, monopodially branched with short circinate branches, with numerous intercalary chlamydospores. Chlamydospores, at first cylindrical, later barrel-shaped or globose. Sporangia 40~60 μ in diam., bright yellow when ripe with fragile wall. Columellae oval or elongate, 30~45 μ long and 25~30 μ wide. Spores oval, 6~8 \times 5~6 μ . Zygo spores unknown. This fungus not grew at 37°C.

Hab. : 5cm. depth.

Mucor circinelloides van Tieghem

Ann. Sc. Nat. 6 sér. 1 : 94 (1875).

Colonies on PDA rather dense. Sporangiophores erect, and deep brown, about 1.5 cm tall, branched sympodially. Branches short or curved. Sporangia globose 50~80 μ in diam., gray-brown, erect or curved, membrane diffluent. Columellae spherical or oval, colorless, smooth. Spores globose or elliptic, 3 μ in diam. 4~5 μ long, colorless, smooth. This fungus not grew at 37°C.

Ha. : Ao Horizon.

Mucor corticolus Hagem

Ann. Mycol. 8 : 277, fig. 8 (1910).

Colonies on PDA gray, cottony. Sporangiophores erect, up to 2cm high, sympodially

* Mycelio in substrato induente zonato, lobato. Hyphis sporangiferis longis ad 350 μ , basi 9.8 μ crassis, apice 4.9 μ . Sporangii 27.4 \times 29.4 μ , sporis elliptici, 6.8 \times 9.8 μ . Chlamydosporis catenatis, nidos in mycelio formantibus, 14.7 μ crassis, albo masa formantibus. Hab. : In humo infura sylvam *Quercus serratae*.

branched. Lateral branches long. Sporangia globose, $50\sim 60\mu$ in diam., with diffluent wall. Columellae egg-shaped, $27\sim 30\mu$ wide, 35μ long, with an indistinct collarette. Spores oval or elliptic $5\sim 7 \times 3.5\sim 5\mu$.

Hab. Aoo Horizon

Mucor fragilis Bainier

Ann. Sc. Nat. 6. sér. 19 : 208, figs. 12~17 (1884).

Colonies on PDA gray to brown, 2~5mm in height. Sporangiphores erect 6~13 μ in diam., with sympodial branches. Sporangia yellowish-gray to olive-brown, 40~75 μ , wall slowly fragmenting. Columellae globose to oval, hyaline up to 45 μ high, with marked collarette. Spores in mass dark-brown, elliptic or cylindrical, 2~4 \times 4~8 μ . Hab.: On dung of rabbits and rats at Aoo Horizon and Ao Horizon of 2cm. depth Hab: On dung of rabbits and rats at Aoo Horizon and Ao Horizon of 2cm depth.

Mucor hiemalis Wehmer

Ann. Mycol. 1: 39, figs. 1~9 (1903).

Colonies on SMA about 1cm high, fine, cottony, white, later yellowish-gray. Sporangiphores unbranched, erect. Sporangia spherical, brownish-yellow, 52 μ in diam., wall diffluent, leaving a collarette. Columellae free, spherical or oval, 28~46 μ . Spores usually variable, the majority elongate, ellipsoid, or kidney-shaped, 8 \times 3.5 μ , smooth, hyaline. Zygosporangia globose, echinulate, 40~90 μ in diam. Heterothallic.

Hab. : Ao Horizon, Horizon in depth of 75cm.

Mucor racemosus Fresenius

in Zycha: Mucorineae, p. 60 (1935).

Colonies on PDA white. Sporangiphores erect, forming a yellow-brown irregularly branched turf of 5~20mm high 8~15 μ wide. Sporangia globose, 20~70 μ in diam., first pale yellow, then yellow-brown. Sporangial wall not diffluent, but fragile, persistent, leaving a collarette. Columellae globose or ovoid, sometimes cuneiform or campanulate, 17~60 μ long 7~30 μ broad at the base. Spores globose or elliptic, 7 \times 8 μ , smooth, yellow in mass. Chlamydospores numerous, formed in the mycelium, or on the sporangiphore; colorless, or yellow, 20 μ in diam. or 11~20 μ in diam. 20~25 μ in length. The fungus not grew at 37°C.

Hab. : 50cm., 75cm. depth

Mucor silvaticus Hagem

Christ. Vidensk. Selsk. Skr. Math. Nat. Kl. 7: 31 (1908).

Colonies on PDA white or gray, dense, formed of thin filaments. Sporangiphores irregularly curved, with one or two lateral branches near the tip 1cm in height, 10 μ in width. Sporangia globose 35~60 μ in diam., wall diffluent, leaving basal collarette, globose or oval 22 \times 28 μ in diam. Spores oval or subglobose 3 \times 5 μ . Chlamydospores numerous, ovoid 16~24 μ in diam.

Hab. : On dung of rabbits at Ao Horizon.

Mucor subtilissimus Oudemans

Nederl. Kruidkund. Arch. 3: 435 (1898).

Colonies on PDA grayish white. Sporangiohores colorless, simple, with two or three septa, 200μ long, $4\sim 7\mu$ in diam. Sporangia globose, colorless, smooth, $40\sim 45\mu$ in diam. Columellae globose, $25\sim 33\mu$ in diam. Spores cylindrical $7\times 3\mu$. Zygosporos and chlamydo-spores unknown.

Hab. : On dung of rabbits at Ao, Aoo Horizon

Piptocephalis lepidula (Marchal) Benjamin

Bull. soc. Royale Bot. Belgique, 2 part, 30; 136 (1891). Benjamin (1959), Aliso 4 (2): 345

Colonies on *Mortierella* sp., on PDA warm buff, forming a turf to 10mm in two weeks; vegetative hyphae septate, $2\sim 3\mu$ in diam. ; Sporophores erect, stolon-like; the lower portion of the main stalk slender, $5\sim 6\mu$ in diam., hyaline, smooth. septate. The fertile branch systems consisted of $2\sim 4$ primary branches, $200\sim 520\mu$ long; secondary branches short producing whorls with $2\sim 4$ branches which ramified dichotomously $3\sim 4$ times; the ultimate branches tapered; head-cells depressed, globose 5.8μ in diam., bearing about 25 merosporangia, containing two ellipsoidal spores. Spores $5\times 2.5\mu$, the terminal spores smaller than the basal one.

Hab. : Parasited on *Mortierella* sp. and *Mucor* sp. at Aoo Horizon.

Rhizopus nigricans Ehrenberg

Nova Acta Acad. Leop. 10 (1): 198 (1818).

Colonies on PDA vigorous, grown with stolons. Stolons creeping, attached by means of rhizoids. Sporangiohores $1\sim 4$ mm. in height $25\sim 40\mu$ in diam. standing three to five in a group. Sporangia first white brilliant then black, later faint gray, globose $100\sim 330\mu$ in diam. Columellae hemispheric, 70μ in diam., 95μ in height. Spores irregularly ovoid, more or less angular, 12μ long 8μ in diam.

Hab. : On dung of rabbits at Aoo Horizon.

Syncephalastrum racemosum Cohn ex Schröeter

Kryptog. Fl. Schlesien 3 (1): 217 (1886).

Colonies on PDA at first white, later gray, about 5mm high. Mycelium with pseudo-holdfasts. Conidiophores vigorous, richly branched. Fruiting head globose or oval, $22\sim 60\mu$ wide, brown or gray, with numerous small warts to which the merosporangia attached. Merosporangia cylindrical of irregular size $5\sim 10$ spores; spores globose $2.5\sim 5\mu$ in diam.

Hab. : 20cm depth.

Syncephalis nodosa van Tieghem

Ann. Sci. Not. 6 sér. 1: 131 pl. 3 (1875). Indoh, H. in Sci. Rep. Tokyo Kyoiku Daigaku 11 (160): 19 (1962).

Merosporangiohores stout, single or $2\sim 3$ in cluster, $110\sim 160\mu$ in height, $8\sim 10\mu$ in diam., wall smooth. Rhizoids short and thick, branched irregularly. Heads obovate,

slightly truncate, 17~19 μ in diam., with many basal cells. Basal cells slightly lobed, each lobes bear a merosporangium. Merosporangia cylindrical, yellowish, formed 2~3 catenate merospores. Merospores cylindrical, 5.5 \times 12.2 μ , with a wall remarkably wrinkled.

Hab. : Parasited on *Mucor* sp. at Ao Horison.

Zygorhynchus heterogamus Vuillemin

Bull. Soc. Mycol. France 19:17 (1903)

Sporangiophores erect, 2mm long 13 μ wide, inegularly branched. Sporangia globose, 50~60 μ in diam, black, wall diffluent, leaving a collarete. Columellae sheriall, smooth. Spores round, 2~3 μ in diam. smooth. Zygosporos formed on the sporangiophores or on special mycelial filaments branched sympodially. Paired gametangia unequal; the one sessile, erect; the other with curved broad suspensor. Zygosporos 50~150 μ in diam. Exine brown, sping with blaek points, intine with simple warts. Chlamydosporos intercalary or terminal, elliptic or globose, 20 \times 24 μ .

Hab. : 20cm depth.

Zygorhynchus moelleri Vuillemin

Bull. Soc. Mycol. France 19. :117 (1903).

Colonies on PDA 0.5cm high, gray, cottony. Sporangiphores simple or branched, bearing 1~2 lateral branches. Sporangia gray-yellow, 48 μ long 50 μ wide, wall not diffluent. Columellae oval, 20~30 μ high 26~36 μ wide, wall smooth. Spores oval, 5 μ long 3~4 μ wide. Zygosporos as in *Z. heterogamus* but smaller, 20~54 μ in diam.

Hab. :5cm, 20cm depth.

Ascomycetes

Chaetomium cochliodes Palliser

N. Am. Flora 3: 61 (1910).

Perithecia on cellulose agar scattered ovate to subglobose, 300~380 μ in diam., with thin, dark brown membrane, thickly haired. Basal and lateral hairs pale brown, septate, tapering toward the end. Terminal hairs flexuous, irregularly spirally curved. Ascospores dark olive brown, lemon-shaped, 9~10.5 \times 7.5~9 μ , apiculate at both ends.

Hab. : On dung of rats at Aoo Horizon, Horizon in depth of 5cm.

Chaetomium fumicola Cooke

Grevillea 1: 176 (1873).

Perithecia on cellulose agar dark olive brown, subglobose, 180~250 μ in diam., ostio-late. Terminal hairs simple or branched; simple hairs tapering toward the tip, smooth, dark brown or black at the base, ; branched hairs few in number or forming a mass on the top of the perithecium, dark brown, smooth, dichotomously or irregularly branched. Asci club-shaped; ascospores obovate, apiculate, 5.5~6 \times 4.5 μ .

Hab. : Aoo Horizon.

Chaetomium globosum Kunze

Syst. Orb. Veg. 1: 156 (1825).

Perithecia scattered on cellulose agar, broadly ovate, pointed at the base, $270 \times 230 \mu$, olivaceous in fresh condition, dark brown in dry specimens, thickly covered with slender hairs. Apical hairs coarse simple, sparingly septate, 4μ thick, 700μ long, in pale olivaceous in fresh condition, light brown in dry condition. Asci oblong-clavate, evanescent; ascospores dark, broadly ovoid, faintly apiculate at the both ends, $8 \sim 9.5 \times 6.5 \sim 8 \mu$. Hab.: 5cm. depth.

Coniochaeta tetraspora Cain

Can. J. Bot. 39: 1231, figs. 3, 9 (1961).

Colonies in PDA velvety, zonate, producing black perithecia. Perithecia pyriform, $180 \times 140 \mu$, covered with straight dark brown septate hairs; peridium dark brown. Asci 4-spored, cylindrical, $43.5 \times 88 \mu$. Ascospores narrow ellipsoid or reniform, 14×8 dark brown, with germ slits. Conidial stage, phialospore- and blastospore-type; conidia ellipsoid $3 \sim 5 \times 1.5 \mu$, forming a globose mass 8.5μ in diam. at the apex of phialide.

Hab.: 20cm. depth.

Eurotium repens (de Bary) Benjamin

Imperfect stage. *Aspegillus repens* de Bary

Mycol. 47: 674 (1955).

Surface mycelium consisting of woven hyphae. Perithecia yellow studded among conidiophores. Asci $10 \sim 11 \mu$; ascospores lenticular, $5 \sim 5.5 \times 4 \sim 4.3 \mu$, smooth walled, equatorial area round, not furrowed.

Colonies on CSA flat, orange-yellow with abundant conidiophores. Conidial heads dull green, $125 \sim 160 \mu$ in diam., consisting of divergent chains of conidia radiating from a hemispherical vesicular apex of the conidiophore $24 \sim 38 \mu$ in diam. Stalks smooth, colorless, $600 \sim 950 \mu$ in length, sterigmata in one series, $7 \sim 9.5 \times 4 \sim 4.5 \mu$. Conidia elliptical to subglobose, spinulose $5 \sim 6.5 \mu$.

Hab.: 10cm. depth.

Gelasinospora longispora Udagawa

Trans. Mycol. Soc. Japan 8, (2): 50 (1967)

Colonies on LEA, spreading broadly, floccose. Perithecia scattered black, pyriform $800 \sim 1000 \times 500 \sim 700 \mu$; glabrous, basal part covered with pale brown septate curved hairs; neck black short papilliform, $400 \sim 450 \mu$ long $300 \sim 400 \mu$ broad. Asci 8-spored, cylindrical, $250 \sim 400 \times 30 \sim 35 \mu$, with a ring of wall at the apex; ascospores ellipsoid $37.5 \sim 42.5 \mu$ long, black, walls with numerous pits measuring $1 \sim 1.5 \mu$ in diam.

Hab.: 2cm. depth.

Melanospora fusispora (Petch) Doguet

Trans. Brit. mycol. Soc. 21: 254 (1938).

Perithecia on CA superficial, scattered, orange, globose, 300μ in diam, developing a papillate ostium, wall yellow. Asci 8-spored, clavate, $66 \times 12 \mu$; ascospores long ellipsoid, fuliginous, $20 \sim 24 \times 6 \sim 9 \mu$.

Hab. : 5cm depth.

Microthecium compressum Udagawa et Cain

Can. J. Bot. 47(12): 1921, fig.7~17, 28 (1969)

Hab. : 30cm. depth.

Microthecium retisporum var. *inferior* Udagawa et Cain

Can. J. Bot. 47(12): 1928, fig.25 (1969)

Hab. : 30cm depth.

Myxotrichum setosum (Eidam) Orr et Plunkett

Can. J. Bot. 41: 1470 (1963).

Cleistothecia on CA scattered, dark brown. Peridial hyphae much branched, erect, dark brown, thick-walled. Appendage dark brown septate, terminal branches protruding from all sides, bristle-like with pointed spines. Asci globose, 5~7 μ in diam.; ascospores hyaline, fusiform, 2.5~3 \times 3.5~5 μ .

Hab. : Ao Horizon, in depth of 2cm.

Podospora sp.

Perithecia on CA scattered, piriform, up to 700 μ tall and 300 μ wide, black. Asci clavate, 8-spored; ascospores limoniform 14.1 \times 10.4 μ .

Hab. ; 5cm depth.

Sordaria fimicola (Rob.). Ces. et de Not.

Dansk Botanisk Arkiv Bind 17(1): 95 (1957).

Perithecia on PDA semiimmersed, black, globose, 350~450 μ high, 300~400 μ in diam., ostiole about 150 μ in diam. Peridium 10~15 μ in diam., ostiole composed of a diverging text, surface paved with the clavate ends of the cells of this tissue. Asci 150 \times 15~18 μ , cylindrical; ascospores 1-seriate, 18~20 \times 10~12 μ , ellipsoid, dark brown, outer epispore gelatinous.

Hab. : On dung of rabbits at 2cm depth, Horizon in depth of 10cm.

Spathularia clavata Fr.

Hab. : Aoo, Ao Horizon in depth of 2cm.

Talaromyces vermiculatus (Dangeard) Benjamin

Imperfect stage. *Penicillium vermiculatum* Dangeard

Le Botaniste 10: 123~139 (1907).

Clonies on MEA attaining a diameter of 7.2cm in 14 days, yellow orange, forming abundant perithecia and pigmented enveloping mycelia; conidial structures produced rarely. Cleistothecia 200~450 μ in diam. ; asci oval to globose, 8~10 μ in diam. 8-spored; ascospores elliptical, echinulate, yellowish, 3.3 \times 4.5 μ .

Conidiophores arising from the substratum, 300 μ by 3.0~3.5 μ , smooth walled; penicilli consisting of verticils of 4~6 metulae. Metulae 8~9.5 μ long 2.8 μ in diam. bearing clusters of 6~10 sterigmata which measuring 7~8 μ long 2.5 μ in diam., tapering to the tips; conidia elliptical, smooth walled 2.8 μ \times 2.5 μ .

Hab. : 2cm depth.

Thielavia terricola (Gilman et Abbott) Emmons

Bull. Torrey Bot. Club. 57: 123~26 (1930).

Colonies on MEA broadly spreading, composed of white, cottony aerial hyphae, 1~5 μ in diam. Ascocarps by means of cleistothecium, spherical, without ostiole, 80~220 μ in diam., black, outer wall of cleistothecium composed of thick walled cells. Asci oval to pyriform, 17.5 \times 32 μ ; ascospores fusiform or elliptical, brown, 7.5 \times 14 μ .

Hab.: 20cm. depth.

Fungi Imperfecti*Acremoniella atra* Sacc.

Saccardo: Sylloge Fungorum 4: 302 (1897).

Colonies on MEA slowly spreading, brown; hyphae yellow, conidiophores erect, simple, hyaline, septate; main axis and branches of conidiophore, terminating a sporogenous cell; each sporogenous cell bearing a single conidium at the tip; conidia globose to ovoid, pigmented, smooth, thick walled, 18.2 \times 20.8 μ .

Hab.: Aoo Horizon

Acremonium sp.

Colonies on CSA forming a white turf; hyphae well branched, septate, prostrate. Conidiophores becoming erect, subligulate, simple or verticillate. Conidia globose to ovoid, 1-celled, hyaline, 3~4 μ , persistent.

Hab.: 2cm. depth.

Aspergillus aculeatus Iizuka

J. Agr. Chem. Japan 27: 806 (1953).

Colonies on CSA growing rapidly to 5~6.5cm in diam. at 25°C, in 14 days, producing a dense stand of conidial structures, and heavily spored, purple-brown or purple-black. Conidial heads globose at first, then splitting into a few compact divergent columns, reaching up to 800 μ in diam., light tan; conidiophores brownish, 1~2mm wide, 9 μ ~2 mm long, smooth; vesicles globose 60~90 μ in diam., brown shades, fertile over the entire surface; sterigmata in a single series, 6.8~10 \times 3.0~4 μ ; conidia elliptical to globose. 3.5~3.8 \times 4.8 μ , echinulate.

Hab.: Aoo Horizon in depth of 15cm and 30cm.

Aspergillus clavato-flavus Raper et Fennell

The Genus *Aspergillus* p.378 (1965).

Colonies on CSA growing rapidly, attaining a diam. of 4.8cm. in 2 weeks, consisting of gray-white surface mycelium. Conidial structures at first bright yellowish, later becoming buffy olive; exudate. Conidial heads globose or slightly radiate, 100~180 μ in diam.; conidiophores septate, with walls faintly yellowish, 1.0~1.5 μ thick, roughened; vesicles clavate or elongate, 20~27 \times 12~18 μ ; sterigmata in two, occasionally three series; conidia oval to elliptical, 3.0~3.3 μ \times 2.8 μ , smooth, yellow. Conidiophores in this strain not tend to develop in fascicles.

Hab. : 30cm depth.

Aspergillus foetidus (Naka.) Thom et Raper

Inst. Govt. Research Formosa Rept. 1 (1907)

Colonies on CSA growing slowly, attaining a diam. of 4.2cm. in 2 weeks, with vegetative mycelium white or yellowish, weakly zonate, bearing olive-brown to brownish black conidial heads; colony becoming reddish brown in age. Conidial heads globose to radiate, 200~400 μ in diam. : conidiophores 500~1000 high 12 μ in diam. walls smooth, colorless or brownish; vesicles subglobose or slightly elongate, 30~45 μ in diam., fertile over the entire surface or the upper three-fourths on vesicles; sterigmata in two series, brown conidia globose, with brown walls, finely roughened, 4.0~4.5 μ in diam., borne in chains.

Hab. : 50cm., 75cm., and 1m. depth.

Aspergillus foetidus (Naka.) Thom et Raper var. *pallidus* Naka., Simo et Wat.

J. Agr. Chem. Soc. Japan 12: 961~965 (1936).

Colonies in CSA attaining a diam. of 2.8cm. in 2 weeks, plane, mycelium at the margin white or yellowish. Conidial heads globose, up to 550 μ in diam., splitting into few columns; conidiophores smooth, colorless or in brownish tints 1mm \times 7~16 μ , vesicles globose, up to 50~58 μ in diam., fertile over the entire surface; sterigmata in two series, brownish; conidia globose or subglobose, spinulose, 3.5~4.5 μ in diam.

This variety differs from the species in its more restricted growth in CSA, the larger dimensions and more olive pigmentation of its conidial structures on MEA.

Hab. : 5cm depth.

Aspergillus fumigatus Fresenius

Beiträge zur Mykologie, p.81, pl. 10, figs 1~11 (1863).

Colonies on CSA velvety or floccose, green to dark green, later black. Conidiophores densely produced, up to 400 μ high 2.5~7 μ in diam., arising directly from submerged hyphae or branching out from aerial hyphae, septate or nonseptate, with flaskshaped vesicles of 20~30 μ in diam., fertile usually on upper half of the vesicle, bearing phialides in one series. 6~7.5 \times 8~2.8 μ , densely crowded. Chains of conidia form solid columns up to 400 \times 50 μ ; conidia dark green in mass, globose, 2.5~3.3 μ .

Hab. : Ao Horizon, Horizon in depth of 15cm and 30cm.

Aspergillus japonicus Saito

Botan. Mag. (Tokyo) 20: 61~63 (1906).

Colonies on CSA growing rapidly, 6.5cm in diam. in 14 days, but consisting of dense, white, irregularly wrinkled basal mycelium which gives rise a dense stand of conidial structures in purple-brown shades. Conidial heads small, radiate or split into few indistinct columns, 300~600 μ long. Conidiophores smooth, colorless or slightly pigmented, 550~1000 \times 5~8 μ ; vesicles colored in brownish yellow shade, globose, 25~30 μ in diam.; sterigmata uniseriate, 5.5~7.5 \times 3.2~4.5 μ , conidia globose, 3.5~4 μ in diam., strongly echinulate, spines 0.5 μ long.

Hab. : Ao Horizon.

Aspergillus niger van Tieghem

Ann. Sci. Nat. Botan. (5) 8: 240 (1867)

Colonies on CSA, rapidly growing with abundant submerged yellow mycelium. Conidiophores arise directly from the substratum, smooth, septate or nonseptate, $200\sim 380\times 7\sim 8\mu$; conidial heads fuscous, blackish-brown, purple-brown, carbonous black, columnar masses of a few conidial chains to the globose or radiate heads, $300\sim 800\mu$ long; vesicles globose, $20\sim 80\mu$ in diam., phialides typically in two series, thickly covering the vesicle, varying greatly in length, $6\sim 9\times 2\sim 3\mu$. Conidia globose, spinulose colored $2.5\sim 4.5\mu$.

Hab. : On dung of rabbits at Aoo Horizon, Horizon in depth of 50cm and 1m.

Aspergillus oryzae (Ahlburg) Cohn

Jahresber, Schles. Ges. Vaterl. Kultur 61: 226 (1883)

Colonies on CSA, growing rapidly, surface mycelium with longstalked conidial structures, aerial mycelium, at first white, becoming pale greenish yellow, conidial heads radiate, $150\sim 300\mu$ in diam; conidiophores arising from the submerged mycelium, colorless, $2.5\sim 5\text{mm.}$ in length, gradually becoming broad, $4\sim 6\mu$ in diam. at the base, to $12\sim 25\mu$ at the tip, with walls roughened. Vesicles subglobose or flask-shaped, with sterigmata covering the entire surface or the upper three fourths, $50\sim 60\mu$ in diam., sterigmata commonly in one series up to $12\sim 14\mu\times 3\sim 5\mu$, or in two series; conidia subglobose or globose when mature, $4.5\sim 6.5\mu$, smooth or roughened, echinulate greenish to brownish yellow, when young.

Hab. : 5cm. depth

Aspergillus terreus Thom

Am. J. Bot. 5. 85 (1918)

Colonies on CSA pinkish-cinnamon to deeper brown when aged, velvety or floccose; conidiophores $150\sim 240\mu$ long $5\sim 8.5\mu$ in diam., more or less flexuous, with smooth wall, septate or nonseptate. Vesicles $12\sim 23\mu$ in diam., bearing sterigmata in two series; primary sterigmata $7\sim 8.5\times 2.5\mu$, secondary sterigmata $5\sim 7\times 2\sim 2.5\mu$; heads becoming solid columnar masses up to 500μ long 50μ in diam. Conidia elliptical to globose, $2.2\sim 3\mu$ in diam., smooth, in long, parallel, adherent chains.

Hab. 75cm. depth.

Aspergillus versicolor (Vuillemin) Tiraboschi

Ann. Bot. (Rome) 7:9 (1908)

Colonies in CSA, white, orange-yellow, reverse to rose or red, surface growth velvety or floccose. Conidiophores up to $500\sim 680\mu$ long $5\sim 9\mu$ in diam., walls smooth, heads $110\sim 123\mu$ in diam., subglobose; vesicles $13\sim 18\mu$ in diam., flaskshaped, fertile on the upper two-thirds surface, with radiating phialides in two series; primary phialides $3\sim 5\times 3\sim 9.5\mu$, secondary $1.5\sim 1.8\times 5\sim 9.5\mu$. Conidia globose, delicately roughened, 4μ in diam.

In some strains, formation of second vesicles was observed. These second vesicles are

originated from several abnormally elongated sterigmata on a primary vesicle.

Hab. : 50cm depth.

Aureobasidium pullulans (de Bary) Arnaud

Ann. Mycol. 8: 475 (1910)

Colonies on MEA white at first, later dark brown and becomes yeast-like. Hyphae dark colored, consisted of elongate cells $20 \times 4 \mu$. Conidia hyaline, ovate $7 \sim 8 \times 3.5 \mu$, borne on broad creeping hyphae or on denticles. Mycelium later divides into a number of isodiametric cells with a thick wall.

Hab. : In snow at Aoo Horizon.

Beauveria bassiana (Balsamo) Vuillemin

Biblioteca Italiana 79, : 125 (1835)

Colonies on CSA growing slowly, floccose, rose brown; hyphae branched, septate, with flask-shaped phialides; conidiophores borne singly, or in groups, occurring in whorls or verticils. Phialides squeeze out sympodulospores in acropetal succession. Sterigmata in a zigzag arrangement. Spores ovoid, yellowish, $1.8 \times 3.0 \mu$.

Hab. : Ao Horizon, Horizon in depth of 1m.

Botryosporium longibrachiatum Oudem.

Saccardo: Sylloge Fungorum 10: 537 (1897)

Colonies on CSA floccose, yellowish; conidiophores erect, dichotomously branched, bearing lateral, fertile branches in acropetal succession. Fertile branch clavate, narrow at the base, broad near the apex, bearing a cluster of spores. Conidia growing on minute denticles, ovoid, $10.4 \times 6.2 \mu$.

Hab. : 2cm depth.

Cladosporium herbarum (Pers.) Link

Obs. Mycol. 2; 37 Mich. II, 472 (1902)

Colonies on CSA mat-like, yellow-green, later black-green; conidiophores erect, little branched, septate, brown, $5 \sim 8 \mu$ in diam.; conidia terminal, single or in chains, of various shapes and size, cylindrical or ellipsoid, $2.8 \sim 5.8 \sim 7.8 \mu$, smoky-brown, usually one-celled.

Hab. : 5cm depth.

Cladosporium resiniae (Lindau) de Vries

Rabenh. Krypt. Fl. Pilge VIII, Hyphomyc. 1: 699 (1906)

Colonies on CSA floccose, brownish-green; hyphae 4.2μ in diam., little branched, septate; conidiophores erect, tapering, bearing short chains of conidia at the tips. Conidia ellipsoid, spindle-shaped, green-brown, hyaline, $5.5 \sim 6.8 \times 3.5 \sim 4.3 \mu$

Hab. : Ao Horizon.

Diheterospora chlamydosporia Barron et Onions

Bot. Gag. 56: 275 (1913)

Colonies on CSA reaching to a diam. of 3.8cm in 14 days, floccose, white to pinkish-brown. Phialophores variable, simple or branched; phialides borne in 3~5 whorls meas-

uring $15\sim 25\mu$ long, 2μ broad, cylindrical, tapering towards apex; phialospores ovoid to cylindrical, smooth, hyaline, $3\times 4\mu$, gathering in balls at the mouths of the phialide, aleuriospores large, muriform, hyaline, at first becoming golden-brown when aged, $15\sim 28\times 15\mu$.

Hab. : 5cm depth.

Fusarium sp. A

Conidia on sporodochia in arched membrane on flattened stromata of various rough types, in dry condition powdery and hyaline. Conidia spindle or sickle-shaped, usually three-septate, $43\times 3.3\mu$, the center cell almost cylindrical, slightly curved, cells of both ends gradually tapered.

Hab. : Aoo Horizon, Horizon in depth of 10cm. and 30cm.

Fusarium sp. B

Conidia long, almost cylindrical $1\sim 5$ septate, rarely non-septate, $10\sim 60\times 2.5\sim 4\mu$; the center cell almost straight or slightly curved; the cells of both sides tapered. Chlamydo-spores $6\sim 11\mu$ in diameter.

Hab. : 5cm., 10cm., and 20cm depth.

Geotrichum candidum Link

Magaz. Naturf. Fr. Berlin 3:17. (1809).

Colonies on CSA cushion-like, somewhat powdery, white; hyphae prostrate, with a few septa. Conidiophores short, erect; conidia in chains, short-cylindrical, truncate at both ends, $5\sim 10\times 4\mu$, hyaline.

Hab. : 5cm. and 30cm depth.

Gliocladium roseum (Link) Thom

Bul. Soc. Mycol. France 23: 111—112, pl. 17, figs. 1—6 (1909).

Colonies on CSA, loose floccose, white, pink in fertile zone, reverse colorless when aged, hyphae simple or rope-shaped. Conidiophores borne as branches of aerial hyphae, $45\sim 120\mu$ long; matured conidiophore, up to 120μ high, enclosed in slime, at the apices; steigmata in 2 series, phialides $12\sim 16.5\times 2\sim 3\mu$, bearing conidia in gelatinous masses. Conidia colorless, appearing granular in plasm, elliptical, $5\sim 7\times 3\sim 4.5\mu$, slightly apiculate, smooth,

Hab. : Aoo Horizon.

Gonatobotrys simplex Corda

Pracht-Flora Eur. Schim. p. 9, pl. 5 (1839).

Colonies on CSA, spreading slowly, floccose, light brown to dark brown, $3.5\sim 4.5\mu$ in diam.; conidiophores septate, branched, $35\sim 100\times 4.5\sim 7\mu$, formed terminally and intercalarly at intervals of $50\sim 75\mu$ as round swellings. Conidia brown, elongate ovoid, $10\sim 15\times 7\sim 10\mu$, apiculate at the basal ends.

Hab. : Aoo Hrizon.

Helminthosporium nodulosum (Berkeley et Curtis) Saccardo

Saccardo. : Sylloge Fungorum 4: 421 (1901).

Mycelium on MEA, sparse, dark brown. Conidiophores erect, simple, curved and geniculate, septate, $80\sim 200\times 6\mu$. Conidia single at apex, brown, straight or curved, fusiform and flattened on one side, obtuse and gradually tapering, with relatively thick walls, $4\sim 10$ septate, $50\sim 95\times 12\sim 16\mu$.

Hab.: Ao Horizon.

Hormodendrum pallidum Oudemans

Saccardo: Sylloge Fungorum 4: 316 (1901).

Colonies on CSA, floccose, gray; conidiophores light gray, septate, constricting at the septa, dendroidly branched, primary and secondary branches decussate, consisting of single cells. Conidia variable in size, $12\sim 18\times 5\sim 8\mu$.

Hab.: Aoo Horizon.

Humicola brevis (Gilman et Abbott) Gilman

Iowa State Coll. J. Sci. 1: 225—344 (1927).

Colonies on CSA, at first felty, brownish-green, sometimes with whitish hyphae risen up from old surface mycelia, later turn to black, consist of dark colored, multiseptate aerial mycelium, bearing short conidiophores, $2\sim 10\mu$ long, dark colored. Conidia borne terminally, pyriform to subglobose, dark brown, $6.5\sim 9.5\times 5.5\mu$, one celled.

Hab.: Aoo Horizon

Humicola grisea Traaen

Myt. Magaz. f. Nat. 52: 19~120 (1914).

Colonies on CSA, well developed, hyphae septate, hyaline, 4μ in diam., bearing masses of yellow-brown conidia. Conidiophores short, subcylindrical, with a single apical spore. Spores globose, with granules, yellow-brown, $9\sim 16\mu$ in diam.

Hab.: 20cm depth.

Monilia acremonium Delacroix

Bull. Soc. Myc. Fr. 13:114, pl. 9. fig. c (1897).

Colonies on CSA, floccose, white; hyphae on media creeping, hyaline, sparsely septate, $4\sim 5\mu$ in diam. Conidiophores erect, with numerous septa, terminated conidial chains, Conidia arthrospore-type ovate-pyriform, truncate at the base, united by small connecting cells, $13\times 8.5\sim 9.5\mu$, hyaline.

Hab.: 30cm depth.

Monilia sitophila (Montagne) Saccardo

Saccardo: Sylloge Fungorum 4: 35 (1901).

Colonies on CSA, white, floccose; conidial masses pale orange or reddish orange. Vegetative hyphae hyaline, branched, septate; surface mycelium carries numerous short branches which grow to chains of arthrospores. Spores ovate to cylindrical, $5.5\sim 13.2\mu$ in diam.

Hab.: Ao Horizon.

Paecilomyces varioti Bainier

Bul. Soc. Mycol. Fr. 23; 26—27 (1907).

Colonies on CSA, growing rapidly, attaining a diam. of 5cm in 7 days, felty, yellowish-buff. Conidiophores arise from aerial, or submerged mycelium, freely or irregularly branched, up to 320 μ long terminated with a verticil of metulae or solitary phialides. Metulae variable in length, phialides 10~25 \times 3.5 μ ; conidia elliptical, smooth, 4.5 \times 2.5 μ ; macrospores ovate, 9 \times 6.5 μ .

Hab. :10cm depth.

Penicillium chrysogenum Thom

U.S.Dept. Agr. Bur. Anim. Ind., Bul. 118: 58 (1910).

Hab. : Aoo Horizon

Penicillium citrinum Thom

U.S.Dept. Agr. Bur. Anim. Ind., Bul. 118: 61 (1910).

Hab. : 75cm depth.

Penicillium commune Thom

U.S.Dept. Agr. Bur. Anim. Ind., Bul. 118: 56 (1910).

Hab. : 10cm depth.

Penicillium corylophilum Dierckx

Soc. Sci. Brux. 25: 86 (1901).

Hab. : Ao Horizon.

Penicillium cyclopium Westling

Arkiv für Botanik 11: 55~56, 90~92, figs 15, 57 (1911).

Hab. : Ao Horizon

Penicillium frequentans Westling

Arkiv für Botanik 11: 58, 133, figs. 39, 78 (1911).

Hab. : 5cm depth.

Penicillium funiculosum Thom

U.S.Dept. Agr. Bur. Anim. Ind., Bull. 118: 69 (1910).

Hab. : 2cm depth.

Penillium janthinellum Biourge

Monogr., La Cellule 33, (1). : 258 (1923).

Eab. : Aoo Horizon, Horizon in depth of 2cm, 5cm, 50cm, 75cm and 1m.

Penicillium nigricans (Bainier) Thom

The Penicillia, p. 351~353 fig. 56 (1930).

Hab. : Aoo and Ao Horizon.

Penicillium notatum Westling

Arkiv für Botanik 11: 55, 95~97, figs. 17, 59 (1911).

Hab. : 30cm depth.

Penicillium pallidum Smith

Trans. Brit. mycol. Soc.18: 88~89, pl.4, figs. 1~2 (1933).

Hab. : 10cm depth.

Penicillium raistrickii Smith

Trans. Brit. mycol. Soc. 18; 90 (1933).

Hab. : Aoo and Ao Horizon.

Penicillium restricum Gilman et Abbott

Iowa State College J. Sci. 1: 297, fig. 32 (1927).

Hab. : Ao Horizon

Penicillium sclerotiorum van Beyma

Zentbl. f. Bakt., (2) 96: 416, figs. 1~2 (1937).

Hab. : 2cm and 10cm depth.

Penicillium spinulosum Thom

U. S. Dept. Agr., Bur. Anim. Ind. Bul. 118: 76 (1910).

Hab. : 20cm depth.

Penicillium steckii Zaleski

Bul. Acad. Pol. Sci. Math. et Nat. Ser. B: 469 (1927)

Hab. : 20cm depth.

Penicillium thomi Maire

Bul. Soc. Hist. Nat. Afr. Nord. 8: 189~192 (1917).

Hab. : Aoo Horizon, Horizon in depth of 10cm.

Penicillium velutinum van Beyma

Zentbl. f. Bakt., (2) 91: 352~353, fig. 6 (1935).

Hab. : 5cm and 10cm. depth.

Penicillium waksmani Zaleski

Bul. Acad. Pol. Sci. Math. et Nat. Ser. B, p. 468 (1927).

Hab. : 10cm depth.

Periconia macrospinisa Lefebare et A.G. Johnson

Mycol. 41: 417~419 (1949).

Colonies on MEA well grown, with many conidiophores. Conidiophores simple, slightly flexuose, dark brown, septate, up to 320μ long, 10μ in diam. at the base, 8μ near the apex. Primary sporogenous cells $7 \times 12\mu$, forming a whorls. Secondary sporogenous cells produced on the primary sporogenous cells, ovoid, verruculose, $7 \times 8\mu$. Conidia black, spherical, with coarse, dark brown spines. $18 \sim 32\mu$, standing singly, sometimes in short fragile chains; spines deciduous.

Hab. : 10cm depth.

Pestalotia guepini Desm

Ann. Sci. Nat. Bot. (2) 13: 182~184, pl. 4, figs. 1~3 (1840).

Colonies on CSA velvety, whitish-yellow, scattering numerous pustules. Pustules punctiform, black, $90 \sim 170\mu$ in diam., globose-lenticular. Conidia erect, $14 \sim 20\mu$, elliptic-fusoid, 5-celled, constricted at septa; exterior cells hyaline, intermediate cells olivaceous, guttulate, $10 \sim 13 \times 5.5 \sim 6.5\mu$; setulae 1~3, $10 \sim 22\mu$ long, divergent; pedicels short, straight.

Hab. : 2cm and 5cm depth.

Pestalotia versicolor Speg.

Michelia 1: 479 (1879).

Colonies on CSA whitish-brown, velvety. Pustules globose-lenticular, 80~210 μ wide. Conidia 5-celled, clavate-fusiform, erect, 22~27 \times 8.5 μ , apical cell fuliginous opaque; with 3 setae 17~27 μ long, widely diverged; intermediate cells olivaceous, base cell guttulate. Hab.: 2cm. and 30cm depth.

Phialophora bififormis sp. nov. (Plate II)*

Colonies on MEA growing slowly reaching 1.7cm in diam., 0.5cm high in two weeks at 25°C, compact, floccose, at first "Lime green", later "Bluish-black"; hyphae brown 2.6~5.2 μ in diam., septate. Phialophores short, unbranched, projecting from hyphae terminally or laterally; phialides light brown, at basal portion 8.5 μ long, 3.8 μ broad, the upper portion consisting collarette. Collarette 3.2 μ long, 2.5 μ at the base and 4.8 μ near the apex. Conidiospores produced endogenously, yellowish, subglobose to oval, 2~6 \times 5.1 μ . Conidiospores remaining in a mass attaching each other with mucilage substance at the top of phialides. In this species, peculiar formation of yeast-like cells is observed, between the hyphal cell and phialides, the yeast-like cells 5~10, yellowish, subglobose, 5.3 \times 3.1 μ , falling together with the phialide when conidiospores detached.

This fungus resembles *Phialophora verrucosa* in the shape of conidia, but the present fungus has larger conidia than *Ph. verrucosa* and produces the yeast-like cells, which is not found in *Ph. verrucosa*. Consequently the author proposes to establish a new species for the fungus.

Type culture No. 400—2, preserved in author's private collection.

Hab.: Aoo Horizon in depth of 2cm, 5cm.

Phialophora sp.

Colonies on MEA growing rapidly, reaching 41cm in diam., 0.4cm high at central area, in two weeks under 25°C at first hyphae submerge the media, radiating and slightly zonating, later produce aerial hyphae throughout media. Aerial hyphae velvety, "Deep brownish drab", reverse "Bluish-black" slowly. Hyphae light grayish-brown, 3.5 μ in diam., septate; phialophores unbranched or irregularly branched; phialides 6.3 μ long 2.4 μ broad, with small collarette. Conidiospores produced endogenously, hyaline, oval-subglo-

Phialophora bififormis sp. nov.

Hyphae aerae numerosissimae, longe, liberae, flexuosae, crescens, compactae, breviter floccosae, superficies coloniae glaucose brunnea vel lividusa (lime green→bluish black sec. Ridgway), margo glaucose brunneus, tergum atrum.

Hyphae membranae olivaceae brunneae, 2.6~5.2 μ crassae, septatae. Conidiophori dispaniculati; phialides dilute brunneae, hyalinae, anguste orcaeformes, 11. 7 \times 3.8 μ , solitariae vel aggregatae, subapices paulo constricti, colli conspici acetabuli.

Conidia endogena, per ostiolum expulsa, numerosa, continua, flavida, subglobosa vel ovata, 2.6 \times 5.1 μ . 5~10 cellulae fermentinae subglobosae flavidae 5.3 \times 3.1 μ , inter phialidem et terminum hyphae monostiche ordinatae, simul cum phialide singulariter disciscenses, gemenses in medio, ad bicellulum vel tricellulum transeunes.

Hab.: In Aoo strato, strato altitudinis 2cm., 5cm. Typus 400~2

bose, $2.1 \times 4.8 \mu$.

This species resembles *Phialophora heterodeae* in shape of phialides and conidia, but the latter species has larger, conidia and its colonies are "Buffy brown"

Hab. : Snow on Aoo Horizon, Horizon in depth of 2cm.

Scopulariopsis acremonium (Del.) Vuillemin

Bull. Soc. Mycol. Fr., 27 :148, fig. 14 (1911).

Colonies on CA growing slowly, 9 mm in diam. in 7 days, velvety to powdery, pale buff; hyphae hyaline, $2.5 \sim 4 \mu$ diam., bearing abundant branches on which conidial fructifications produced; penicillus with very short stalk, bearing a verticil of phialides, or a mixed verticil of metulae and phialides. Conidia oval, with truncate base and pointed apex, $5.6 \times 3.5 \mu$, becoming cream-colored, when matured.

Hab. : Aoo Horizon.

Stemphylium botryosum Wallroth

Saccardo.: Sylloge Fungorum 4: 522 (1901).

Colonies on CA very dark, orbicular; mycelium consisted of thin, irregularly branched, at first hyaline, later dark brown, septate, flexuous, moniliform hyphae. Conidiophores arise as branches, flexuous, hyaline or brown-colored, rough, simple or apically forked. Conidia with short pedicel, globose, elliptical or oblong, divided horizontally into 2~6 cells by horizontal, vertical sometimes oblique septa isabel-colored to brownish-black, $25 \sim 38 \times 17 \sim 21 \mu$; wall finely dotted when aged.

Hab. : Aoo Horizon.

Trichocladium asperum Harz

Saccardo.: Sylloge Fungorum 4: 376 (1901).

Colonies on CA floccose, at first white, later black. Mycelium consisted of $2.6 \sim 3.5 \mu$ thick hyaline yellowish, branched, sparsely septate, hyphae. Conidiophores arise as short side branches, $3 \sim 10 \mu$ long. Conidia at first hyaline, later brown to black, oval, two-celled; upper cell spherical, brown to black, thick-walled, spiny; lower cell smaller, spiny, $20 \sim 22 \times 9 \sim 12 \mu$,

Hab. ; Ao Horizon.

Trichoderma viride Pers ex Fries

Neues Magaz. Bot. 1; 92 (1794).

Colonies on CSA spreading rapidly, forming a thin mycelial layer with patches of bluish green. Conidiophores erect, bearing terminally conidial heads, conidia globose or slightly ovate, $2.5 \sim 3 \mu$ in diam., green.

Hab. : Ao Horizon, Horizon in depth of 2cm, 5cm, 20cm, 30cm, 75cm and 1m.

Tritirachum roseum van Beyma

Antonie van Leeuwenhoek, 10; 118.

Colonies on MEA floccose, brownish-yellow; hyphae branched, septate, $1.7 \sim 2 \mu$ in diam.; Conidiophores upright, long, verticillately branched, 3~4 whorls of branches, apical branches. apical branches rachis-shaped, zigzag, fertile, $1.7 \sim 2 \mu$ in diam. $30 \sim 50 \mu$

long. Conidia apically or laterally produced, hyaline, 1-celled, subglobose, smooth, $2.3 \sim 2.7 \times 2 \mu$.

Hab. : Aoo and Ao Horizon.

Verticillium albo-atrum Reinke et Berthold

Saccardo: Sylloge Fungorum 10: 547 (1901).

Colonies on PDA, spreading, brownish. Conidiophores erect, simple, dark colored, paler at the apex, with up to whorls, 3~5 branches in a whorl; branches septate, simple or branched in whorls; terminal branchlets thickened at the base, narrowed at the apex, erect. Conidia elongate egg-shaped, hyaline, then brownish, $5 \sim 12 \times 3 \mu$.

Hab. : 50cm depth.

Verticillium effusum Otth

Saccardo. : Sylloge Fungorum 11: 599 (1901).

Colonies on CA and CSA white to yellow-brown turf short. Conidiophores branched oppositely, bearing short bulbous phialides, 3~4 in each verticil, $6 \sim 10 \mu$ long. Conidia single, globose, $3 \sim 5 \mu$ in diam.

Hab. : on dung of rats at Aoo Horizon.

Verticillium terrestre (Link) Lindau

Saccardo. : Sylloge Fungorum 4: 152 (1901).

Colonies on CSA white, spreading, floccose, consisting of dense branched hyphae. Conidiophores erect, septate, usually with 4 whorls of branchlets rarely branched verticillately. Conidia globose to elliptical, hyaline, $4 \times 5 \mu$.

Hab. : 5cm depth.

Dark hyphae A

Colonies on CSA spreading slowly, floccose, brown; hyphae septate, light brown, $2.5 \sim 3 \mu$ in diam. Not sporulated on certain media.

Hab. : 30cm depth.

Dark hyphae B

Colonies on CSA spreading very slowly, velvety, dark brown; hyphae septate, dark brown, 2.5μ in diam., forming numerous sclerotia-like body which consisting thick walls, variably shaped. Chlamydospores globose, hyaline, 10.5μ in diam.

Hab. : 1m depth.

Dark hyphae C

Mycelium on CSA spreading rapidly, immersed in the medium; hyphae hyaline, 4.5μ in diam., bearing black perithecium-like bodies which subglobose, $20 \times 19.5 \mu$, in the medium. This fungus produced neither asci nor ascospores.

Hab. : 30cm depth.

Dark hyphae D

Colonies on CSA spreading slowly, floccose, gray; hyphae septate, hyaline, 3.2μ in diam., bearing numerous chlamydospores intercalary at the hyphae. Chlamydospores hyaline, thick walled, globose or subglobose, 15.6μ in diam.

Hab. : 75cm depth.

Yeast

Cryptococcus diffluens (Zach) Lodder et Kreger van Rij

The Yeasts, p. 391 (1967).

Growth in MEA after 3 days at 25°C., cells are round or oval, $3.5\sim 6.8 \times 4.3\sim 7.5\mu$, single or in pairs. A ring and a sediment are formed. After one month at 17°C., a thick slimy yellowish pellicle and a slimy yellowish white sediment are formed, The cells are surrounded by a capsule. In slide cultures, no pseudomycelium is formed. Fermentation absent.

Sugar assimilation as follows:

Glucose positive, Maltose positive, Galactose positive, Lactose negative, Saccharose positive.

Assimilation of potassium: nitrate. Positive.

Ethanol as sole source of carbon. No growth.

Splitting of arbutin. Weak positive.

Hab. : 2cm. depth

Rhodotorula rubra (Demme) Lodder em. Hasegawa

Hefen 1, p. 69 (1934).

Growth in MEA after 3 days at 25°C. cells are long-oval, $2\sim 4 \times 5\sim 10\mu$, single or in pairs. The streak culture after one month at 17°C. is smooth and shiny, rugose and dull, often mucous; the color is red to orange red.

Slide culture, no pseudomycelium. Fermentation absent.

Sugar assimilation: Glucose positive, Maltose positive, Galactose positive, Lactose negative, Saccharose positive

Assimilation of potassium nitrate. positive. Ethanol as sole source of carbon: scanty growth.

Splitting of arbutin: negative.

Hab. : 2cm depth.

Basidiomycetes

The following species of the Basidiomycetes were collected from the litter layer, the rotten stumps and the surface soil under the litter in the larch forest.

Boletinus pictus (Peck) Peck

Camarophyllus pratensis (Fr.) Karst.

Camarophyllus virgineus (Fr.) Karst.

Cantharellus cibarius Fr.

Coriolus versicolor (Fr.) Quéf.

Fomitopsis insularis (Murr.) Imaz.

Hirschioporus abietinus (Fr.) Donk
Hirschioporus fusco-violaceus (Fr.) Donk
Inocybe praetervisa Quél.
Laccata sp. (Fr.) Berk et Br.
Lactarius piperatus (Fr.) S. F. Gray
Lycoperdon gemmatum Fr.
Marasmiellus delicatellus (Peck) Sing.
Mycena sanguinolenta (Fr.) Quél.
Naematoloma fasciculare (Fr.) Quél.
Ramaria aurea (Fr.) Quél.
Russula aurata Fr.
Russula sanguinea Fr.
Stereum sanguinolentum (A. et S.) Fr.
Suillus aeruginascens (Secr.) Snell
Suillus grevillei (Klotzch) Sing.

Discussion

As shown in the results mentioned in the former chapter, the species number of fungi isolated from each soil horizons become gradually fewer according to the depth, from Aoo horizon to under layers. More than a half of species of mycoflora inhabit the soil horizon of Aoo and Ao in the forest.

The most phycomycetous fungi distribute in upper soil layers between Aoo horizon and Ao horizon of 5cm depth. But several species of *Mortierella* were isolated from soil horizon B 30 and 50 cm depth and *Mucor hiemalis* and *M. racemosus* were found from horizon B 50 and 75 cm depth.

The dominant species in the larch forest are *Trichoderma viride*, *Penicillium janthinellum*, *Aspergillus fumigatus*, *Mucor fragilis*, *Mortierella alpina*, *M. ramanniana*, *M. ramanniana* var. *angulispora*, *Aspergillus niger* groups, *Mortierella nana*, *Phialophora biformis* sp. nov., *Ph. sp.*, *Mucor hiemalis* and *Mortierella elongata*.

By means of LEA plate culture, the following 19 species were isolated: *Mortierella elongata*, *M. ramanniana* var. *angulispora*, *Mucor fragilis*, *Chaetomium cochliodes*, *Gelasinospora longispora*, *Aspergillus foetidus*, *Aureobasidium pullulans*, *Fusarium* sp. a, *Gonatobotrys simplex*, *Humicola brevis*, *H. grisea*, *Penicillium chrysogenum*, *P. commune*, *P. cyclopium*, *P. janthinellum*, *P. raistrickii*, *P. steckii*, *Phialophora bifora* sp. nov., *Trichoderma viride*. It is noticeable fact that *Gelasinospora* isolated only on this medium. The author considers that this species is a peculiar fungus to larch forest soil, because the another record of this species from Japan is reported by S. Udagawa (1966) isolating also from a larch forest soil at 20°C. But *Mucor corticolus*, *Gelasinospora longispora*, *Aspergillus fumigatus*, *A. niger*, *Humicola brevis* and *Penicillium janthinellum* were isolated only at 30°C. Such fungi must be regarded as thermotolerant.

On the other hand, following species were isolated incubating at 5°C.: *Mortierella alpina*, *M. nana*, *Mucor hiemalis*, *Piptopezialis lepidula*, *Syncephalis nodosa*, *Myxotrichum setosus*, *Aspergillus niger*, *Aureobasidium pullulans*, *Beauveria bassiana*, *Botryosporium longibrachiatum*, *Gonatobotrys simplex*, *Penicillium chrysogenum*, *P. commune*, *P. cyclopium*, *P. funiculosum*, *P. spinulosum*, *Phialophora bififormis* sp. nov., *Stemphileium botryosum*. The growth of these fungi is rather slow but well on various kind of media at 5°C. The author considers that it is necessary to isolate by means of such methods for the study of soil mycoflora, because we can find pretty number of fungi can not grow under ordinary temperature.

Warcup (1959) reported 122 species of fungi occurred in pasture soil of various pH values. He used only Dox agar with 0.5% yeast extract and employed soil plate method for the isolation at 22.5°C. 24 species of his isolations are common to the species of the present study. That is: *Absidia glauca*, *Mortierella alpina*, *M. humilis*, *M. isabellina*, *ramanniana*, *Myxotrichum (Gymnoascus) setosus*, *Trichoderma viride*, *Trichocladium asperum*, *Penicillium nigricans*, *P. raistrickii*, *P. janthinellum*, *P. frequentand*, *Humicola grisea*, *Mucor hiemalis*, *M. racemosus*, *Zygorhynchus moelleri*, *Chaetomium fumicola*, *Aspergillus fumigatus*, *A. terreus*, *A. versicolor*, *Cladosporium herbarum*, *Gliocladium roseum* and *Periconia macrospina*.

Tresner and his coworker (1954) investigated soil microfungi in hardwood forests (*Quercus velutina*, *Q. alba*, *Q. rubra* and *Acer saccharum*), in Wisconsin. They isolated 53 species of fungi by dilution method, on soil extract medium. The common 13 species to the results of the present research are *Absidia glauca*, *Mucor hiemalis*, *Mortierella ramanniana*, *Cladosporium herbarum*, *Penicillium janthinellum*, *P. waksmani*, *P. raistrickii*, *P. funiculosum*, *P. restrictum*, *P. steckii*, *P. spinulosum*, *P. nigricans* and *P. thomi*.

Thornton (1956) surveyed the occurrence of fungi in soils of a forest of oakwood and heath. He isolated 53 species of fungi by means of only a single method of screen immersion plates. 17 species of them are common to the fungi of the present research, and they are as follows: *Mucor hiemalis*, *Mortierella ramanniana*, *M. humilis*, *M. nana*, *M. gracilis*, *M. alpina*, *M. elongata*, *Zygorhynchus moelleri*, *Trichoderma viride*, *Humicola grisea*, *Gliocladium roseum*, *Penicillium nigricans*, *P. notatum*, *P. spinulosum*, *P. frequentans*, *P. thomi*, *P. waksmani*.

Gochenaur and Backus (1967) reported 115 species of fungi from willow bushes and cottonwoods in Wisconsin. They isolated them only by means of dilution method on glucose-ammonium nitrate nutrient agar. The common 19 species of the fungi to the present research are as follows: *Absidia glauca*, *Aspergillus fumigatus*, *A. niger*, *Aureobasidium pullulans*, *Beauveria bassiana*, *Gliocladium roseum*, *Mortierella alpina*, *Mucor fragilis*, *M. hiemalis*, *Penicillium cyclopium*, *P. funiculosum*, *P. janthinellum*, *P. nigricans*, *P. raistrickii*, *P. spinulosum*, *P. steckii*, *P. thomi*, *Thielavia terricola*, *Trichoderma viride*.

Brandsberg (1969) studied qualitatively, 128 species of fungi on litters of conifers, a

fir and pines. He employed dilution method, on 8 kinds of media: MMA, CSA, Blake-slee's malt agar, V—8 juice agar, water agar, Cooke's rose bengal agar, soil extract agar and duff decoction agar. The following 28 species of fungi are common to the present research: *Absidia glauca*, *A. spinosa*, *Mortierella ramanniana*, *Mucor hiemalis*, *Rhizopus nigricans*, *Melanospora fusispora*, *Aspergillus fumigatus*, *A. niger*, *A. versicolor*, *Aureobasidium pullulans*, *Beauveria bassiana*, *Cladosporium herbarum*, *Gliocladium roseum*, *Penicillium chrysogenum*, *P. citrinum*, *P. corylophilum*, *P. cyclopium*, *P. frequentans*, *P. funiculosum*, *P. nigricans*, *P. notatum*, *P. raistrickii*, *P. steckii*, *P. thomi*, *P. velutinum*, *Stemphiliium botryosum*, *Trichoderma viride*, and *Verticillium trrestre*.

Wang (1965) isolated 84 species of fungi from pulp and raw paper in pulp mill. It is an interesting fact that 22 species of them are common to the result of the present research. They are *Mortierella isabellina*, *Mucor hiemalis*, *Syncephalastrum racemosum*, *Aspergillus fumigatus*, *A. niger*, *A. repens*, *A. terreus*, *A. versicolor*, *Aureobasidium pullulans*, *Beauveria bassiana*, *Cladosporium herarum*, *Geotrichum candidum*, *Penicillium citrinum*, *P. corylophilum*, *P. cyclopium*, *P. frequentans*, *P. funiculosum*, *P. janthinellum*, *P. notatum*, *P. thomi*, *P. vermiculatus* and *Trichoderma viride*. Most of them can be supposed to be inhabitants in the original forest soil.

Comparing these results to the isolation of soil fungi of the larch forest, the author has been able to isolate the most number of species. It is why that the author collected the fungi by means of many kind of methods, in spite of the soil samples carried out in a limited forest. In conclusion, it must be intended to employ as many kinds of media and of isolating methods as possible, to achieve complete results, in the floral survey of soil fungi.

Summary

A floral survey of the soil microfungi, in the larch forest in Sugadaira was carried out. In order to record as far as completely the mycoflora of that area, the author tried every possible means, and was able to isolate 567 strains of fungi, and identified 110 species of mold fungi. The dominant species are *Trichoderma viride*, *Penicillium janthinellum*, *Aspergillus fumigatus*, *Mucor fragilis*, *Mortierella alpina*, *M. ramanniana*, *M. ramanniana* var. *angulispora*, *M. nana*, *Aspergillus niger* groups, *Phialophora biformis* sp. nov., *Mucor hiemalis* and *Mortierella elongata*.

From Aoo and Ao layers, more than half species of fungi of that aeria were isolated. Phycomycetous fungi were isolated from upper soil horizons, Aoo and A (2 cm and 5cm depth), and Ascomycetes distributed between the horizons of A (2cm depth) and B (30 cm depth).

Phialophora biformis sp. nov. and *Mortierella zychae* var. *japonica* nov. var. are described as new to science.

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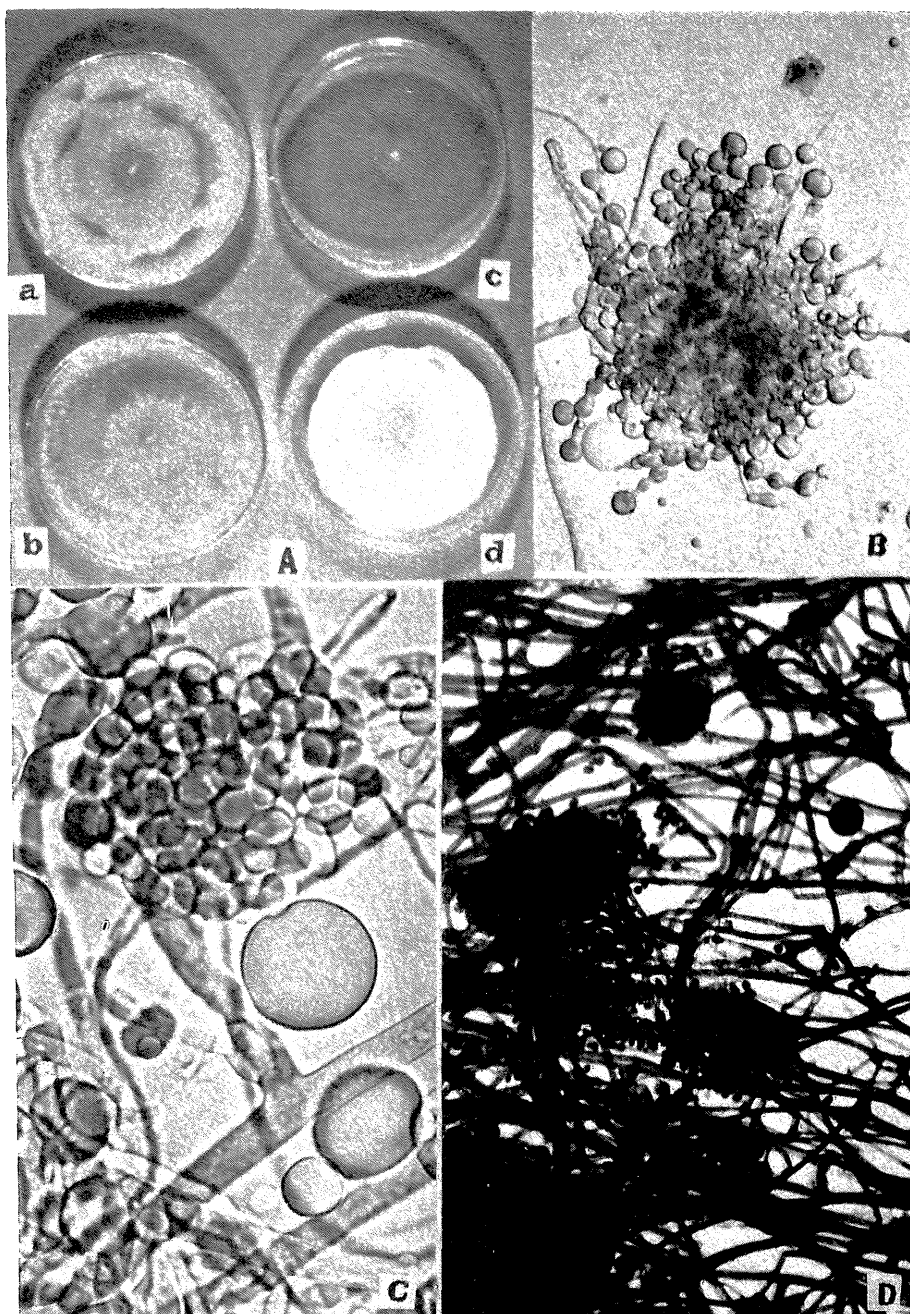
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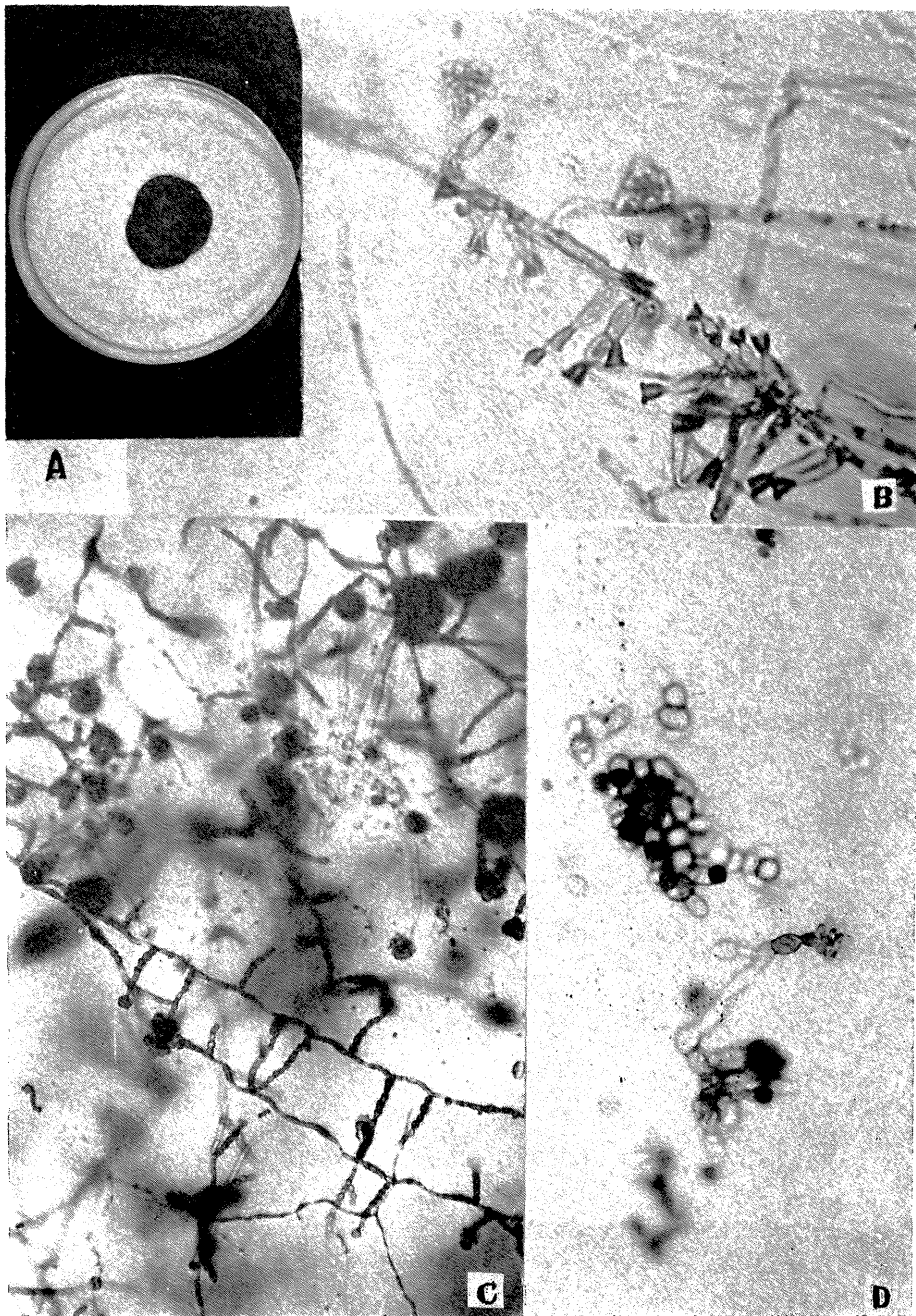
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Mortierella zychae var. *japonica* nov.

- A. Mycelium a. on MEA, b. on PDA, c. CSA, d. on SMA
 B. A mass of gemmae
 C. Spores D. Sporangium
 (A×1/3; B. C×1200; D×300)



Phialophora biformis sp. nov.

- A. Mycelium
 - B. Phialides
 - C. Showing a serial yeast-like cell
 - D. Showing the budding of yeast-like cells
- (A $\times 2/5$; B, D $\times 1200$; C $\times 300$)