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Myxomycetous Genera *Perichaena* and *Trichia* in Taiwan

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ABSTRACT. Five species and one variety of the genus *Perichaena*, and seven species and three varieties of *Trichia* have previously been reported from Taiwan. In this paper two newly recorded species, *P. pedata* and *T. papillata*, and a new species, *P. papulosa*, are described and illustrated. Keys to the *Perichaena* and *Trichia* species of Taiwan are also provided.

Keywords: Myxomycetes; *Perichaena*; Taiwan; *Trichia*; Trichiales; True slime molds.

INTRODUCTION

The genera *Perichaena* and *Trichia*, belonging to Arcyriaceae and Trichiaceae of Trichiales, respectively, are characterized by having tubular capillitial threads. While the capillitial threads of *Perichaena* are slightly roughened or marked by warts or spines on the surface, those of *Trichia* are of free elaters with acute or acuminate ends and marked by 2-5 spiral bands on the surface. Their spores are bright-colored and usually yellow in mass (Martin and Alexopoulos, 1969). To date, five species and one variety of *Perichaena*, and seven species and three varieties of *Trichia*, have been recorded in Taiwan (Nakazawa, 1929; Liu, 1980, 1982, 1983, 2005; Wang et al., 1981; Chung and Liu, 1997; Chung et al., 1998; Chung and Tzean, 1998; Liu et al., 2002a, 2002b). In this paper two newly recorded species, *P. pedata* (A. & G. Lister) G. Lister and *T. papillata* Adamonyte, and a new species, *P. papulosa* Liu & Chang, are described and illustrated. Voucher specimens were deposited at the herbarium of the National Museum of Natural Science, Taichung, Taiwan (TNM).

TAXONOMY

Key to species of *Perichaena* in Taiwan (inspired by Martin and Alexopoulos, 1969)

1. Fructifications predominantly plasmodiocarpous 2
   Fructifications predominantly sporangiate 4
2. Plasmodiocarps dull yellow-brown to dark-brown, long slender, curved or net-like 3
   Plasmodiocarps dark reddish brown, often elongated or ring-like, varying to sporangiate, rarely stipitate; capillitium strongly spinulate, with long spines, sometimes marked by reticulate ridges ..... *P. chrysosperma*
3. Spores 10-14 μm diam ..... *P. vermicularis*
   Spores 7.5-10 μm diam ..... *P. vermicularis* var. *microsperma*
4. Sporangia flattened on a broad, continuous base, usually densely aggregated and angular from pressure; dehiscence circumscissile ..... *P. depressa*
   Sporangia not flattened, often clustered but not angular; dehiscence circumscissile or irregular 5
5. Sporangia mostly stalked 6
   Sporangia sessile, short-plasmodiocarpous or annulate 7
6. Peridium bearing one prominent wart on the top of sporangium ..... *P. papulosa*
   Peridium not as above ..... *P. pedata*
7. Sporangia dehiscing by a clearly preformed lid; the line of dehiscence wavy; capillitium usually scanty, minutely warted or spiny, rarely smooth ..... *P. corticalis*
   Sporangia dehiscing irregularly; capillitium scanty, or absent, smooth ..... *P. liceoides*

Perichaena chrysosperma (Currey) A. Lister, Mycet. 196. 1894.

Description and illustration: Liu (1983).

Perichaena corticalis (Batsch) Rost., Mon. 293.1875.

Description and illustration: Liu (2005).

The fruiting bodies resemble those of *P. tessellata* in having a dark outer peridium separated by a yellow and membranous inner peridium to form a polygonal areolae in outer appearance. The mostly plasmodiocarpous

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fructification and the thicker capillitial threads (2-4 μm diam) are distinct characters separating the present species from *P. tessellata*, which is sporangiate with capillitial threads of 1.5 μm diam.

Perichaena depressa Libert, Pl. Crypt. 378. 1837.

Description and illustration: Liu (1982).

Perichaena liceoides Rostaf., Mon. 293.1875.

Description and illustration: Nakazawa (1929); Chung and Liu (1997).

Perichaena papulosa Liu & Chang, sp. nov. (Figure 1)

Etymology. Latin, *papulosus* = pustular, referring to the sporangium with a prominent papilla.

Fructificationes dispersae, sporangiatae, 0.2-0.44 mm altitudinem totam. Sporangia stipitata, globosa, depresse globosa, vel oblonge ovata, 0.11-0.25 mm diam., ochracea, brunneolo-aurantiaca vel fusca, tuberculo fusco ad nigello summo. Stipes erectus, brevis, cylindricus, 0.05-0.20 mm longus, fuscus. Hypothallus membranaceus, fuscus. Peridium simplex, translucidum, cum basilari

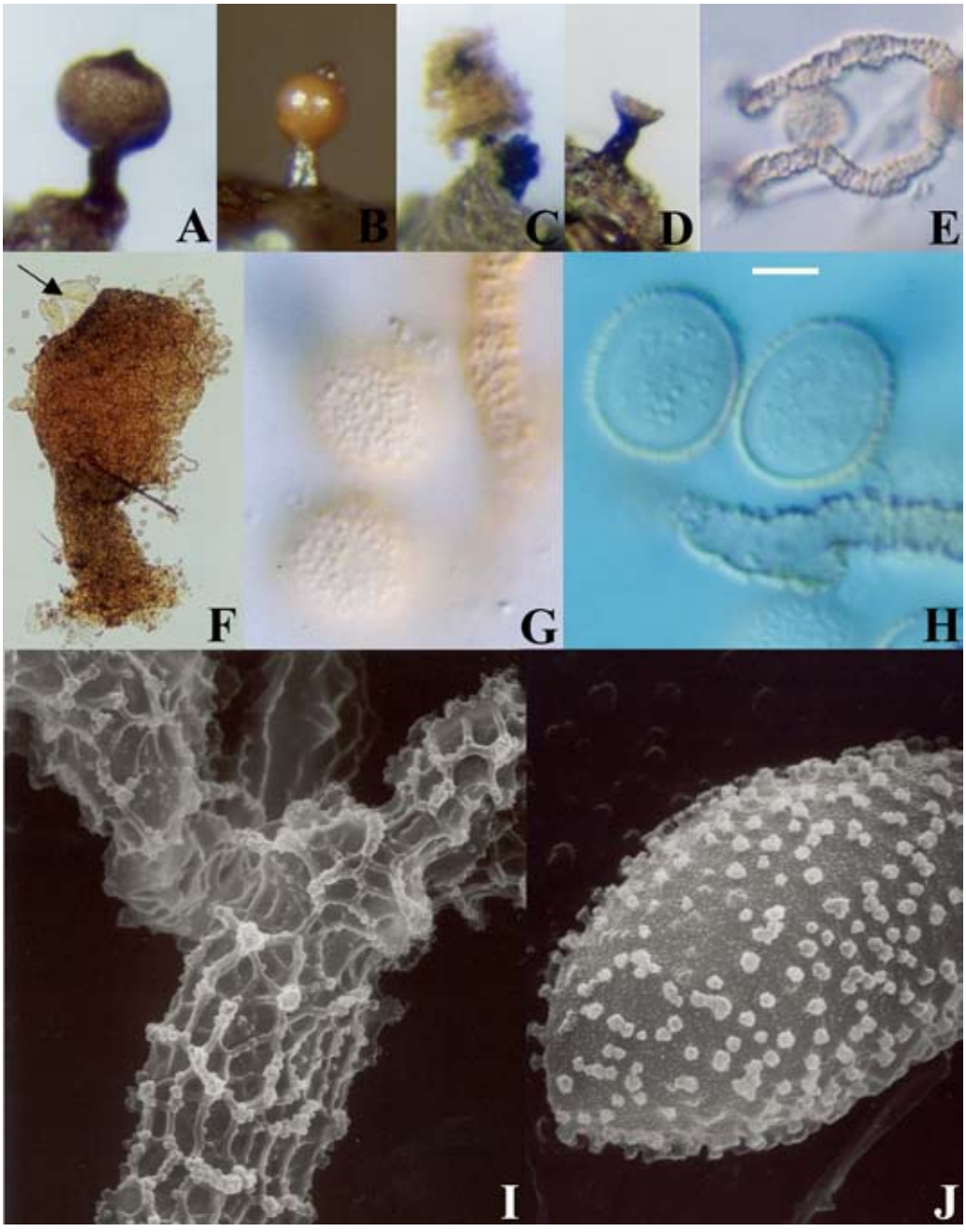

Figure 1. *Perichaena papulosa*. A, fruiting body; B, young fruiting body; C, dehiscing sporangium, showing the elastic capillitium; D, the sporangium after dehiscing; E, capillitium; F, sporangium under transmitted light, showing the protuberance (arrow); G, surface view of spores and capillitial thread; H, marginal view of spores; I, capillitial thread by SEM; J, spore by SEM. Scale bar: A-D = 150 μm, E = 8 μm, F = 80 μm, G-H = 4 μm, I-J = 1 μm.

parte disciformi post dehiscentem. Capillitium elasticum, abundum, sordide flavum, browneolum luce transmissa, dense notatum e verrucis in annulari facie, 3-4 μm diam. Sporae in cumulos ochraceae vel sordide flavae, bruneolae luce transmissa, subglobosae vel ovatae, 9-10 μm diam., minute echinulatae. Plasmodium ignotum.

Fructifications sporangiate, scattered, 0.20-0.44 mm in total height. Sporangia globose, depressed globose, or oblong ovate, 0.11-0.25 mm in diameter, stipitate, ochraceous, brownish orange or darker, orange brown when young, spotted with one dark brown to blackish protuberance at the top. Stalks erect, short, cylindrical, 0.05-0.20 mm in length, dark brown, filled with amorphous matters under transmitted light, arising from a membranous dark brown hypothallus. Peridium single-layered, transparent, upwardly dehiscent leaving a disk-like or wok-like basal part. Capillitium elastic, abundant, dull yellow, tinted with brownish color by transmitted light, marked by closely arranged warts in ring-like appearance, 3-4 μm in diameter. Spores in mass ochraceous or dull yellow, brownish by transmitted light, subglobose or ovate, 9-10 μm in diameter, spinulate. Plasmodium not observed.

Holotype. Taipei City, Yangmingshan National Park, on fallen twigs and leaves, *CHL B2206* (TNM F19096), Jul. 21, 2000 (moist-chamber culture: 8/1/2000-10/7/2000).

Additional specimens examined. TAIPEI COUNTY: Shih-ting, Wenshan Botanical Gardens of National Taiwan University, on plant litter, *CHL B2381* (TNM F19097), Oct 9 1999; on plant litter, *CHL B2386* (TNM F19098), Dec 25 1999. TAIPEI CITY: Yangmingshan National Park, on fallen twigs and leaves, *CHL B2205* (TNM F19095), Jul 21 2000 (moist-chamber culture: 8/1/2000-10/6/2000).

Distribution. Known only from Taiwan.

This species is distinct in having stipitate sporangia marked on the top with one prominent wart or papilla. Compared with *Perichaena pedata*, another species with stalked fruiting bodies, this species is much smaller (less than 1/2) in total height, stalk length, and sporangial diameter but similar in spore size, color, and surface markings. The surface markings of capillitial threads of these two species are also quite different. The capillitial threads of *P. papulosa* are marked by low warts arranged in a ring-like manner while those of *P. pedata* are marked by prominent spines that are arranged irregularly.

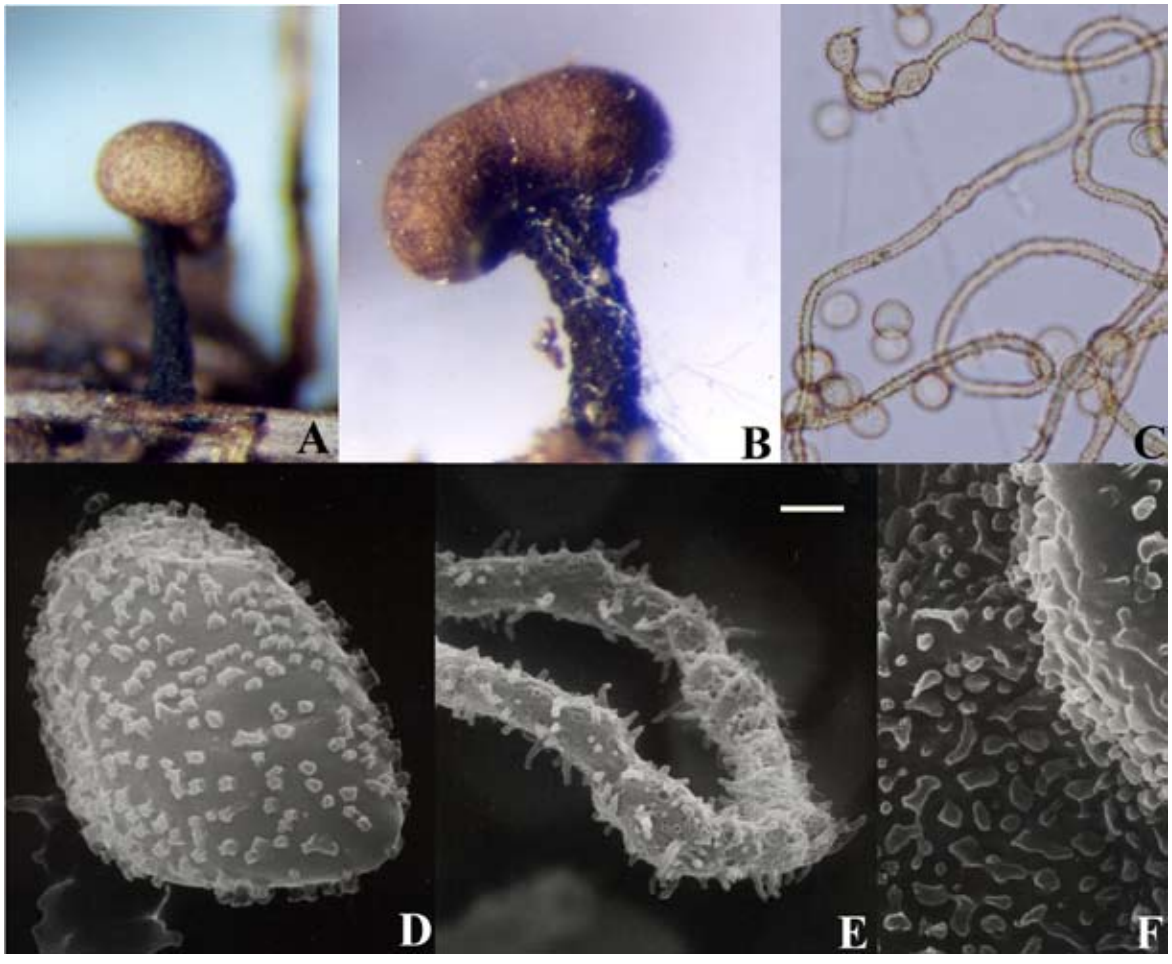

Figure 2. *Perichaena pedata*. A-B, fruiting bodies; C, capillitium; D, spore by SEM; E, capillitial thread by SEM; F, inner peridium by SEM. Scale bar: A-B = 150 μm, C = 15 μm, D, F = 5 μm, E = 3 μm.

Perichaena pedata (A. & G. Lister) G. Lister, J. Bot. 75: 326. 1937. (Figure 2)

Fructifications sporangiate, scattered, solitary, occasionally two in a cluster with sporangia united, 0.75-0.95 mm in total height. Sporangia stipitate, globose to subglobse, pale yellowish to orange brown, 0.3-0.6 mm in diameter. Stalks erect, cylindrical, stout, roughened, dark brown to black, 0.45-0.60 mm high. Peridium single, membranous, with deposition of granular matter. Hypothallus inconspicuous. Capillitium consisting of yellow threads, the threads scarcely branched, with occasional bulbous expansions, prominently marked with spines or minute scattered warts, 3-5 µm in diameter. Spores orange yellow in mass, pale yellowish by transmitted light, globose to subglobse, minutely warted, 9.5-10.0 µm in diam. Plasmodium not observed.

Specimens examined. TAIPEI COUNTY: Shih-ting, Wenshan Botanical Gardens of National Taiwan University, on fallen twigs and leaves, *CHL B2382* (TNM F19091), Jun 12 1999 (moist-chamber culture: 9/20-10/22/1999); on plant litter, *CHL B2384* (TNM F19093), Oct 9 1999.

Distribution. America, Europe, Asia (Japan, Taiwan).

The sporangia of this species and those of *Hemitirchia minor* are similar in shape and color. They both have stalked sporangia. The capillitial threads of our specimens also resemble those of *H. mino*r (Yamamoto, 1998) in diameter and surface markings except the spiral bands. The capillitial threads of *H. minor* bear faint spiral bands (Lister, 1911; Ing, 1999). The spiral bands, nevertheless, were not found by SEM in our specimens (Figure 2E).

Perichaena vermicularis var. **microsperma** Y. Yamam. & Nann.-Brem., Proc. Kon. Ned. Akad. Wet. C. 98: 323. 1995.

Description and illustration: Liu et al. (2002a).

Perichaena vermicularis (Schw.) Rost., Mon. App. 34. 1876.

Description and illustration: Liu (1982).

Key to species of *Trichia* from Taiwan (inspired by Martin and Alexopoulos, 1969)

1. Typically sessile, sporangiate or plasmodiocarpous 2
   Typically sporangiate and distinctly stalked 5
2. Spores prominently reticulate 3
   Spores spinulate or minutely warted 4
3. Spores coarsely reticulate, bands of reticulation pitted, 12-15 µm diam ..... *T. favoginea*
   Spores delicately reticulate, 10-12 µm diam .. *T. scabra*
4. Elaters smooth, with several large rounded expansions along the length .....*T. contorta* var. *karstenii*
   Elaters spinulate, swellings may present before tips .....*T. contorta* var. *iowensis*
5. Spores prominently reticulate 6
   Spores spinulate or warted 7
6. Spores coarsely reticulate, bands of reticulation pitted, 12-16 µm diam..... *T. verrucosa*
   Spores delicately reticulate, 8-10 µm diam..*T. decipiens*
7. Peridium not bearing protuberances 8
   Peridium bearing prominent protuberances ....*T. papillata*
8. Elaters with long acuminate tips..... 9
   Elaters with short acute tips..... 10
9. Peridium black or dark purple, without wax scales ....*T. botrytis* var. *botrytis*
   Peridium covered with gray-green or yellow wax scales ..... *T. botrytis* var. *cerifera*
10. Elaters, smooth, marked with regular spirals..... .....*T. munda*
    Elaters, spinulate, marked with close spirals.. *T. erecta*

Trichia botrytis (J.F. Gmel.) Pers., Neues Mag. Bot. 1: 89. 1794.

Description and illustration: Liu (2005).

Trichia botrytis var. **cerifera** G. Lister, J. Bot., Lond. 53: 211. 1915.

Description and illustration: Nakazawa (1929).

Trichia contorta var. **iowensis** (T. Macbr.) Torrend, Broteria 7: 55. 1908.

Description and illustration: Nakazawa (1929).

Trichia contorta var. **karstenii** (Rostaf.) Ing, Trans. Brit. Mycol. Soc. 48: 647. 1965.

Description and illustration: Liu (1983).

Trichia decipiens (Pers.) T. Macbr., N. Am. Slime-Moulds 218. 1899.

Description and illustration: Liu (2005).

Trichia erecta Rex, Proc. Acad. Phila. 42: 193. 1890.

Description and illustration: Chung and Tzean (1998).

Trichia favoginea (Batsch) Pers., Neues Mag. Bot. 1: 90. 1974.

Description and illustration: Liu (1980).

Trichia munda (A. Lister) Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 327. 1925.

Description and illustration: Liu et al. (2002b).

Trichia papillata Adamonyte, Mycotaxon 87: 380. 2003. (Figure 3)

Fructifications sporangiate, scattered, solitary or gregarious, 0.77-1.30 mm in total height. Sporangia stipitate, turbinate or globose, 0.25-0.64 mm diam, brown

to blackish brown. Peridium double, the inner layer membranous, translucent, appearing as narrow bands separating the outer peridium into reticulate pattern, outer layer opaque, composed of dark granular thickenings, separating before dehiscence and forming areolae, with a protuberance at the center of each areola, dehiscing along the membranous bands of the inner peridium. Stalks up to 0.6 mm long (about 1/3-1/2 of total height), dark, cylindrical. Capillitium composed of yellow brown tubular threads, the capillitial threads unbranched, nearly identical in diameter along the length and often with acuminated ends, 3.0-3.5 µm in diameter, bearing 3-4 spinulate spiral bands. Spores bright yellow brown in mass, brownish by transmitted light, subglobose or ovoid, (7.2-) 8.0-8.5 (-9.0) µm in diameter, minutely warted. Plasmodium yellow.

Specimens examined. TAIPEI COUNTY: Shih-ting, Wenshan Botanical Gardens of National Taiwan University, on plant litter, *CHL B2388* (TNM F19101); *CHL B2389* (TNM F19102), Aug 31 1999. Wu-lai, on plant litter, *CHL B163* (TNM F19103), Feb 25 1982 (moist-chamber culture: 7/22/1982-10/4/1982). TAIPEI CITY: Yangmingshan National Park, on fallen twigs and leaves, *CHL B2387* (TNM F19100), June 26 2001 (moist-chamber culture: 6/26/2001-8/8/2001).

Distribution. Lithuania (Adamonyte, 2003), Taiwan.

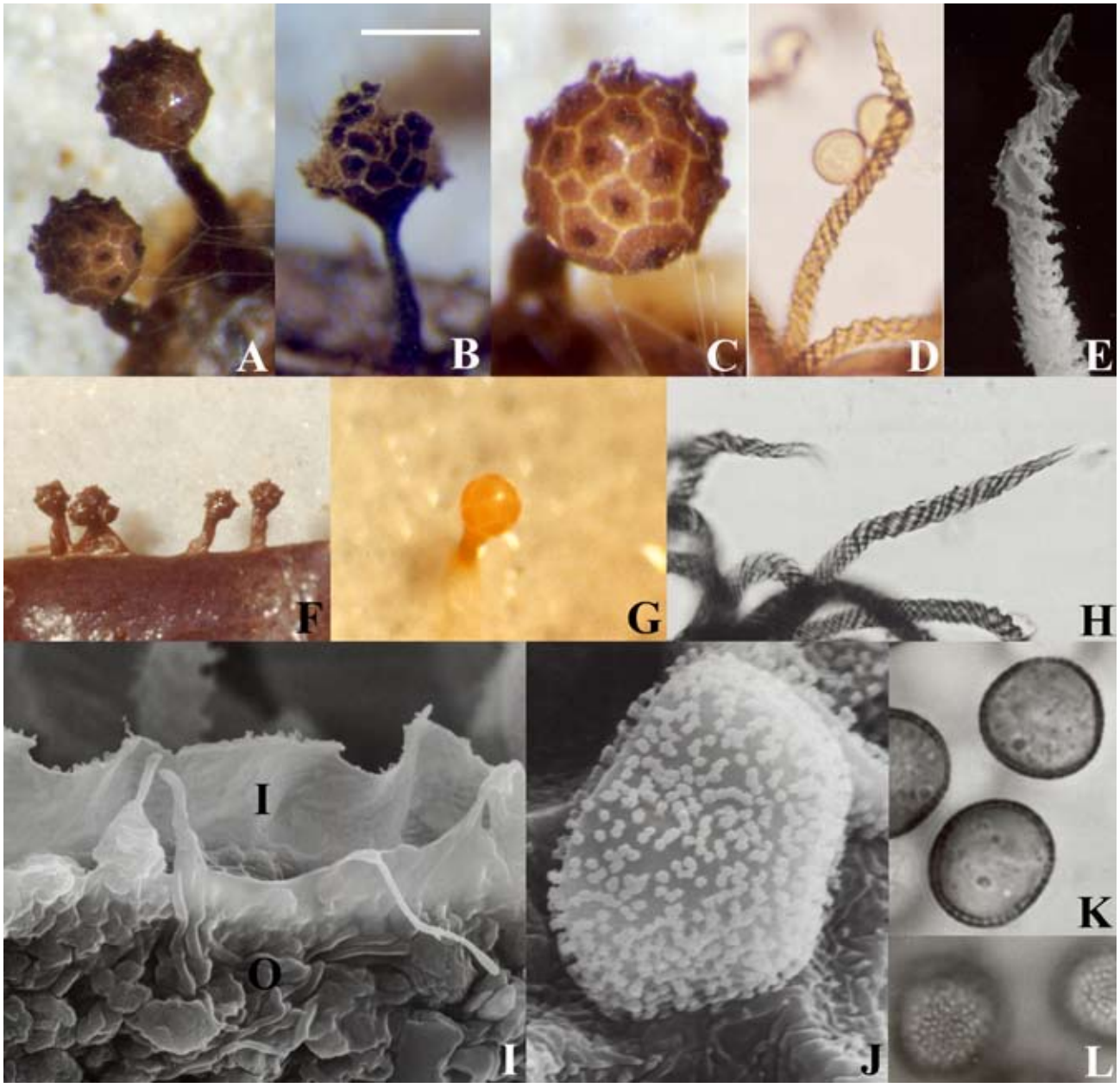

Figure 3. *Trichia papillata*. A-C, fruiting bodies; D-E, H, capillitium; F-G, young fruiting bodies; I, outer (O) and inner (I) peridium; J, spore by SEM; K-L, marginal and surface view of spores. Scale bar: A, C = 400 µm, B = 500 µm, D, H = 20 µm, E = 6 µm, F-G = 900 µm, I = 2.5 µm, J = 1.5 µm, K-L =8 µm.

The distinct character of this species is the turbinate or nearly globose sporangia with conspicuous protuberances on the nut-brown-colored outer peridium, a character not known in any other species of *Trichia*. All the specimens are harvested from moist-chamber culture.

Trichia scabra Rost., Mon. 258. 1875.

Description and illustration: Liu (1982).

Trichia verrucosa Berk., in Hook., f. Fl. Tasm. 2: 269. 1859.

Description and illustration: Nakazawa (1929).

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台灣黏菌：蓋碗黏菌屬與團毛黏菌屬

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蓋碗黏菌屬在台灣共紀錄有 5 種又 1 個變種，而團毛黏菌屬在台灣共紀錄有 7 種又 3 個變種，本篇進一步報導另兩種台灣新紀錄物種：柄蓋碗黏菌 (*Perichaena pedata* (A. & G. Lister) G. Lister) 與乳凸團毛黏菌 (*Trichia papillata* Adamonyte)，與一世界新種：頂皰蓋碗黏菌 (*P. papulosa* Liu & Chang)。內文並分別提供台灣所有紀錄的蓋碗黏菌屬與團毛黏菌屬種類之檢索表。

關鍵詞：黏菌綱；蓋碗黏菌屬；臺灣；團毛黏菌屬；團毛黏菌目；真黏菌。