Yosio Kobayasi & Kazuko Konno: Watermoulds isolated from soil in Tsushima Island (1)

Concerning to the plant distribution the Tsushima Island is very important, which is situated in the Korea Strait between Korea and Kyūshū of Japan. At there the common elements of Korea and Japan are found in the locally scattered small areas of natural forests. Moreover, the elements of subtropical zone of south Japan such as evergreen oak and camellia are growing in lowland by the influence of warm current washing along the coast of this Island.

Consequently, some interesting fungi are expected to be found in this Island.

The senior author collected the soil samples from the 59 localities of different environmental area and isolated the watermoulds from these samples using many kinds of baits in October 1969. In the present paper, 19 species of chytridiaceous fungi and 12 species of other groups of watermoulds are enumerated. Chytridium pilosum is new to science, and the followings are new to Japan.

- Rhizophydidum elyensis
- R. keratinophilum
- R. spinosum
- R. stipitatum
- Phlyctochytrium papillatum
- Blytiumyces laevis
- Chytridiomyces suburceolatus
- Nowakowskiiella profusa
- Lagenidium pygmaeum

Soil samples collected in Tsushima Island

2. Soil in thin wood
3. Ditch soil among thin wood

* National Science Museum, Ueno Park, Tokyo.
4. Soil of dried rice field after harvest, Tutu
5. Compost heap, Tutu
6. Soil among grove of Takuzudama shrine
7. Soil in dried rice field called "sinden"
8. Sand of seashore, Komoda, Oct. 21 '69
9. Mud of pond of brackish water, Komoda Shrine
10. Brackish water algae in pond, Komoda Shrine
11. Mud in Komoda Harbor
12. Soil in rice field, Komoda
13. Sand along river near Yatate-yama
14. Soil in ancient tomb, Yatate-yama
15. Roadside soil of Sasu
16. Soil of Okubi-zuka
17. Soil in dried rice field of Kyôzuka
18. Soil along river, Kyôzuka
19. Soil of graveyard, Banshôin, Izuhara, Oct. 21 '69
20. Spring water in Banshôin
21. Soil in Bamboo bush of Banshôin
22. Soil in ditch of Izuhara Shrine
23. Soil among grove of Izuhara Shrine
24. Wet soil in Izuhara Shrine
25. Soil at the top of Tatikameiwa, Izuhara
26. Spirogyra in river of Izuhara
27. Sea-algae along seashore, Ozaki, Oct. 19 '69
28. Wet soil of rice field, Ozaki
29. Soil in thin wood, Ozaki
30. Wet soil of abandoned rice field, Ozaki
31. Sand of river beach, Imazato
32. Soil on cliff along sea shore, Imazato
33. Soil in grove of Keti Shrine
34. Wet soil of rice field, Keti
35. Mud along river, Keti
36. Soil in dried rice field, Nita, Oct. 17 '69
37. Wet soil in rice field, Nita
38. Sand of river beach, Nita
39. Soil in wood, Nita  
40. Sand of river beach, Sisimi  
41. Soil in wood mixed with camellias, Sisimi  
42-43. Soil in wood, Sisimi  
44. Soil along river, Mt. Mitake, Oct. 18 '69  
45. Soil along ridge of Mt. Mitake  
46. Soil at the top of Mt. Mitake  
47. Soil among evergreen forest, Mt. Mitake  
48. Soil in Cryptomeria forest near Dōzaka  
49. Soil along river between Dōzaka and Sago  
50. Soil along river between Dōzaka and Sago  
51. Soil in rice field, Sago  
52. Sand of seashore, Sasuna, Oct. 19 '69  
53. Soil in river, Sasuna  
54. Soil in wood, Sasuna  
55. Soil along stream, Waniura  
56. Sand along river, Ooura  
57. Sand of seashore, Ooura  
58. Soil near the mouth of river, Waniura  
59. Soil in buckwheat field, Waniura  

1. Rozella sp.  

Zoosporangia filling the host hyphae, up to six, developing in a series, clavate, cylindrical or doliform, 14-16 μ high, 21-35 μ in diameter, with one low discharge papilla, 3-4 μ in diameter; zoospore not observed; resting sporangia cylindrical, doliform or irregular, up to 160 μ in height, up to 70μ in diameter, resting spores up to thirty eight in each sporangia, spherical, blackish brown, 12-18 μ in diameter, wall densely spinulate, spines triangular 1-1.5 μ broad at base, abruptly tapering to the end, 2-2.5 μ long, with a large oil globule.  

Hab. Parasitic on Allomyces sp. from soil No. 1.  

This species does not correspond with description of R. allomicis in shape and density of the spines and color of the resting spores.  


Zoosporangia spherical to subspherical, somewhat angulate by papillae,

when mature, 9-55 μ (av. 31.8 μ) in diameter, wall smooth thin with 2-12 (rarely 1-17) exit papillae 6-10 μ in diameter, 1 μ in height; rhizoidal system single, main axis up to 7 μ (mostly 5 μ) thick, branching two to three times and tapering; zoospores elongate at emergence, soonly becoming to globose or spherical 2.5-3.5 μ in diameter, with a small refractive globule, flagellum 15-20 μ long, emerging individually but simultaneously from several exit pores.

Hab. Saprophytic on snake skin bait from soil Nos. 25, 45 and on chitin bait from soil No. 31.


Zoosporangia spherical to subspherical, 13-42 μ in diameter, wall spiny or warty, with 2-6 exit papillae, spines or hairs 5-45 μ long, thin, warts simple or bifurcate 0.5-1.2 μ in width, 2-5 μ in length (mostly 3 μ); rhizoid branching and extending, 35 μ long, main axis 5 μ in width; zoospores hyaline spherical, 2-3 μ in diameter, with a small refractive globule, flagellum 11-14 μ in length. Resting spores spherical, 10-15 μ in diameter, wall thick, brown with numerous prominent warts.

Hab. Saprophytic on human hair and snake skin baits from soil Nos. 4, 35 and 42.

The feature of the ornamentation of the zoosporangial wall differs among strains; spines in No. 4 are very long, thread like and warts very few, spines in No. 35 are not so long and spines in No. 42 very few, and thick bifurcate warts occupy the surface of the wall.


Zoosporangia globose, 17-26 μ in diameter, with a broad apical papilla, wall smooth hyaline; rhizoid branched; zoospores spherical, 3-4 μ with a colorless refractive globule, flagellum 15-20 μ long, emerging through a broad apical pore formed upon the deliquescence of papilla. Resting spores not observed.

Hab. Saprophytic on pine pollen bait from soil Nos. 21 and 41.

5. **Rhizophydium sphaerotheca** Zopf in Abhandl. Naturforsch. Ges. Halle 17: 92, Pl. 2, Figs. 33-41 (1887); Sparrow, Mycologia 24: 275, Fig. -- 9 --

Hab. Saprophytic on pine pollen bait from soil Nos. 2, 14, 17, 24, 25, 31 and 39.


Zoosporangia stipitate, spherical, subspherical, obpyriform, 13–30 μ in height, 11–29 μ in diameter, wall thin smooth with 1–3 exit papillae, sporangial stalk up to 25 μ long; rhizoid delicate, branched; zoospores spherical, 2.5–3 μ in diameter, within a hyaline refractive globule, flagellum 13–17 μ in length, emerging through deliquescent papillae individually, and swimming instantly. Resting spores abundant, stipitate, spherical, 6–11 μ in diameter, wall spinose, about 1 μ thick, spines simple, 2–3 μ long. Resting spores germination not observed.

Hab. Saprophytic on eroded cellophane by Chytridium in soil No. 47.

According to Willoughby, this species was observed only on substratum heavily eroded by Rhizophlyctis rosea. It was reported by Dogma from fungi free lense paper bait decomposed by bacteria. In the Japanese material, it is observed on cellophane, on which, thalli of Chytridium pilosum was growing.

It is a question whether this species needs in its growth, hydrolysed products of cellulose, produced by other fungi and bacteria, or other hyper-parasitic chytrids. The Japanese species occurs frequently on sporangia of Chytridium pilosum directly, and, moreover, tangles with rhizoids and hyphae of other fungi which are extending to the water from the edge of the cellophane. But, rhizoids of R. spinosum are too tenuous to define whether or not the rhizoids are inserting into the thalli of Chytridium pilosum and hyphae of other fungi. But, the development and maturation of Chytridium pilosum seem to be not prevented by growth of R. spinosum.


Zoosporangia stipitate, spherical to subspherical, 30–45 μ in diameter, wall smooth, hyaline, with two to four exit papillae 8–12 μ in diameter,
non-apophysate; rhizoidal system arising from a single axis on the sporangium, ramified and developed luxuriantly; zoospores spherical, 3-4 μ in diameter with one small refractive globule, flagellum 20-25 μ, emerging by deliquescence of the papillae.

Hab. Saprophytic on snake skin bait from soil No. 37.

8. Rhizophydium sp. (no. 1)

Zoosporangia spherical or globose, 24-92 μ in diameter, wall smooth, yellow-brown, 1-1.5 μ thick, with an apical discharge papilla 4-8 μ in height, 8-20 μ in diameter at the base, rhizoidal system arising from one place of the zoosporangial base, branching and tapering towards the end, extending up to 400 μ long or more, main axis up to 8 μ or more in diameter; zoospores spherical colorless, 4-5 μ in diameter within a hyaline refractive globule 1-2 μ in diameter, flagellum 23-28 μ in length, fully formed zoospores emerging by deliquescence of papilla.

Hab. Saprophytic on snake skin and bee wings bait from soil Nos. 34, 41.

This chytrid is characterised by yellow-brown sporangial wall and broad, low exit papilla, whose wall is thin and colorless.

9. Rhizophydium sp. (no. 2)

Zoosporangia subspherical, 12-57 μ in height, 9-49 μ in width, or spherical, 15-40 μ in diameter, wall hyaline smooth thin, with an apical inconspicuous exit papilla, 5-15 μ in diameter; rhizoidal system arising from a basal portion of the sporangium, sessil or seldom stipitate, main axis up to 7 μ thick, branching and extending up to 100 μ long or more (rarely 200 μ); zoospores spherical, 3-4 μ in diameter, within a spherical refractive globule, 1-2 μ in diameter, flagellum 20-25 μ long, discharging by deliquescence of the exit papilla.

Hab. Saprophytic on cellophane bait from soil Nos. 24, 48.

This chytrid grows in a cluster on cellophane and is extending rhizoids radially.

10. Phlyctochytrium papillatum Sparrow in Mycologia,44: 764, Fig. 1, p-q (1952).

Zoosporangia spherical to subspherical, 21-23 μ in diameter with two to three discharge papillae, 3-4 μ in diameter; endobiotic portions consist of an apophysis and rhizoids, apophysis spherical or globose, 5-7 μ in diameter,
rhizoid branching and extending up to 20 μ long or more. Zoospores and resting spores not observed.

Hab. Saprophytic (?) on pine pollen bait from soil D-4; D-9.

11. Blyttoomyces laevis Sparrow in Mycologia 44: 765, Fig. 1, 1-0 (1952).

Zoosporangia subglobose, ovate or flattened globose; 9-22 μ in height, 9-27 μ in diameter, wall thin smooth, with an apical, subapical or lateral apiculus and 1-3 exit pores, apiculus thick walled, 3-6 μ in diameter at base, 2-4 μ in height; intramatrical portion consists of an apophysis and rhizoid, apophysis small, it seems almost fusiform swelling of rhizoidal axis, 2.5-4 μ in diameter at the largest place, rhizoid sparsely branched; zoospores small, spherical, about 3 μ in diameter.

Hab. Saprophytic on pine pollen bait from soil No. 44.

*Blyttoomyces laevis* was described at first as a parasite of *Zygnesia*. In the Japanese species, it seems to be a saprophyte of pine pollen; the zoosporangium of this material is, furthermore, larger than the original description, although in morphological features, it is surely the same with Sparrow's figures.


Hab. Saprophytic on cellophane bait from soil, Nos. 5, 14, 15, 17, 23, 25, 29, 38, 40, 45, 54 and 59.

13. Rhizophlyctis sp.

Zoosporangia oval or pyriform, 30-105 μ in height, 25-87 μ in diameter, spherical, 40-92 μ in diameter, wall yellowish; smooth, 1-2 μ thick with a large low barely perceptible exit papilla which seldom protruding and fairly conspicuous; rhizoidal system arising from several portions of the sporangium, much branching to the end; zoospores spherical 4-6 μ in diameter, with one to several hyaline refractive globule, flagellum 25-35 μ long. Resting spores not observed.

Hab. Saprophytic on snake skin bait from soil Nos. 20, 45 and on bee wings bait from soil Nos. 21, 38, 45 and 48.
This fungus has sometimes a thick walled papillate appendix on the surface of the zoosporangium on the snake skin, 5-12 \( \mu \) in diameter.

This species is very similar to *Rhizophlyctis* sp. 3, described by Willoughby from Australian soil in 1965 (Arch. f. Mikrob. 52: 107 Figs. 4a–e.).

14. *Cladochytrium* sp.

Polycentric, zoosporangia spherical, elongate, elliptical, pyriform, urceolate or various shaped, 12-48 \( \mu \) in long axis, 12-31 \( \mu \) in others, with or without a long neck, endo-operculate, nonapophysate; rhizomycelium profuse, 4-8 \( \mu \) in width, without fusiform swellings; zoospores spherical to globose, 4-5 \( \mu \) in diameter, within a small refractive globule, flagellum 30-35 \( \mu \) long, emerging in mass by dehiscence of gelatinous plug and perhaps an endo-operculum, and after 30-40 \( \mu \) sec., get motility and dispersing. Resting spores abundant and formed preceeding for zoosporangium, spherical or various shaped, 15-25 \( \mu \) in diameter, resting sporangial wall thin, spore wall 2-3 \( \mu \) in thickness, content granulate with a spherical oil globule 7-10 \( \mu \) in diameter.

Hab. Saprophytic on cellophane bait from soil No. 36.

This chytrid resembles closely to *Nowakowskia multispora* Karling (1963), but there are several following differences; zoospores are slightly bigger, flagellum is longer and the most of the zoosporangia do not possess a long exit tube. The endo-operculum was inconspicuous and could not be recognized in living materials, but it was observed after the materials were fixed.

15. *Chytridium pilosum* Kobayasi et Konno sp. nov.

Zoosporangia globosa 15-30 \( \mu \) in diam., saepe binis-quinis sporangii multiplicatis, manifeste 2-5 lobatis, ad 70 \( \mu \) in diam. attingentis, peridiis fuscatis, conferte spinosis, spinis elongatoconicis vel triangulis 1-8 \( \mu \) longis, ad basim 4 \( \mu \) in diam., operculo apicale vel subapicale, 12-35 \( \mu \) in diam. Rhizoideum e basi vel parte constricta zoosporangii oriundum, basi dilatatum et discoideum, apice profuse ramosum, ramis ca 35 \( \mu \) longis. Zoosporae extra foramen zoosporangii conglobatae vesiculiformes, inde liberationes, sphericae 4-6 \( \mu \) diam., cum globulis nonnullis pallide aurantiacis, flagello 25-30 \( \mu \) longo.

Zoosporangia globosa, 15-30 \( \mu \) in diameter, occasionally two to five globes or clubs complicated, forming 2 to 5 lobe reactions, and up to 70 \( \mu \) in diameter, wall brown, densely spinose, spines filamentous to triangular, 1-8 \( \mu \) in length, up to 4 \( \mu \) in width at the base, operculum apical or subapical, 12-35 \( \mu \) in di-
ameter, with same surface with sporangial wall; rhizoidal system arising from a base of the zoosporangium or from a constricted portion in complicated sporangia, base of rhizoidal axis up to 30 μ in diameter, sometimes abruptly narrowed to one half or to one-fifth, consequently, forming disk shaped basal appearance in thick ones, rhizoids branching profusely and extending up to 350 μ or more; zoospores emerging by dehiscence of operculum, and conglomerate at orifice of zoosporangium, enveloped with vesicle, and freed or discharged soon after the rupturing of vesicle. Zoospores spherical 4-6 μ in diameter with several pale orange globules in it, flagellum 25-30 μ in length.

Hab. Saprophytic on cellophane bait from soil No. 47. (Type preserved in the Herbarium of Nat. Sci. Museum, Tokyo)

Among the genus Chytridium, there are no species with ornamented walled sporangia with branched rhizoid as this material. On the other hand, in the genus Chytromyces, Fay described C. spinosus in 1947, which has spinose wall and branched rhizoid. But this species differs in several respects from C. spinosus. In Fay's species, zoosporangia are pyriform and with colorless spinose wall, and opercula are apiculate but without spines. But in Chytridium pilosum, zoosporangia are globose in simple ones, lobate in complicated ones, with brownish spinose wall and opercula are non-apiculate but spinose as in wall.

In the old culture occasionally observed dark coloured and more larger and densely spinulate thick walled thalli, as if a resting spores, but they discharge zoospores in the same manner as in zoosporangium. It seems that the variation range of the color and thickness of wall and of the size and shape of spines are very wide. Therefore, functionally and morphologically, it cannot be decided that the above mentioned thalli are resting spores.

Scale of all figures except L and M to left scale.
It is very interesting to see how or why irregularly lobate zoosporangium is formed. The wall of the constricted portions of the irregular zoosporangium is extremely thick. It may be assumed that the wall is thickened partially before its full growth and the following enlargement occurs at the thinner part of the wall and finally the lobate sporangium will be formed. The lobate form was first recognized four days after the beginning of the infection.

The developmental process is illustrated in Fig. 2-D-H. The development of rhizoids and the enlargement of the zoosporangia are proceeding simultaneously. Spine formation begins on the third day. After ten days or two weeks zoosporangia are mature and begin to discharge zoospores.


Zoosporangia suburate or ovate, 7-11 μ in height, 6-9 μ in diameter, wall thin smooth, with a broad apical exit papilla, operculum saucer shaped, 4-8 μ in diameter; rhizoidal system directly arising from the base of the sporangium, branching sparsely zoospores and resting spores not observed.

Hab. Parasitic on *Rhizophydium sphaerotheca* growing on pine pollen bait from soil No. 44.


Hab. Saprophytic on cellophane bait from soil No. 40.


Zoosporangia subspherical ovate or pyriform, 14-25 μ in height, 12-22 μ in diameter, with one operculate exit papilla or rarely with an exit tube, wall smooth, non-apophysate; rhizomycelia profuse, richly branched, 2-6 μ in diameter; zoospores hyaline spherical, 5-8 μ in diameter with one little refractive globule, flagellum 35-43 μ long, emerging in compact mass by dehiscence of the operculum.
Hab. Saprophytic on cellophane bait from soil Nos. 7, 12, 23 and 37.

In our opinion, the differences between *N. profusa* from *N. elegans* are thick rhizomyceilia, non-apophysate zoosporangia, and zoospores with a very small oil drop.


Thallus irregularly tubular, contorted, discharge tubes protruding up to 12 μ long, tapering to the end; zoospores fusiform to reniform, 7.5 μ in length 4.5 μ in width, laterally biflagellate, emerging into vesicle at the orifice and completely differentiated in it. Gametangia not observed.

Hab. Saprophytic in pine pollen bait from soil. No. 35.

* A revision of the genus *Randia* L. in Eastern Asia.* (Takasi Yamazaki) 山崎 敬：東アジアにおけるミサオノキ属の再検討*

The genus *Randia* was a very heterogenous pantropical assemblage of species. The type of the genus (the American species *Randia mitis* L.) having the tetrad pollen differs from the majority of the Asiatic species which have single pollen grains. The African species of the genera *Randia* and *Gardenia* were divided into 21 genera by Keay (1961). *Aidia, Xeromphis* and *Rothmannia* being included in these African genera are recognized in several Asiatic species. The Asiatic species of these group can be distinguished in five genera by the characters of branching system, inflorescence, corolla and ovary. Three genera agree with *Aidia, Xeromphis* and *Rothmannia*. In the other two, it is necessary to describe a new genus and to reapply a genus *Oxyceros*. These five genera are distinguished as follows:

A. Stem being monopodial branching system. Corolla small less than 4 cm long. Calyx tube glabrous inside.