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# A New Species of the Hypocreales (Ascomycota) from Mt. Changbaishan, Northeast China

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**Abstract** A new species, *Hypocrea corrugata* Doi, P.-G.Liu & Tamura is described from cool temperate zone of East Asia and North America. This species is characterized by the stromata similar to those of *Hypocrea rufa* (Pers.: Fr.) Fr. in fresh samples, but distinctly rugose and brick-red to dark vinaceous in dried specimens. The stromata are produced from lenticels of bark of dead branches or trunks of *Betula* or *Alnus*. Its *Trichoderma* anamorph belongs to the *T. harzianum* aggr. defined by Rifai (1969). It has pale green, shortly ellipsoid-obovate conidia and its branching pattern of conidiophore is the *Trichoderm*-type somewhat close to the *Verticillium*-type. This species has often been confused with *H. rufa*.

**Key words:** Fungi, Hypocreales, *Hypocrea*, *Trichoderma*, new species, Changbaishan, Jiling Prov., China.

## Introduction

During our taxonomic studies on *Hypocrea* and its allies in China, we found a new species of *Hypocrea* on *Betula* in the western slope of Mt. Changbaishan, Jiling Prov., north-east China in 1998. The fresh stromata of this species are similar to those of *Hypocrea rufa* (Pers.: Fr.) Fr., some species of *H. aurantia*-group with brick-red stromata, or *Hypocrea muroiana*, however, in dried specimens, the stromata become brick-red to dark vinaceous and distinctly corrugate (rugose).

Although some specimens of this species are deposited in several herbaria, usually they have been identified as *Hypocrea rufa* (Pers.: Fr.) Fr.

There has been no record of its anamorph. We obtained a *Trichoderma* anamorph with pale green, short ellipsoid-ovate conidia from the part-spores of a specimen (holotype) collected from Mt. Changbaishan. This *Trichoderma* anamorph is clearly different from those of *Hypocrea rufa* as well as other similar species. This new species is described below.

## Description of *Hypocrea corrugata*

***Hypocrea corrugata*** Doi, P.-G. Liu & Tamura, sp. nov. (Fig. 1, 2 & 3)

Stromata pulvinata, disciformia vel irregularia, solitaria vel aggregata in lenticellis alborium insidentia, in vivo rufa vel vinosa, 1–3×2–3 mm lata, 0.8–1.2 mm crassa, in sicco vinosa vel fere nigricantia, valde corrugata. Textura strati superficialis stromatorum epidermoidea, brunneora, cellulis texturorum brunneolis, 2.5–3.5 μm crassa. Hyphis stromatorum interiorum subter peritheciis irreguraliter ventricosis, tenui-tunicatis, hyalinis, 8–25 μm crassis.

Perithecia in stromatibus superficialibus immersa, ellipsoidea vel obovata, longitudinaliter fere elongata, 170–250 μm in diametro verticali. Asci cylindrici, 62–67× 3.1–3.4 μm, 16-partospori. Partosporis hyalinis, minute pusticulato-tuberculatis, dimorphis; partosporis distalibus subglobosis vel ovatis, 2.8–3.8×2.5–3.3 μm, partosporis proximalibus obovato-ellipsoideis vel subcylindricis, 3.1–3.9×2.2–2.8 μm.

Culturae in agaro malti rapide crescentes. Partes conidiferae dispersae vel aggregatae, virides. Conidiophora mononemata vel aggregata, *Trichoderma*-typici. Conidiophora mononemata effusa super agaro. Conidiophora aggregata caespites minores formantia. Phialides graciles vel plus minusve curvae, verticillatae, ampuliformes vel lageniformes, 8–14×1.8–2.6 μm.

Conidia in muco aggregata, pallide viridis, ellipsoid-ovata, basi leviter truncata, laevia, 2.6–4.3×1.7–2.8 μm. Chlamydosporae raro, globosae vel subellipsoideae, terminales vel intercalares, hyalinae, laeves, 8–19×7–12 μm.

Stromata pulvinate, disciform or irregularly shaped, scattered or gregarious on lenticels of bark of dead trees, 1–3×2–3 mm diam., 0.8–1.2 mm thick, base narrow, margin free, reddish brown to vinose in fresh samples, vinose to almost black in dried specimens. Tissue of stromal surface (on which perithecial ostioles are situated) be-

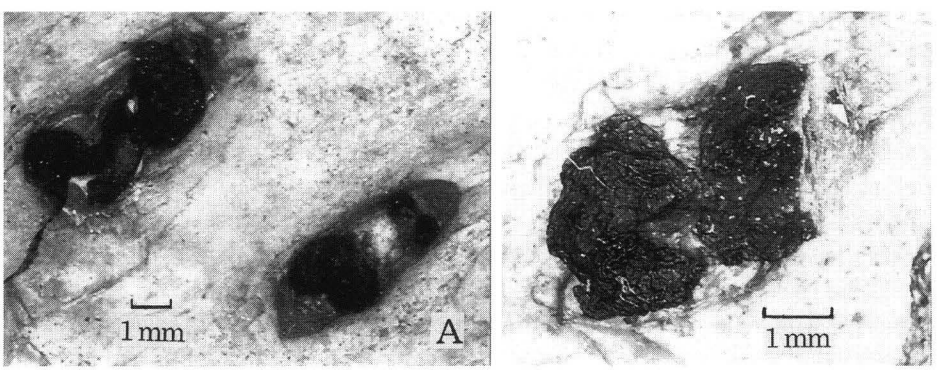


Fig. 1. *Hypocrea corrugata* Doi, P.-G. Liu & Tamura, sp. nov. (TNS-F-7034, Isotype) A. Habit of stromata on lenticels of *Betula* sp. B. Stromata in shrunk, depressed and rugose condition of dried specimen.

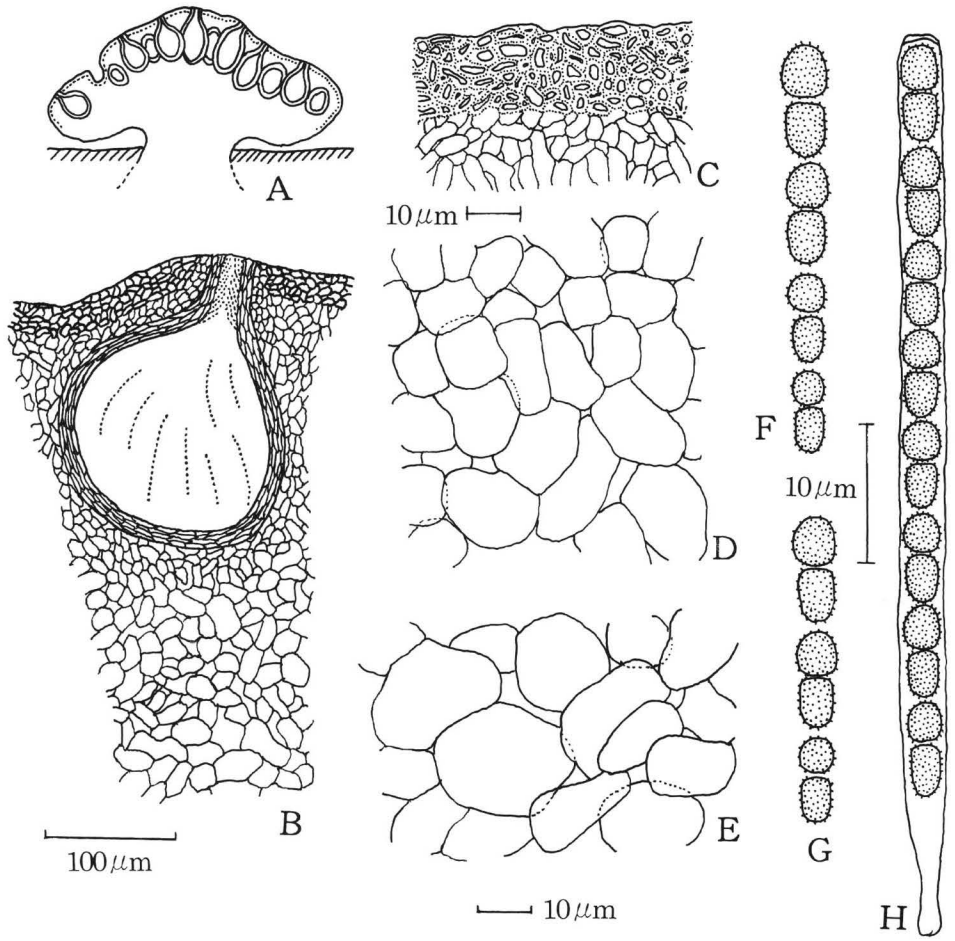


Fig. 2. *Hypocrea corrugata* Doi, P.-G. Liu & Tamura, sp. nov. (TNS-F-7034, Isotype) A. Longitudinal section of stromata (a schematic pattern). B. Longitudinal section of stroma. C. Longitudinal section of *textura epidermoidea*-type tissue of the stromal surface layer on which perithecial ostioles are stituated. D. Cells of internal region of stroma below perithecia (longitudinal section). E. Cells of basal region of stroma (longitudinal section). F. Part-spores of PDD 14543. G. Partspores of PDD 13071. H. Ascus and part-spores of isotype in TNS.

longs to *textura epidermoidea*, forming a region 18–23 μm thick, cells 3–7×2–4 μm, with thick, brownish-colored walls. Tissue of stromal interior below perithecia composed of colorless, thin-walled, 16–27×7–23 μm wide cells, most of these cells being transformed or collapsed and causing rugose surface of stromata in dried specimens.

Perithecia ellipsoidal or obovate-subglobose, generally crowded and longitudinally elongate, 170–250 μm in high, completely immersed in stroma, ostiolar canal

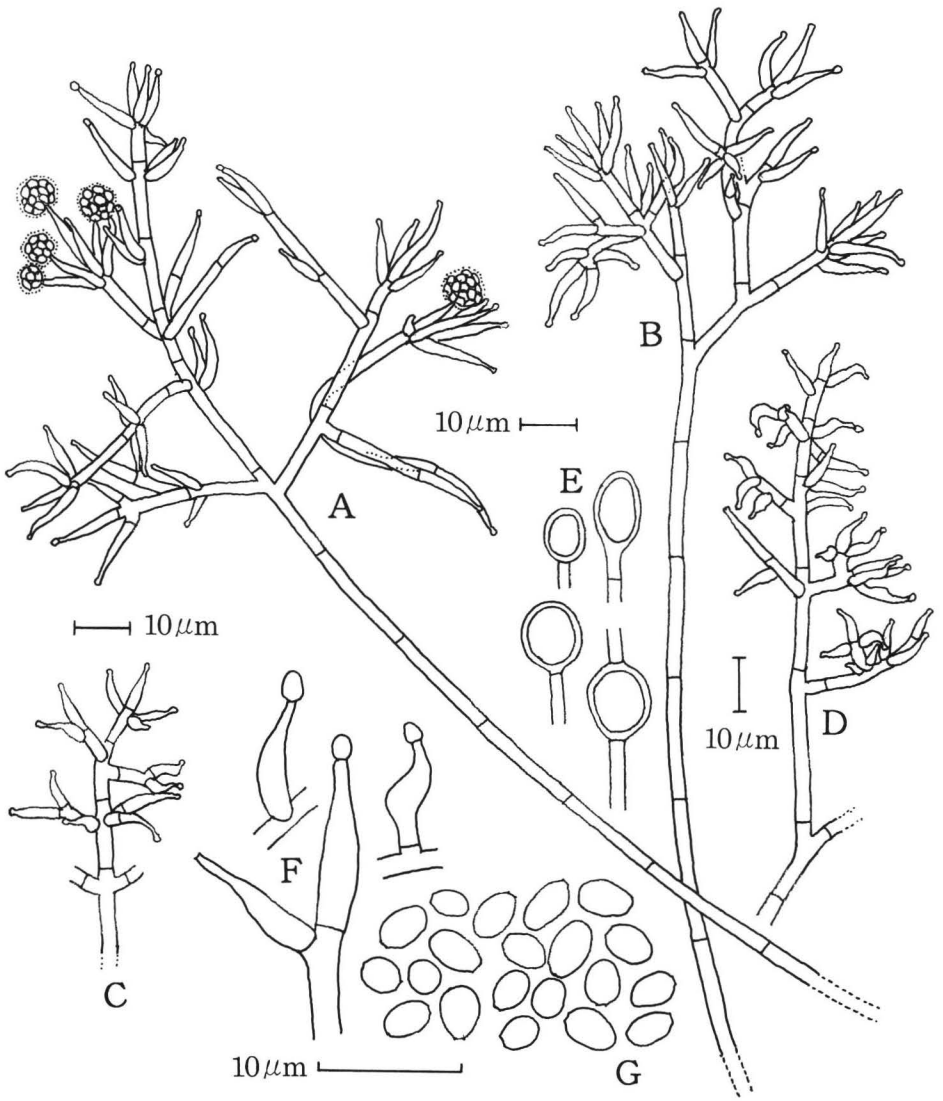


Fig. 3. *Trichoderma* anamorph of *Hypocrea corrugata* Doi, P.-G.Liu & Tamura, sp. nov., drawn from the cultures of the holotype specimen (HKAS 32630) A & B. Conidiophores in younger stages. C & D. Conidiophores in older stages. E. Chlamydospores. F. Slender or irregularly curved phialides. G. Conidia.

40–70 μm long, 35–50 μm wide. Asci cylindrical, apex thickened, 62–67×3.1–3.4 μm, with 16 uniseriate part-spores. Part-spores colorless, minutely pusticulate-tuberculate, dimorphic: distal part-spores ovate-subglobose, 2.8–3.8×2.5–3.3 μm, proximal part-spores obovate-ellipsoid to subcylindrical, 3.1–3.9×2.2–2.8 μm.

**Characteristics in culture.** On slant of 1% malt agar in cotton-plugged culture tubes at room temperature (22–26°C) in diffused daylight, part-spores germinated within 2 days. Colonies expanding rapidly (diameter of colony increasing 1–2 cm per day in Petri dish), at first smooth, translucent, lacking aerial hyphae except conidiophores; hyphae septate, smooth, 2–11 μm wide, colorless; agar media scarcely colored.

Conidiophores produced at first near the inoculated point, later spread over the mycelial colony, scarcely froming pulvinate tufts.

Conidiophores macronematous, arising from the surface of the colony, mononematous or aggregated into tufts, froming pale green concentric rings on plate agar of Petri dish; colonies of conidiophores at first white, becoming pale green (27A5–28A5, in Kornerp & Wanscher, 1967).

When mononematous, main branch of conidiophores long, up to 400 μm, up to 11 μm wide, and side branches produced with acute angles with the main branch, mostly at the upper portion of conidiophores, the primary side branches 30–90 μm long, 1.9–3 μm wide at the base. The secondary side branches arising with acute angles with the primary side branches, up to 20 μm long, 2–2.5 μm wide at the base, sometimes the tertiary side branches produced with acute angles with the secondary side branches, up to 6 μm long, about 2 μm wide at the base.

Phialides produced verticillately at the tip of branches of conidiophores, slender, attenuate toward the tip, or ampuliform when often more or less irregularly curved, 6–16×1.8–2.6 μm, periclinal thickening not clear, collarette not flared.

Conidia pale green (27A–28A5, in Kornerp & Wanscher, 1967), held in a mucilaginous drop at the tip of each phialide or forming larger drops fused with drops of some neighburing phialides, ellipsoid or ovate-ellipsoid with minute truncate base, smooth, 2.6–4.3×1.7–2.8 μm. Chlamydospores rare on agar plate or slunt media, often produced on thin agar film on a slide glass on which part-spores being dispersed for isolation, smooth, colorless, globose or ellipsoid, 8–19×7–12 μm.

Habitat. On lenticels of bark of dead branches or trunk of *Betula* or *Alnus*.

Known distribution. North-east Asia (northeast China, on *Betula*) and North America (Canada, on *Alnus*).

Holotype: On lenticels of bark of *Betula* sp., around the hot spring region, western slope of Mt. Changbaishan, ca.1,300 m alt., Chaoxiezhu State, Jiling Prov., China, Sept. 6, 1998, P. G. Liu & Y. Doi, DL' 98-15=HKAS 32630 (isotype in TNS, F-7034 = Doi's collection no. D.9754). Subcultures are kept in the laboratory of P.-G. Liu, HKAS. Dried cultures and slide preparates of cultures are deposited in TNS.

Other specimens examined. On *Alnus* sp., Beer Island, Lake Temagami, Ontario, Canada, Aug. 1935, H. S. Jackson (Univ.Toronto Crypt. Herb. 8320, duplicate in PDD, as PDD 13071, identified as *Hypocrea rufa* (Pers.) Fr.; On *Alnus incana*, Costella Lake, Algonquin Park, Ontario, Canada, Sept. 14, 1939, R. F. Cain (Univ. of Toronto Crypt. Herb.15903, duplicate in PDD as PDD 14543.)

Notes. 1. This species resembles *Hypocrea rufa*, *H. muroiana*, and some species of the *H. aurantia* group in general appearance of stromata when fresh. However, the surface of the stromata of this new species are distinctly corrugate (rugose) when dry. The rugose condition of stromata in dried specimens of this species is due to the structure of the stromal tissue, i.e., the cells of stromal interior below perithecia are larger, thin-walled and they are easily depressed, transformed or collapsed. As a result the surface of stroma become prominently shrunk and rugose.

2. The branching pattern of conidiophore of this *Trichoderma* anamorph with pale green, short ellipsoid to ellipsoid-ovate conidia is somewhat close to the *Verticillium*-type rather than a normal *Trichoderma*-type. This *Trichoderma* state belongs to the *Trichoderma hamatum* aggr. Defined by Rifai (1969). The pale green color of conidia as well as the growth pattern of colonies of this species resemble those of *Hypocrea albofulva* Berk. & Br.

3. *Hypocrea rugulosa* Berk. & Cooke (in Cooke, 1884), reported from India, also resembles *Hypocrea corrugata* in general appearance of stroma, however, the former species has green part-spores and it belongs to the Subsect. *Creopus* in the genus *Hypocrea*, whereas *H. corrugata* belongs to the Subsect. *Hypocrea*, in the infrageneric classification proposed by Doi (1969, 1972).

4. The stromata of two Canadian collection of this species are brownish even in dried specimens, whereas those of the Chinese collection are vinose to almost black in dried specimens. We consider that the color variation of stromata is not important to separate Chinese strains from Canadian strains at any taxonomic rank.

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## References

Cooke, M. C., 1884. Notes on Hypocreaceae, *Grevillea* **12**: 77–83.

Doi, Y. 1969. Revision of the Hypocreales with cultural observations IV. The genus *Hypocrea* and its allies in Japan (1) General part. *Bull. Natn. Sci. Mus. Tokyo*, **12**: 693–724.

Doi, Y. 1972. Revision of the Hypocreales with cultural observations IV. The genus *Hypocrea* and its al-

lies in Japan (2) Enumeration of the species. *Bull. Natn. Sci. Mus. Tokyo*, **15**: 649–751.

Kornerup, A. & H. H. Wanscher, 1967. Methuen Handbook of Colour 2nd ed., 243 pp. Methuen & Co. Ltd., London.

Rifai, M. A, 1969. A revision of the genus *Trichoderma*. *Mycol. Papers* (116): 1–56.