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A new variety of *Myxotrichum ochraceum* from Japanese soil

Shigeru Uchiyama[1], Seigo Kamiya[1] and Shun-ichi Udagawa[2]

[1] Exploratory Research Laboratories, Tsukuba Research Institute, Banyu Pharmaceutical Co.,Ltd., 3, Ookubo, Tsukuba-shi, Ibaraki 300-33, Japan

[2] Nodai Research Institute, Tokyo University of Agriculture, 1-1-1, Sakuragaoka, Setagaya-ku, Tokyo 156, Japan

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***Myxotrichum ochraceum* var. *frigidum*, a new variety of *Myxotrichum*, is described and illustrated from the material from Japanese soil. It is morphologically characterized by dull green to black ascomata with a yellow-orange centrum, peridium consisting of a fragile hyphal network, peridial hyphae with internal coiled branches and short spine-like appendages, pale yellow fusiform striate ascospores, and the absence of an anamorph. The new variety primarily differs from the type variety in the absence of elongate appendages. A key to all accepted species of the genus is revised.**

Key Words——ascomycete; Japan; Myxotrichaceae; *Myxotrichum ochraceum* var. *frigidum*; soil fungus.

The onygenalean genus *Myxotrichum* Kunze (Myxotrichaceae) was redefined by Orr et al. (1963) to accommodate seven species: *M. chartarum* (Nees) Kunze, *M. aeruginosum* Mont., *M. deflexum* Berk., *M. ochraceum* Berk. et Br., *M. setosum* (Eidam) Orr et Plunkett, *M. stipitatum* (Lindfors) Orr et Kuehn and *M. carminoparum* Robak. Orr and Kuehn (1964) distinguished *Toxotrichum* Orr et Kuehn from *Myxotrichum* by tuberculate peridial hyphae which are unbranched and anastomosed more or less dichotomously or trichotomously to form a network with the only free ends represented by elongate appendages. However, Apinis (1964) reduced *Toxotrichum* to a synonym and replaced *T. cancellatum* (Phillips) Orr et Kuehn in *Myxotrichum*. He also described a new taxon on Scotch pine deck planking, *M. berkeleyi* Apinis. Currah (1985), in his monographic treatise on the Onygenales, added *M. bicolor* (Ehrenberg) Fr. as a lichenicolous member of *Myxotrichum*, while *M. carminoparum* was recognized as an atypical form of *M. chartarum*. A further addition to the genus was made by Udagawa et al. (1994) who described *M. arcticum* Udagawa, Uchiyama et Kamiya as a new species isolated from Alaskan arctic soil.

Myxotrichum species are common inhabitants of the humus layers in forest soils and the ability of most isolates to grow and sporulate at low temperatures suggeste their colonization as cellulolytic saprophytes in cold environments.

During our recent studies of soil microfungi, an interesting isolate of *Myxotrichum* was obtained following the incubation of a soil sample at 15°C. Apart from the difference of peridial elements on the outer surface of ascomata, this isolate showed a close relationship with *M. ochraceum* in its ascomata with a yellow-orange centrum, peridial hyphae with internal coiled branches, short-stipitate asci and pale yellow fusiform striate ascospores. The asci and ascospores are also quite similar in size to those of *M. ochraceum*. It is described as a new variety of *M. ochraceum* in this paper.

Taxonomy

Myxotrichum ochraceum Berk. et Br. **var. *frigidum*** Uchiyama, Kamiya et Udagawa, var. nov.

Figs. 1-8

A specie differt ascomatibus minoribus et appendicibus elongatis deficientibus. Anamorphosis abest.

Holotypus BF 49396, colonia exsiccata in cultura ex solo sylvae, Gunma, in Japonia, 15.vii.1994, a S. Uchiyama et S. Kamiya isolata et ea collectione fungorum, Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: Latin, *frigidus*=cold, referring to the psychrophilic growth.

Colonies on PYE growing restrictedly, attaining a diameter of 14-15 mm in 28 days at 15°C, radially sulcate to convolute, centrally raised, floccose, consisting of a compact mycelial felt, with loose aerial hyphae, Light Orange (M. 5A4, after Kornerup and Wanscher, 1978) or Pale Luteous (Rayner, 1970); ascomata not produced; exudate and soluble pigment abundant, Dark Brown (M. 9F5) or Bay (R); odor moldy; reverse and agar Dark Brown (M. 9F5) or Blood Colour (R).

Colonies on potato-carrot agar growing restrictedly, attaining a diameter of 13-15 mm in 28 days at 15°C, plane, floccose, consisting of a thin basal felt, producing abundant ascomata on the felt, loosely intermixed with aerial hyphae, Greyish Green (M. 28D-C5) or Yellow-green (R); exudate abundant, clear; reverse Brown (M. 5E4) or Isabelline (R).

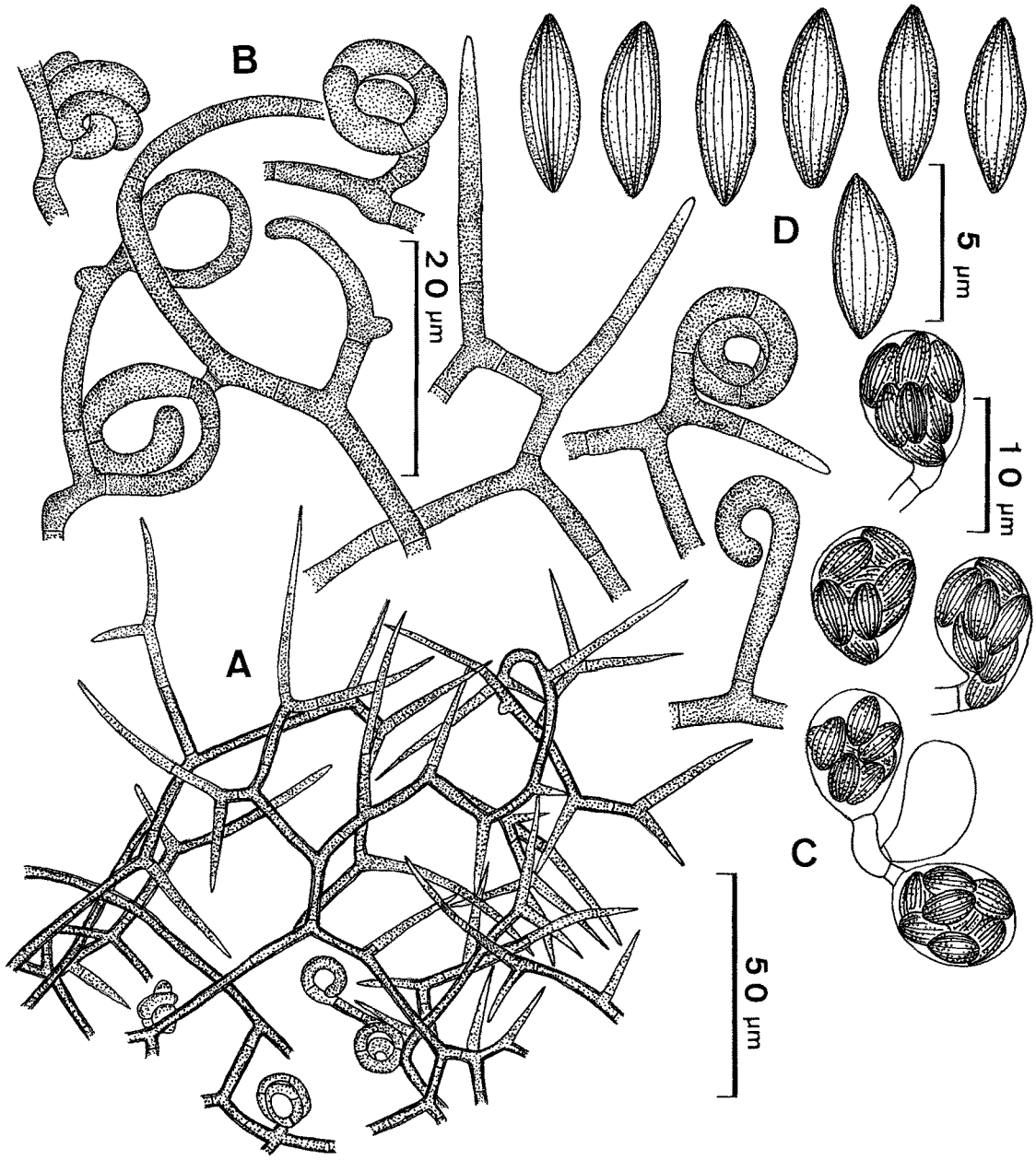
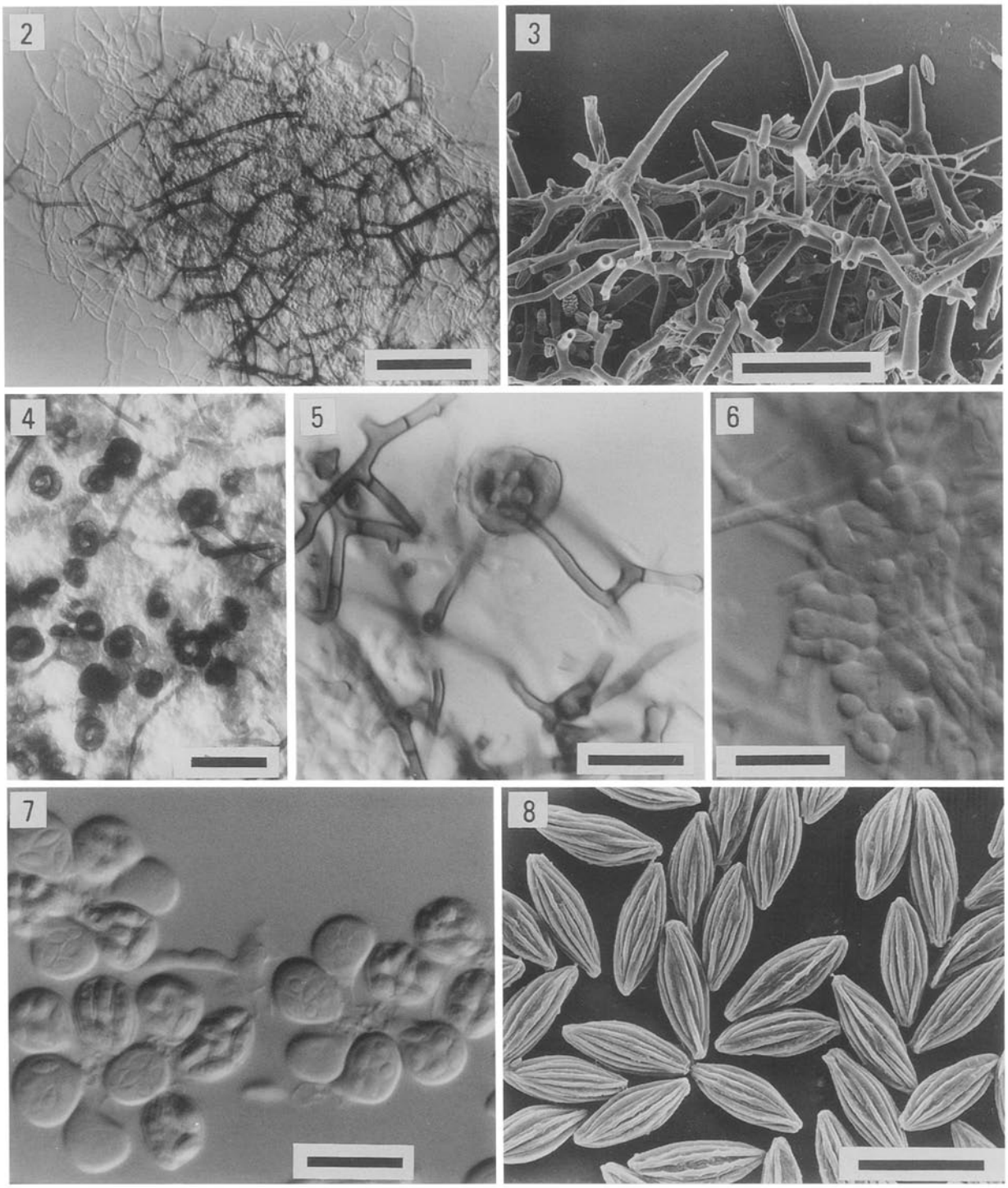


Fig. 1. *Myxotrichum ochraceum* var. *frigidum* (BF 49396).
A. Peridial hyphae with appendages. B. Internal coiled branches of peridial hyphae and appendages. C. Asci. D. Ascospores.

Colonies on oatmeal agar growing restrictedly, attaining a diameter of 12-13 mm in 28 days at 15°C, velvety, plane or slightly radially sulcate, consisting of a thin basal felt, producing abundant ascomata as described on potato-carrot agar, Greyish Green (M. 28C3) or Greenish Glaucous (R); exudate absent; reverse and agar Light Brown (M. 6D4) or Hazel (R).

Ascomata superficial, often confluent, at first dull green to dark brown, becoming nearly black in age, with a yellow-orange centrum, globose to subglobose, 120-200 μm in diam excluding the appendages. Peridial hyphae dark brown to brownish black, thick-walled, septate, often constricted at the septum, 1.5-3 μm in diam, smooth, branched and anastomosed to form a fragile network, with internal branches with free ends terminating in a circinate or spirally coiled tip; internal branches up to 22.5-38 μm, 2-4.5 μm in diam, dark brown to brownish black, septate, thick-walled, smooth; appendages peripheral, short, spine-like, straight or somewhat bent, dark brown, often paling toward the rounded or blunt apex, up to 20-30 μm long 2-3 μm in diam at middle, unbranched, septate, thick-walled, usually smooth. Asci hyaline, 8-spored, subglobose to ovoid or pyriform, 7.5-11 × 6-8 μm, short-stipitate, evanescent. Ascospores pale yellow, fusiform, 3.5-5.5(-7.5) × 2-2.5 μm, more or less acuminate at both ends, striate.



Figs. 2–8. *Myxotrichum ochraceum* var. *frigidum* (BF 49396).
2. Ascoma. 3. Appendages of peridial hyphae (SEM). 4. Internal coiled branches of peridial hyphae. 5. Peridial hyphae with a coiled branch. 6. Ascomatal initial. 7. Asci. 8. Ascospores (SEM).
Scale bars: 2=50 μm; 3, 4 =20 μm; 5–7=10 μm; 8=5 μm.

Vegetative mycelium consisting of hyaline to brown, branched, septate, mostly smooth-walled, 1–3 μm diameter hyphae. Ascomatal initials appeared as swollen side branches which arise from aerial hypha, soon coiled and forming a compact mass. Anamorph lacking.

Cellulolytic.

Major ubiquinone: Q-10(H_2).

At 25°C, growth and ascomatal formation are conspicuously reduced. At 37°C, growth is nil.

Specimen examined: a dried culture isolated from

forest soil, Ozegahara moor, Katashina-mura, Tone-gun, Gunma-ken, Japan, 15 July 1994, BF 49396 (holotype). The type specimen is deposited in the Natural History Museum and Institute, Chiba, Japan (CBM).

The outstanding characteristics of *M. ochraceum* var. *frigidum* are: 1) psychrophilic growth, which is shown to grow better at 15°C than at 25°C, 2) dull green to nearly black ascomata with a yellow-orange centrum, 3) peridium consisting of a fragile hyphal network, 4) peridial hyphae with internal coiled branches and with peripheral short spine-like appendages, 5) the absence of elongate appendages, 6) pale yellow fusiform striate ascospores, and 7) the absence of anamorph.

There is some confusion surrounding the original material of *M. ochraceum* studied by Berkeley and Broome. This has been clarified in detail by Orr et al. (1963), who designated "D. Saccardo, Mycotheca Italica, No. 192" as a neotype, stating that Berkeley and Broom's material was "unavailable for study." Comparing the other known species of the genus, *M. ochraceum* is distinctive primarily in producing ascomata with a particularly yellow-orange centrum due to the color of ascus clusters, peridial hyphae with certain internal coiled branches, and two types of ascomatal appendages, which are spine-like and extremely long straight ones.

Myxotrichum ochraceum vars. *ochraceum* and *frigidum* are practically identical. Variety *frigidum* differs from var. *ochraceum* in having smaller ascomata (150-500 μm in var. *ochraceum*) and the absence of elongate ascomatal appendages. The new variety is somewhat similar to *M. arcticum* in its psychrophilic growth and the absence of elongate appendages, but differs from the latter in slower growth (about half growth-rate), the smooth peridial hyphae with coiled branches, the absence of *Oidiodendron* anamorph and the ubiquinone system (Q-10(H_2) vs. Q-9 as the major ubiquinone in *M. arcticum*).

Key to the species of *Myxotrichum**

1. Elongate ascomatal appendages always present ···2
1. Elongate ascomatal appendages never present ·····8
2. Some or all appendages uncinate ·····3
2. Appendages straight or only bent, not uncinate ·····4
3. Peridial apices witches'-broom-like; appendages all uncinate ·····*M. chartarum*
3. Witches'-broom character absent or not prominent; appendages straight, bent or uncinate···*M. aeruginosum*
4. Appendages branched ·····5
4. Appendages unbranched, of radiating spines arising from arched asperulate hyphae of the peridium ·····*M. cancellatum*
5. Appendages branched only on lower half ·····6
5. Ascomata bramble-like; appendages branched almost to apex, with lateral branches usually deflexed ·····*M. deflexum*
6. Ascomata with a pale colored centrum appendages less than 450 μm long ·····7
6. Ascomata with an intensely yellow-orange centrum; peridial hyphae with internal coiled branched; appendages up to 1650 μm long·····
·····*M. ochraceum* var. *ochraceum*
7. Appendages 200-450 μm long, with deflexed branches at the base; asci not stipitate ·····*M. berkeleyi*
7. Appendages 60-215 μm long, with branches not deflexed; asci long-stipitate ·····*M. stipitatum*
8. Ascomata not associated with lichen; ascospores small, less than 7.5 μm long ·····9
8. Ascomata on lichens; ascospores 8-14 × 3-6 μm ·····*M. bicolor*
9. Ascomata with a white centrum; peridial hyphae and appendages usually asperulate; *Oidiodendron*-anamorph present ·····*M. arcticum*
9. Ascomata with a yellow-orange centrum; peridial hyphae and appendages smooth; peridial hyphae with internal coiled branches; anamorph not observed ·····*M. ochraceum* var. *frigidum*

* The key by Orr et al. (1963) is revised.

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