

# A study of *Peniophora* species in Taiwan with clamped hyphae

Sheng-Hua Wu

Department of Botany, National Museum of Natural Science, Taichung, Taiwan 40419, Republic of China

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**Abstract.** In this preliminary survey of Taiwanese *Peniophora* species with clamped hyphae five species are described: *P. cinerea*, *P. ovalispora*, *P. pseudonuda*, *P. scintillans*, and *P. cf. septentrionalis*. Apart from *P. cinerea*, all are newly recorded from Taiwan. Cultural studies are provided for the five species. Compatibility tests have been conducted for many specimens to confirm their specific identifications.

**Keywords:** Compatibility; Corticiaceae; Cultural studies; *Peniophora*; Taiwan; Taxonomy.

## Introduction

This study is a preliminary survey of the *Peniophora* species in Taiwan with clamped hyphae. The genus *Peniophora* Cooke is generally regarded by mycologists as a member of the Corticiaceae s.l. (Basidiomycota). *Peniophora* is characterized by a combination of features: Presence of lamprocystidia or gloeocystidia or both; basidia clavate; pale-red spore deposits; smooth-walled, inamyloid and indextrinoid spores; tetrapolar sexuality and normal nuclear behavior or homothallism. Some species of *Peniophora* are capable of growing on living plants as parasites. Therefore, studies of this group may enhance our knowledge of plant pathology. Some species of *Peniophora* are associated with *Tremella* spp. (Chen, 1998). Species delimitation in *Peniophora* is more difficult than in most other corticioid genera, due to the similarity of the main morphological characters. Information concerning plant hosts, measurements of basidiospores based on spore deposits, and compatibility tests will be helpful for species identification. Before this study, Lin and Chen (1990) reported four species of *Peniophora* from Taiwan. They are *P. aurantiaca*, *P. cinerea*, *P. incarnata*, and *P. spathulata*. Their identification of *P. cinerea* was confirmed by my examination of voucher specimens.

## Materials and Methods

Specimens provided for this study were collected from various localities in Taiwan during 1988-1997. Studied fungal specimens and cultures are deposited at the herbarium of the National Museum of Natural Science of ROC (TNM). Methods for examining specimens have been previously described (Wu, 1990). Cultural description and species code system are basically from Nobles (1965) with amendments by Boidin and Lanquetin (1983). Minor modifications to Nobles' code system have been presented by

some other mycologists. Nobles' code as detailed by Nakasone (1990) was adopted in this study. Methods of cultural studies, determination of sexuality, and compatible tests have been previously described (Wu, 1996).

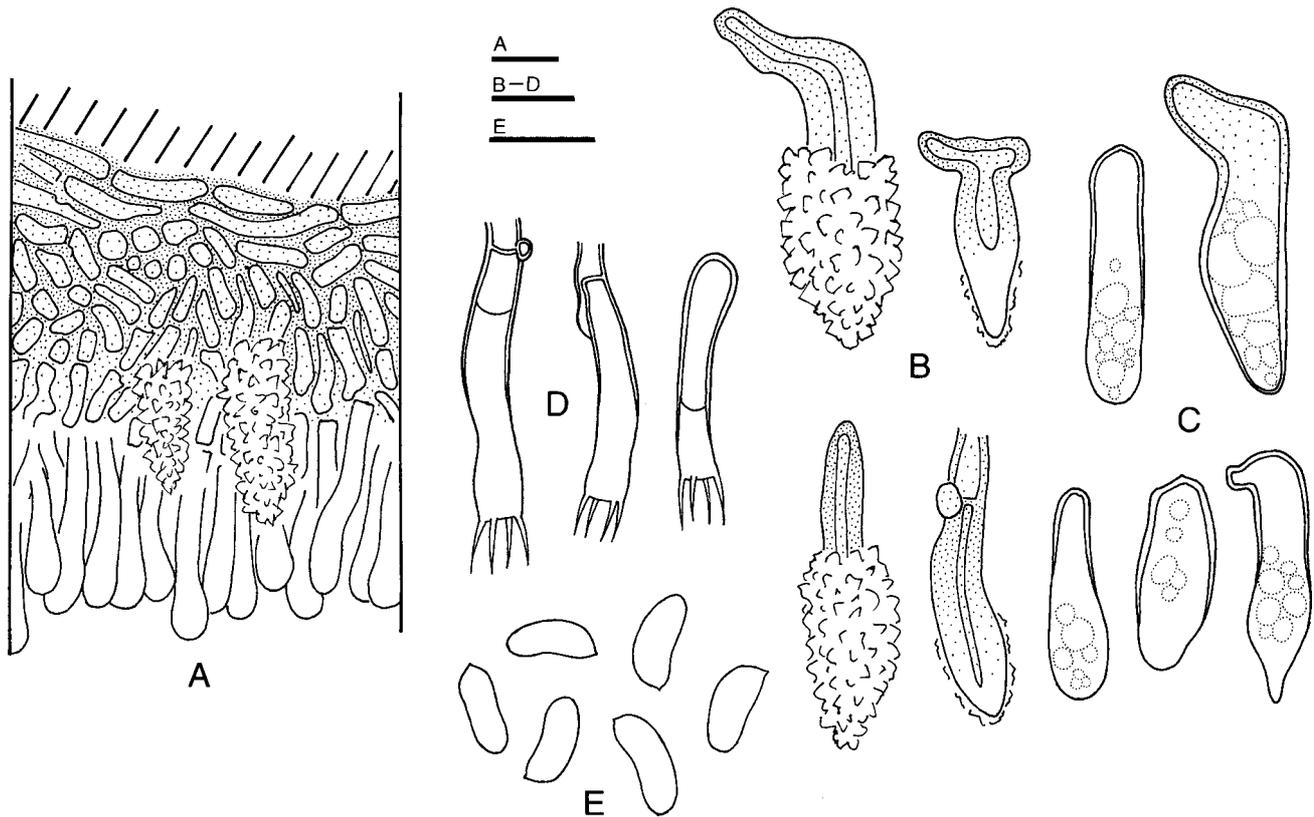
## Taxonomy

### 1. *Peniophora cinerea* (Pers.:Fr.) Cooke, Grevillea 8: 20. 1879. Figure 1

Basidiomes resupinate, effuse, adnate, membranaceous or subceraceous, 40-150  $\mu\text{m}$  thick in section. Hymenial surface gray, purplish gray, pinkish gray, or yellowish gray, smooth, cracked; margin fairly determinate, concolorous.

Hyphal system monomitic; hyphae nodose-septate. Subiculum fairly uniform, composed of a thin basal layer, with compact texture; hyphae brownish, mainly horizontal, usually glued together, 2.5-5  $\mu\text{m}$  diam.,  $\pm$  thick-walled. Hymenium  $\pm$  thickening, of compact texture; hyphae brownish to colorless, mainly vertical, rather indistinct, slightly thick-walled. Lamprocystidia heavily encrusted, conical, brownish towards bases, 20-45  $\times$  8-12  $\mu\text{m}$  (encrustation included), with 1.5-4  $\mu\text{m}$  thick walls. Gloeocystidia colorless or brownish especially towards bases, cylindrical, sometimes with acute apices, 25-60  $\times$  6-11  $\mu\text{m}$ ,  $\pm$  thick-walled towards bases, SA-. Basidia subclavate, 25-35  $\times$  5-6.5  $\mu\text{m}$ , 4-sterigmate. Basidiospores narrowly ellipsoid, adaxially slightly concave or flat, smooth, thin-walled, (6.3-) 7-9  $\times$  2.5-4  $\mu\text{m}$ , IKI-, CB-.

*Specimens examined.* **TAIWAN.** TAIPEI: National Taiwan University, on branch of *Bridelia balansae*, 31 May 1988, Wu 880531-2 (TNM); on branch of *Liquidambar formosana*, 19 Aug 1988, Wu 880819-3 (TNM); on branch of *Ficus virgata*, 15 Jan 1988, Wu 880115 (TNM); on branch of *Elaeocarpus sylvestris*, 15 May 1989, Wu 890515a (TNM). Yangminshan, alt. 600 m, on branch of angiosperm, 13 Dec 1990, Wu 901213-3 (TNM). HSINCHU: Kuanwu, alt. 1,900 m, on branch of angiosperm, 24 Aug 1988, Wu 880824-51, 880824-60 (TNM). MIAOLI: Takeshan, alt. 550 m, on branch of *Prunus campanulata*,



**Figure 1.** *Peniophora cinerea* (Wu 9310-63). A, Basidiome section; B, Lamprocystidia; C, Gloeocystidia; D, Basidia; E, Basidiospores. Scale bars = 10  $\mu\text{m}$ .

25 Mar 1994, Wu 9403-17, 9403-18 (TNM). TAICHUNG: Pilu, alt. 2,000 m, on branch of *Alnus formosana*, alt. 1,900 m, 6 Dec 1991, Wu 911206-9 (TNM); on branch of angiosperm, Wu 911206-16 (TNM). Hsienpaotai, alt. 900 m, on branch of angiosperm, 6 Dec 1991, Wu 911206-46, 911206-54 (TNM). NANTOU: Sunlinhsi, alt. 1,700 m, on branch of angiosperm, 11 Oct 1991, Wu 911011-41 (TNM); on branch of *Liquidambar formosana*, 1 Jul 1992, Wu 9207-12 (TNM); 19 Sep 1992, Wu 9209-45, 9209-46 (TNM). Tsuifeng, alt. 2,300 m, on branch of angiosperm, 16 Feb 1993, Wu 9302-43, 9302-52, 9302-65 (TNM); 21 Sep 1993, Wu 9309-16 (TNM). Piluhsi, alt. 2,300 m, on branch of angiosperm, 13 Apr 1993, Wu 9304-8 (TNM); alt. 2,100 m, Wu 9304-43 (TNM). Yushan National Park, between Kuankao and Patungkuan, alt. 2,700-3,000 m, on branch of angiosperm, leg. Y.M. Ju, 8 Jan 1988, Wu 880108-15 (TNM); between Kuankao and Tuikuan, alt. 2,400 m, on branch of angiosperm, 26 Jul 1988, Wu 880726-53 (TNM). Huisun Forestry Station, alt. 770 m, on branch of angiosperm, 12 Dec 1997, Wu 9712-35 (TNM). CHIAYI: Yushan National Park, Lulinshan, alt. 2,650 m, on stem of *Polygonum cuspidatum*, 13 Oct 1993, Wu 9310-63 (TNM). Yushan National Park, entrance of Salihshienhsi Forest Road near Tungpu, alt. 1,300 m, on branch of angiosperm, 24 Nov 1993, Wu 9311-48 (TNM); 7 Dec 1994, Wu 9412-1 (TNM). Yushan National Park, Nanshi Forest Road, alt. 2,100 m, on branch of *Alnus formosana*, 7 Oct 1992, Wu

9210-68 (TNM); alt. 1,950 m, on branch of angiosperm, 3 May 1994, Wu 9405-54 (TNM); alt. 1,650 m, on branch of angiosperm, 3 May 1994, Wu 9405-20 (TNM). Yushan National Park, Shenmu Forest Road, alt. 1,950 m, on branch of *Alnus formosana*, 7 Oct 1992, Wu 9210-72 (TNM). KAOHSIUNG: Liukuei, on branch of angiosperm, 13 Jul 1989, Wu 890713-4 (TNM). ILAN: Chilanshan, alt. 400 m, on branch of angiosperm, 18 Nov 1992, Wu 9211-1 (TNM).

*Statistical analyses of basidiospores.* Wu 911011-41:  $6.5\text{-}8 \times 2.8\text{-}3.8 \mu\text{m}$  ( $X = 7.39 \pm 0.52 \times 3.01 \pm 0.24 \mu\text{m}$ ,  $n = 30$ ). Wu 9210-68:  $7\text{-}8.2 \times 3\text{-}4 \mu\text{m}$  ( $X = 7.61 \pm 0.44 \times 3.45 \pm 0.36 \mu\text{m}$ ,  $n = 30$ ). Wu 9302-43:  $7.8\text{-}8.9 \times 3\text{-}4 \mu\text{m}$  ( $X = 8.26 \pm 0.34 \times 3.34 \pm 0.28 \mu\text{m}$ ,  $n = 30$ ). Wu 9209-45:  $7\text{-}8.8 \times 2.8\text{-}3.1 \mu\text{m}$  ( $X = 7.61 \pm 0.48 \times 2.93 \pm 0.10 \mu\text{m}$ ,  $n = 30$ ). Wu 9302-52:  $7\text{-}8.6 \times 2.5\text{-}3 \mu\text{m}$  ( $X = 7.89 \pm 0.53 \times 2.77 \pm 0.19 \mu\text{m}$ ,  $n = 30$ ). Wu 9310-63:  $7\text{-}9 \times 2.5\text{-}3.6 \mu\text{m}$  ( $X = 8.15 \pm 0.55 \times 3.01 \pm 0.24 \mu\text{m}$ ,  $n = 30$ ). Wu 9311-48:  $6.3\text{-}8 \times 2.5\text{-}3.5 \mu\text{m}$  ( $X = 7.11 \pm 0.56 \times 2.93 \pm 0.29 \mu\text{m}$ ,  $n = 30$ ). Wu 9403-17:  $7.2\text{-}9.1 \times 2.5\text{-}3.2 \mu\text{m}$  ( $X = 8.44 \pm 0.49 \times 2.98 \pm 0.14 \mu\text{m}$ ,  $n = 30$ ). Wu 9403-18:  $7.2\text{-}9.1 \times 2.8\text{-}3.3 \mu\text{m}$  ( $X = 8.29 \pm 0.53 \times 3.02 \pm 0.09 \mu\text{m}$ ,  $n = 30$ ).

*Distribution.* Cosmopolitan.

*Cultural description* (combined from PS-mycelia of Wu 9302-43, Wu 9405-5, and Wu 9405-20). 1 wk growth: Colony radius 27-35 mm. Advancing zone even. Mat whitish. Aerial mycelium absent or pellicular near inoculum, downy-cottony elsewhere. 2 wk growth: Colony radius 60-

70 mm. Mat whitish. Aerial mycelium pellicular near inoculum, downy-cottony elsewhere. Advancing hyphae colorless, nodose-septate, 1.5–4.5  $\mu\text{m}$  diam., thin-walled. 3 wk growth: Plates covered. 6 wk growth: Mat whitish near inoculum, brownish elsewhere. Aerial mycelium sparse and slightly pellicular near inoculum, downy towards growth margins. Hyphal system monomitic; hyphae nodose-septate. Aerial hyphae colorless, yellow or brownish, moderately ramified, 1.5–5  $\mu\text{m}$  diam., thin-walled, sometimes irregularly swollen, usually guttulate, occasionally covered with brownish excreted materials; gloeoplerous hyphae or gloeocystidia occasionally present, SA-. Submerged hyphae colorless, moderately ramified, usually guttulate, 1.5–6.5  $\mu\text{m}$  diam., Crystals present, thin-walled. No distinct odor. Not fruiting.

*Oxidase reactions.* TAA: +++, 30–40; +++, 40–65. GAA: +++, tr; +++, tr to 12. TyA: - (slightly brownish), 35–50; - (slightly brownish), 90+.

*Sexuality.* Tetrapolar ( $A_1B_1$ : 1, 8;  $A_1B_2$ : 4, 6, 7, 9;  $A_2B_1$ : 3, 5, 9;  $A_2B_2$ : 2, 10) for *Wu 9302-52*.

*Species code.* 2a, 3c, 15b, 32, 37, 39, 43, 54, 60, 61.

*Nuclear behavior.* Normal. Spores uninucleate, MS-mycelium uninucleate, PS-mycelium dikaryotic (studied from *Wu 9302-52*).

*Remarks.* This species complex has cosmopolitan distribution, from temperate to tropical regions. Hallenberg and Larsson (1992) performed compatibility tests mating three specimens from Taiwan (*Wu 890515*, *Wu 880726-53*, *Wu 880824-51*) with foreign strains. All three have high degree of intercompatibility with European and Canadian specimens. The following Taiwanese collections of *P. cinerea* were compatible in this study with the tester strain *Wu 9302-52*. *Wu 880531-2*, *Wu 880726-53*, *Wu 880824-51*, *Wu 890515*, *Wu 890713-4*, *Wu 911011-41*, *Wu 911206-9*, *Wu 911206-54*, *Wu 9207-12*, *Wu 9210-68*, *Wu 9210-72*, *Wu 9211-1*, *Wu 9302-43*, *Wu 9304-8*, *Wu 9304-43*, *Wu 9309-16*, *Wu 9310-63*, *Wu 9311-48*, *Wu 9403-17*, and *Wu 9405-54*.

## 2. *Peniophora ovalispora* Boidin et al., Bull. Soc. Mycol. France 107: 108. 1991. Figure 2

Basidiome resupinate, effuse, adnate, membranaceous, 40–120  $\mu\text{m}$  thick in section. Hymenial surface yellowish orange, smooth or slightly tuberculate, sometimes cracked; margin fairly determinate, concolorous.

Hyphal system monomitic; hyphae nodose-septate. Subiculum fairly uniform, composed of a fairly thin basal layer, with compact texture; hyphae colorless, mainly horizontal, sometimes glued together, 1.5–4.5  $\mu\text{m}$  diam., thin- or slightly thick-walled. Hymenium thickening, with compact texture; hyphae colorless, mainly vertical, dextrinoid, thin-walled. Lamprocystidia numerous, immersed or emergent, overlapping in hymenial layer, heavily encrusted, conical, colorless, 20–40  $\times$  7–11  $\mu\text{m}$  (encrustation included), with 1–2  $\mu\text{m}$  thick walls. Gloeocystidia not abundant, colorless, cylindrical, usually tapering to nar-

row apices, 25–40  $\times$  6–9  $\mu\text{m}$ , thin-walled, SA-. Basidia subclavate to almost cylindrical, sometimes slightly constricted in the middle, 14–20  $\times$  4–4.5  $\mu\text{m}$ , some with thickened walls toward bases, 4-sterigmate. Basidiospores broadly ellipsoid, smooth, thin-walled, (4-) 5–6 (-6.3)  $\times$  3–4  $\mu\text{m}$ , IKI-, CB-.

*Specimens examined.* TAIWAN. TAIPEI: Yangminshan, alt. 400 m, on branch of *Duranta repens*, 1 Jul 1988, *Wu 880701-4* (TNM); alt. 600 m, on branch of angiosperm, 20 Nov 1992, *Wu 9211-93* (TNM). Kungliao, alt. 200 m, on branch of Araliaceae, 25 Jul 1991, *Wu 910725-7*, Lin 566-1 (TNM). HSINCHU: Sanshui, on branch of angiosperm, 4 Apr 1988, *Wu 880404-2*, *880404-4* (TNM). ILAN: Jentse, alt. 380 m, on branch of angiosperm, 22 Nov 1988, *Wu 881122-45* (TNM); Chilanshan, alt. 400 m, on branch of angiosperm, 18 Nov 1992, *Wu 9211-15* (TNM); Fushan Nature Reserve, alt. 600 m, on branch of angiosperm, 9 Mar 1993, *Chen 160* (TNM). NANTOU: Yushan National Park, between Kuankao and Tuikuan, alt. 2,300 m, on branch of living *Pittosporum illicioides*, 28 Jul 1988, *Wu 880728-42* (TNM); Shenmu Forest Road, alt. 1,300 m, on rotten culm of bamboo, 7 Oct 1992, *Wu 9210-87* (TNM). Tsuifeng, alt. 2,300 m, on branch of angiosperm, 16 Feb 1993, *Wu 9302-62* (TNM 9306-37); Sunlinhsi, alt. 1,700 m, on branch of living? *Acer serrulatum*, 19 Jun 1993, *Wu 9306-34*, *9306-37*, *9306-47* (TNM); Neimaopu, Dachieshan, alt. 750 m, on branch of angiosperm, 13 Oct 1994, *Wu 9410-17* (TNM); Tungpu, alt. 1,300 m, on branch of angiosperm, 13 Oct 1994, *Wu 9410-32* (TNM). KAOHSIUNG: Liukuei, Shanping, alt. 750 m, on branch of angiosperm, 7 Nov 1991, *Wu 911107-26*, *911107-41* (TNM).

*Statistical analyses of basidiospores.* *Wu 9211-93*: 4–5.5  $\times$  3–4  $\mu\text{m}$  ( $X = 4.83 \pm 0.46 \times 3.23 \pm 0.33 \mu\text{m}$ ,  $n = 30$ ). *Wu 9302-62*: 5–6.3  $\times$  3.3–4  $\mu\text{m}$  ( $X = 5.75 \pm 0.40 \times 3.73 \pm 0.22 \mu\text{m}$ ,  $n = 30$ ). *Wu 911107-26*: 5–6  $\times$  3–4  $\mu\text{m}$  ( $X = 5.60 \pm 0.36 \times 3.48 \pm 0.38 \mu\text{m}$ ,  $n = 30$ ).

*Distribution.* Réunion (type locality) and Taiwan.

*Cultural description* (from PS-mycelia of *Wu 9211-93*). 1 wk growth: Colony radius 25 mm. Advancing zone even. Mat white. Aerial mycelium pellicular around inoculum, downy-cottony towards growth margins. 2 wk growth: Colony radius 57 mm. Advancing zone even. Mat white. Aerial mycelium pellicular around inoculum, downy towards growth margins. 3 wk growth: Plates covered. 6 wk growth: Mat whitish, slightly brownish-tinted. Aerial mycelium pellicular. Hyphal system monomitic; hyphae nodose-septate. Aerial hyphae colorless, sparsely ramified, usually guttulate, 2–3.5  $\mu\text{m}$  diam., thin-walled. Submerged hyphae colorless, moderately ramified, 2–5  $\mu\text{m}$  diam., thin-walled. Cuboid crystals present. Odor fragrant. Not fruiting.

*Oxidase reactions.* TAA: +++, 14–20; 37–43. GAA: +++, tr; tr. TyA: -, 45–50; 90+.

*Species code.* 2a, 3c, 7, 32, 36, 37, 38, 43, 50, 54, 60, 61.

*Sexuality.* Tetrapolar ( $A_1B_1$ : 1, 8;  $A_1B_2$ : 4, 5, 10;  $A_2B_1$ : 2, 6, 7;  $A_2B_2$ : 3, 9) for *Wu 9211-93*.

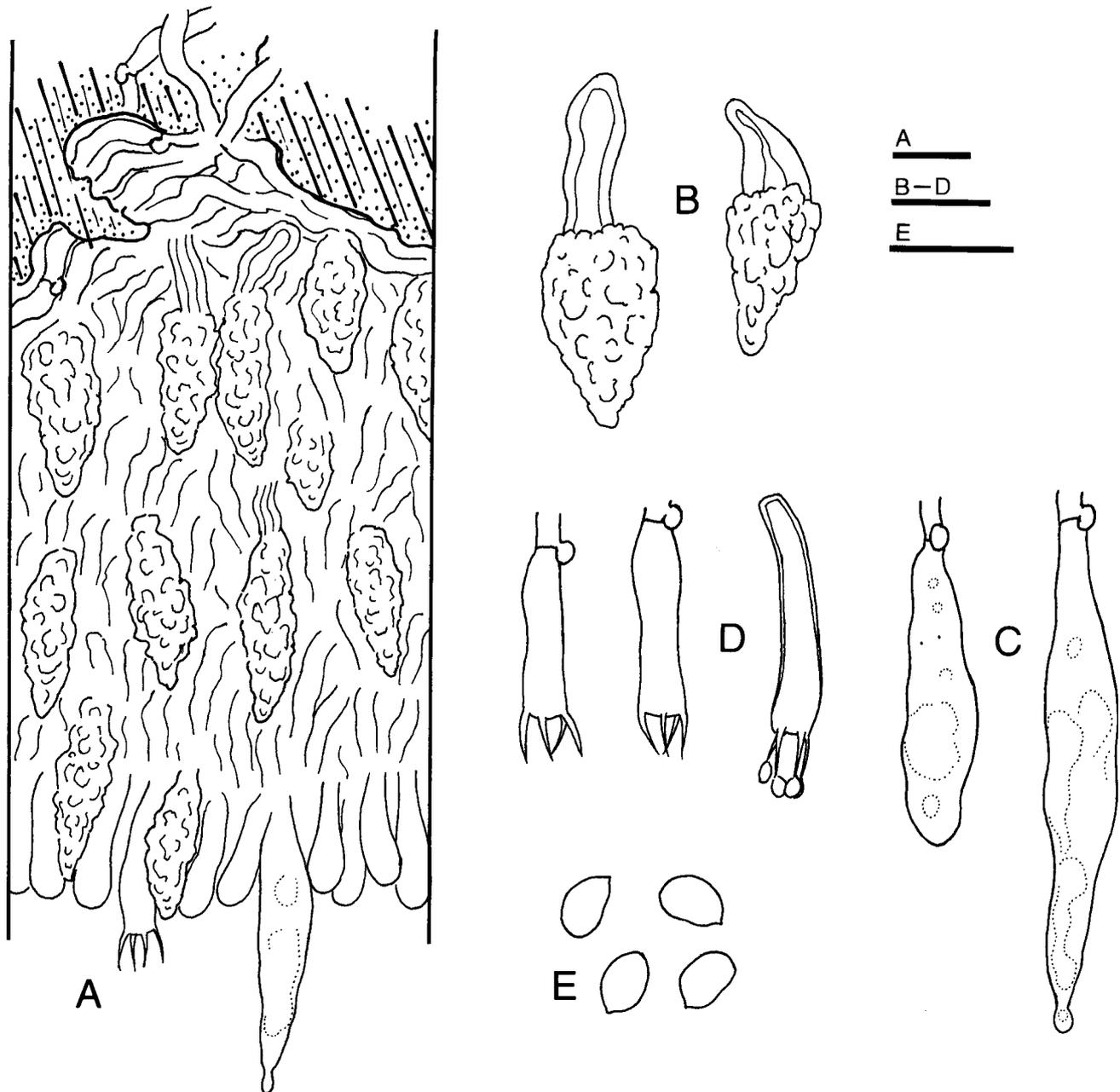
*Nuclear behavior.* Normal. Spores uninucleate, MS-mycelium uninucleate, SC-mycelium dikaryotic (studied from *Wu 9211-93*).

*Remarks.* *Peniophora ovalispora* is closely related to *P. scintillans*. Morphologically the former has smaller basidiospores. Boidin et al. (1991) proved incompatibility between specimens of these two species. Incompatibility was also obtained in this study by crossing *Wu 9211-39* (*P. ovalispora*) with *Wu 881026-21* (*P. scintillans*). In this study, specimens *Wu 880404-2*, *Wu 880404-4*, *Wu 880701-4*, *Wu 881122-45*, *Wu 911107-26*, and *Wu 9211-15*, were compatible with the tester *Wu 9211-93*.

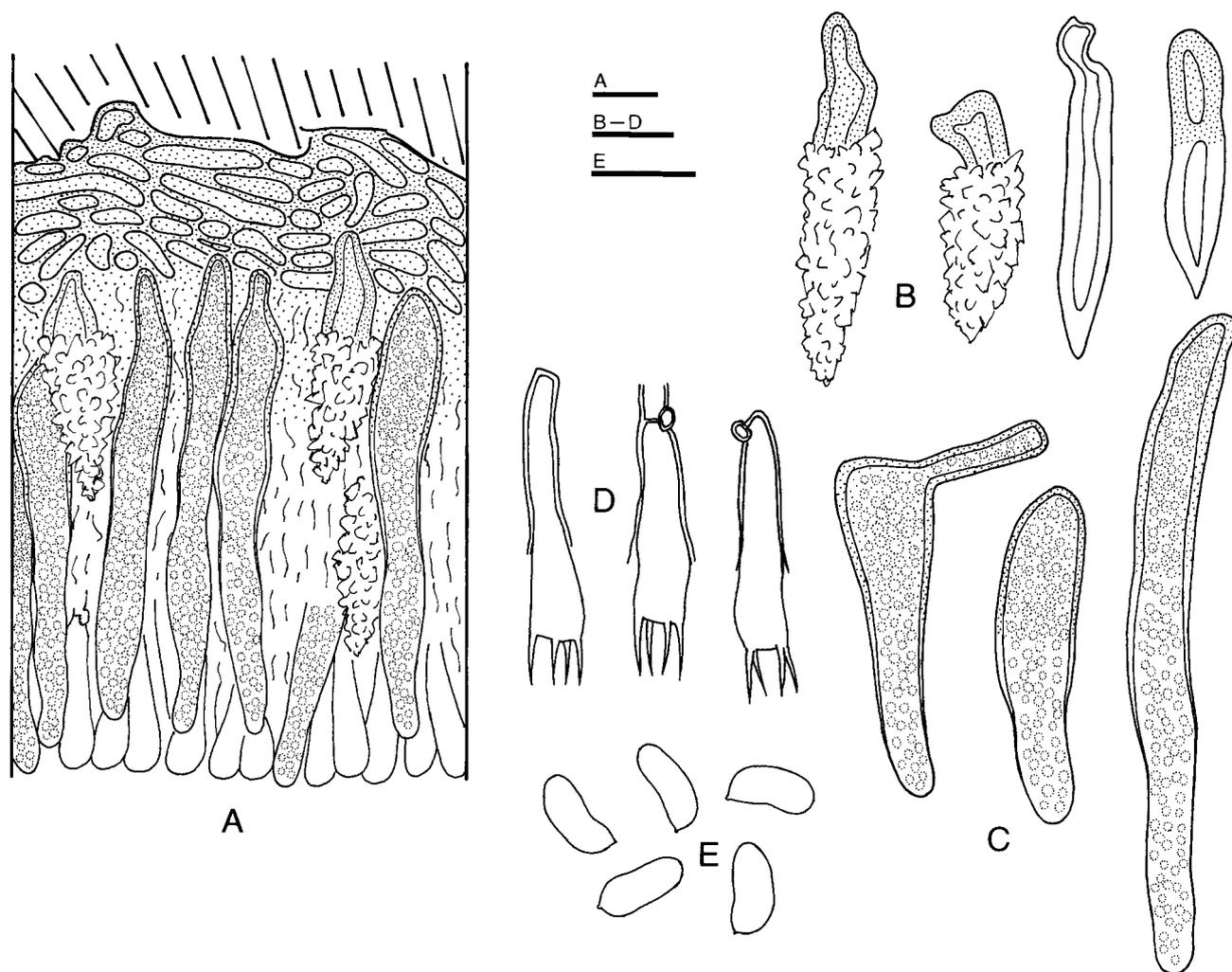
**3. *Peniophora pseudonuda*** Hallenb., *Mycotaxon* 11(2): 459. 1980. Figure 3

Basidiome resupinate, effuse, adnate, membranaceous or subceraceous, 50-120  $\mu\text{m}$  thick in section. Hymenial surface yellowish gray, smooth, cracked; margin thinning, concolorous, pruinose.

Hyphal system monomitic; hyphae nodose-septate. Subiculum fairly uniform, composed of basal layer, with compact texture; hyphae brownish, mainly horizontal, usually glued together, 2.5-5  $\mu\text{m}$  diam.,  $\pm$  thick-walled. Hymenium  $\pm$  thickening, with compact texture; hyphae colorless, mainly vertical, rather indistinct, thin-walled.



**Figure 2.** *Peniophora ovalispora* (*Wu 9211-93*). A, Basidiome section; B, Lamprocystidia; C, Gloeocystidia; D, Basidia; E, Basidiospores. Scale bars = 10  $\mu\text{m}$ .



**Figure 3.** *Peniophora pseudonuda* (Wu 9211-110). A, Basidiome section; B, Lamprocystidia; C, Gloeocystidia; D, Basidia; E, Basidiospores. Scale bars = 10 µm.

Lamprocystidia usually immersed, heavily encrusted, conical, colorless or slightly brown,  $20\text{--}45 \times 8\text{--}15$  µm (encrustation included), with  $1\text{--}2.5$  µm thick walls. Gloeocystidia numerous, brownish towards bases, cylindrical with narrower apices, slightly flexuous,  $40\text{--}90 \times 7\text{--}14$  µm, thick-walled towards bases, slightly SA+. Basidia subclavate,  $24\text{--}33 \times 5.5\text{--}7$  µm, 4-sterigmate. Basidiospores ellipsoid, adaxially slightly concave, smooth, thin-walled,  $8\text{--}10.2 \times 3\text{--}4.2$  µm ( $X = 9.15 \pm 0.64 \times 3.56 \pm 0.36$  µm,  $n = 30$ ), IKI-, CB-.

*Specimen examined.* **TAIWAN.** TAIPEI: Yangminshan, alt. 600 m, on branch of angiosperm, 20 Nov 1992, Wu 9211-110 (TNM).

*Distribution.* Iran (type locality) and Taiwan.

*Cultural description* (from PS-mycelium of Wu 9211-110). 1 wk growth: Colony radius 20-25 mm. Advancing zone fairly even. Mat white. Aerial mycelium pellicular. 2 wk growth: Colony radius 40-46 mm. Advancing zone slightly fimbriate. Mat whitish. Aerial mycelium almost absent. 3 wk growth: Colony radius 63-75 mm. Advanc-

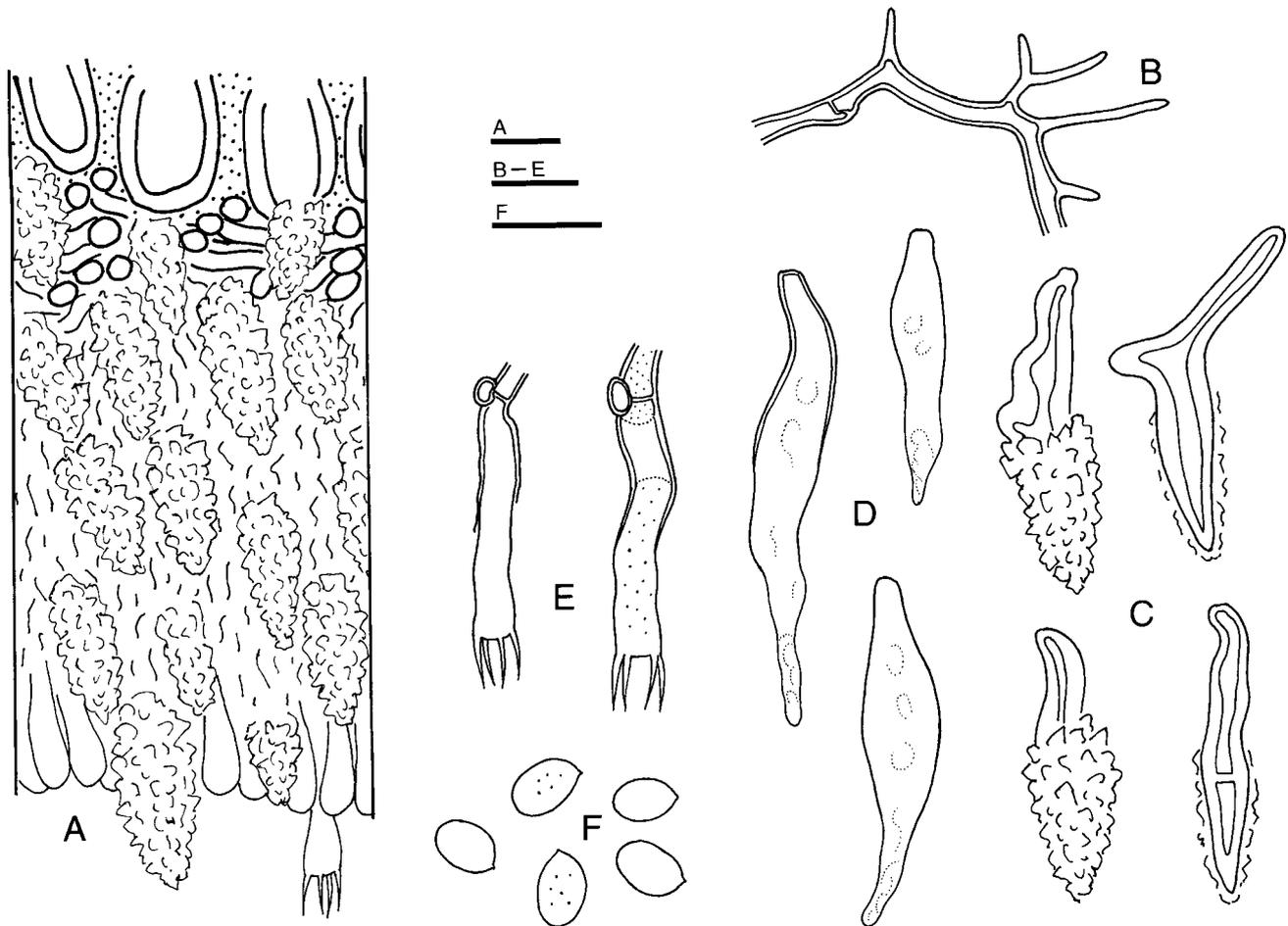
ing hyphae colorless, nodose-septate,  $1.5\text{--}3$  µm diam., thin-walled. 4 wk growth: Plates covered. 6 wk growth: Mat white, slightly brownish-tinted. Aerial mycelium pellicular, irregularly reticulate-porous. Monomitic. Hyphae nodose-septate. Aerial hyphae colorless, moderately ramified, usually guttulate, occasionally irregularly swollen,  $1.5\text{--}4.5$  µm diam., thin-walled; gloeoplerous hyphae and gloeocystidia occasionally present, SA-. Submerged hyphae colorless, moderately ramified, occasionally swollen, usually guttulate, secondary septa occasionally present,  $1.5\text{--}6.5$  µm diam., thin-walled. Cuboid crystals present. No distinct odor. Not fruiting.

*Oxidase reactions.* TAA: +, tr; 23-37. GAA: +, tr; tr to 15. TyA: - (slightly brown), 12-15; 25-30.

*Species code.* 2a, 3c, 15b, 32, 36, 37, 38, 44, 54, 60, 61.

*Sexuality.* Tetrapolar ( $A_1B_1$ : 1, 3, 10;  $A_1B_2$ : 4, 6, 8;  $A_2B_1$ : 2;  $A_2B_2$ : 5, 7, 9) for Wu 9211-110.

*Nuclear behavior.* Normal. Spores uninucleate, MS-mycelium uninucleate, SC-mycelium dikaryotic (studied from Wu 9211-110).



**Figure 4.** *Peniophora scintillans* (Wu 901125-16). A, Basidiome section; B, Quasi-binding hyphae; C, Lamprocystidia; D, Gloeocystidia; E, Basidia; F, Basidiospores. Scale bars = 10 µm.

*Remarks.* *Peniophora pseudonuda* differs from *P. nuda* (Fr.) Bres. in having thicker basal layer of the basidiomes and broader basidiospores, additionally has comparatively longer and narrower gloeocystidia. It also resembles *P. fissilis* Boidin et al., but differs in having obtuse apices of the gloeocystidia, and has slightly larger basidiospores.

**4. *Peniophora scintillans*** G.H. Cunn., Trans. Roy. Soc. New Zealand 83: 268. 1955. Figure 4

Basidiome resupinate, effuse, adnate, membranaceous, 50-150 µm thick in section. Hymenial surface grayish yellow or grayish pink, smooth, sometimes cracked; margin fairly determinate, concolorous.

Hyphal system essentially monomitic, some specimens with quasi-binding hyphae near substratum; generative hyphae nodose-septate. Subiculum fairly uniform, composed of a fairly thin basal layer, with compact texture; generative hyphae colorless or yellowish, glued together, 2-4 µm diam., usually slightly thick-walled; quasi-binding hyphae rarely present near substratum, colorless or yellowish, 0.5-1.5 µm diam. Hymenium thickening, with compact texture; hyphae colorless, mainly vertical, thin-

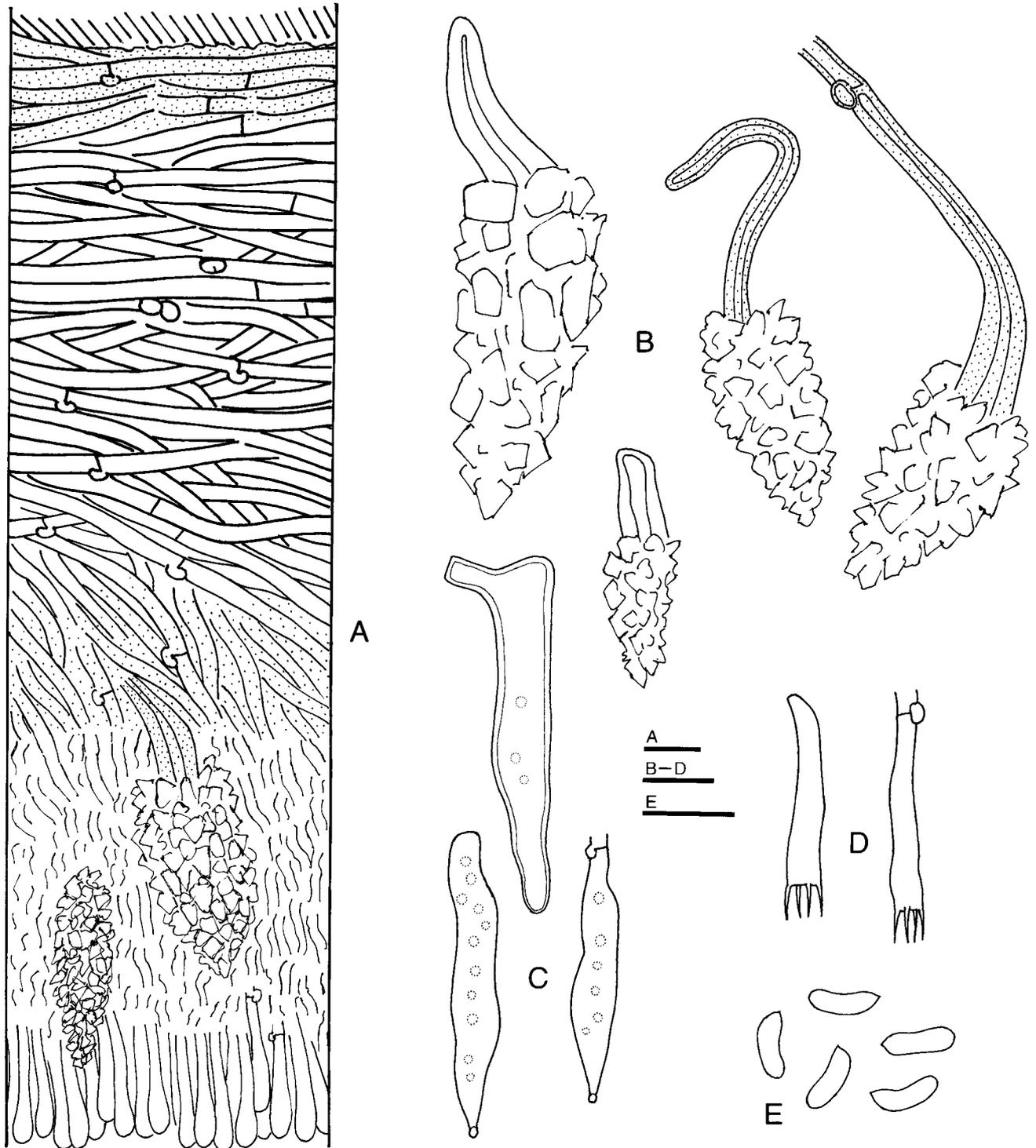
walled, dextrinoid. Lamprocystidia numerous, immersed or emergent, overlapping in subhymenium, heavily encrusted, conical, colorless, slightly yellow or rarely slightly brown, 25-45 × 8-12 µm (encrustation included), with 1-2.5 µm thick walls. Gloeocystidia fairly few, colorless, cylindrical, tapering to narrow apices, 25-50 × 6-10 µm, thin-walled, SA-. Basidia subclavate, 25-33 × 5-6 µm, 4-sterigmate. Basidiospores broadly ellipsoid, smooth, thin-walled, (5-) 5.7-7 (-7.5) × 3.7-4.8 µm, IKI-, CB-.

*Specimens examined.* **NEW ZEALAND.** Bay of Plenty, Mt. Te Aroha, on *Laurelia novaezelandiae*, leg. G.H. Cunn., Sep 1954 (holotype, PDD 13828). **TAIWAN.** TAIPEI: Kungliao, alt. 200 m, on branch of *Lagerstroemia subcostata*, 25 Nov 1990, Wu 901125-16 (TNM). Yangminshan, alt. 600 m, on branch of angiosperm, 13 Dec 1990, Wu 901213-13 (TNM). NANTOU: Sun-Moon Lake, on branch of angiosperm, alt. 750 m, 26 Oct 1988, Wu 881026-21 (TNM). TAICHUNG: Chiapaotai, alt. 900 m, on branch of angiosperm, 6 Dec 1991, Wu 911206-14 (TNM). PINGTUNG: Kengting National Park, Changle, alt. 250 m, on branch of angiosperm, 20 Feb 1992, Wu 9202-36 (TNM). TAITUNG: Taimali, alt. 600 m, on branch of angiosperm, 19 May 1989, Wu 890519-35 (TNM).

*Distribution.* New Zealand (type locality), Madagascar, Réunion, and Taiwan.

*Cultural description* (FB-mycelium from *Wu 901125-16*). 1 wk growth: Colony radius 27 mm. Advancing zone fairly even. Mat white, slightly dirty-tinted. Aerial mycelium pellicular around inoculum, downy-cottony elsewhere. 2 wk growth: Colony radius 60 mm. Advancing zone some-

what bayed. Mat white, slightly clay colored tinted. Aerial mycelium pellicular-downy around inoculum, downy-cottony elsewhere, ± zonate. 3 wk growth: Plates covered. 6 wk growth: Mat white, slightly brownish-tinted. Aerial mycelium pellicular, almost absent around inoculum. Hyphal system monomitic; hyphae nodose-septate. Aerial hyphae moderately or richly ramified, colorless or rarely



**Figure 5.** *Peniophora cf. septentrionalis* (*Wu 9310-114*). A, Basidiome section; B, Lamprocystidia; C, Gloeocystidia; D, Basidia; E, Basidiospores. Scale bars = 10 µm.

brownish, usually guttulate, 1-3.5  $\mu\text{m}$  diam., thin-walled; gloeoplerous hyphae or gloecystidia colorless or rarely brownish, 3-6  $\mu\text{m}$  diam., with walls up to ca. 1  $\mu\text{m}$  thick, SA-. Submerged hyphae colorless, moderately or sparsely ramified, usually guttulate, 1-3.5  $\mu\text{m}$  diam., thin-walled. Cubical crystals present. No distinct odor. Not fruiting.

*Oxidase reactions.* TAA: +++, 28-33; 45-53. GAA: +, +, +, +, tr; tr. TyA: -, 36-42; 90+.

*Species code.* 2a, 3c, 15b, 32, 36, 37, 38, 43, 54, 60, 61.

*Sexuality.* Tetrapolar (Boidin et al., 1991).

*Nuclear behavior.* Normal. Spores uninucleate, MS-mycelium uninucleate, PS-mycelium dikaryotic (Boidin et al., 1991).

*Remarks.* As mentioned above, *P. scintillans* has larger basidiospores than *P. ovalispora*. Cunningham (1963) reported spores for *P. scintillans* to be  $6-7 \times 3.5-4 \mu\text{m}$ . My measurements from the type specimen are similar,  $6-7.5 \times 3.5-4.5 \mu\text{m}$ . Stalpers and Buchanan (1991), based on the same specimen, found spores sizes to be  $5.5-8 \times 3.5-4.5 (-5) \mu\text{m}$ . The measurement provided by Boidin et al. (1991) for this species is slightly smaller ( $4.5-6(-7) \times 3.2-4.2 \mu\text{m}$ ). I found one of the specimens (LY 12415) studied by Boidin et al. (1991) as *P. scintillans* to be compatible with two Taiwanese specimens (*Wu 890519-35* and *Wu 901125-16*) in this study.

**5. *Peniophora cf. septentrionalis*** Laurila, Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo 10 (4): 10. 1939. Figure 5

Basidiome resupinate, effuse, adnate, subceraceous, 150-500  $\mu\text{m}$  thick in section. Hymenial surface pink or grayish pink, smooth, occasionally cracked; margin determinate, quite often separate from the substratum, colorous or slightly paler.

Hyphal system monomitic; hyphae nodose-septate. Subiculum fairly uniform, composed of a rather thick basal layer, with compact texture; hyphae brownish next to substratum and hymenium, colorless elsewhere, mainly horizontal, sometimes glued together, 2.5-5  $\mu\text{m}$  diam., with 0.6-1.2  $\mu\text{m}$  thick walls. Hymenium  $\pm$  thickening, with compact texture; hyphae colorless, mainly vertical, rather indistinct, thin-walled. Lamprocystidia variably abundant, mostly immersed, heavily encrusted, conical, colorless or slightly brown,  $30-90 \times 10-20 \mu\text{m}$  (encrustation included), with 1-2.5  $\mu\text{m}$  thick walls. Gloecystidia variably abundant, colorless, cylindrical with obtuse apices or fusiform with acute apices,  $30-80 \times 5-10 \mu\text{m}$ , thin- to thick-walled, SA-. Basidia subclavate,  $25-30 \times 4-5 \mu\text{m}$ , 4-sterigmate. Basidiospores subballantoid, adaxially slightly concave, smooth, thin-walled,  $6.3-7.5 \times 2-2.5 \mu\text{m}$ , IKI-, CB-.

*Specimen examined.* TAIWAN. NANTOU: Yushan National Park, Nanhsi Forest Road, alt. 2,200 m, on branch of angiosperm, 14 Oct 1993, *Wu 9310-114* (TNM); Yushan National Park, between Kuankao and Tuikuan, alt. 2,400 m, on branch of *Alnus formosanum*, 26 Jul 1988, *Wu 880726-55* (TNM).

*Distribution.* North Europe, North America, Russia, and Taiwan.

*Cultural description* (from PS-mycelium of *Wu 9310-114*). 1 wk growth: Colony radius 35 mm. Advancing zone even. Mat whitish or slightly brown. Aerial mycelium downy-cottony. 2 wk growth: Colony radius 70 mm. Advancing zone fairly even. Mat white. Aerial mycelium pellicular near inoculum, downy-cottony and with sparsely porose-reticulate morphology elsewhere. Advancing hyphae sparsely ramified, nodose-septate, 2.5-5  $\mu\text{m}$  diam., thin-walled. 3 wk growth: Plates covered. 6 wk growth: Mat white. Aerial mycelium almost absent close to inoculum, slightly pellicular with porose-reticulate appearance elsewhere. Hyphal system monomitic; hyphae nodose-septate. Aerial hyphae colorless, sparsely or moderately ramified, usually guttulate, 1.5-3  $\mu\text{m}$  diam., thin-walled. Submerged hyphae colorless, moderately ramified, 2-5  $\mu\text{m}$  diam., thin-walled. No distinct odor. Not fruiting.

*Oxidase reactions.* TAA: +, +, +, 30; 50-60. GAA: +, +, +, +, 25-40; 50-60. TyA: -, 30-50; 90+.

*Species code.* 2a, 3c, 7, 32, 36, 38, 43, 54, 60, 61.

*Sexuality.* Tetrapolar ( $A_1B_1$ : 1;  $A_1B_2$ : 3, 6, 7, 8, 10;  $A_2B_1$ : 4, 5;  $A_2B_2$ : 2, 9) for *Wu 9310-114*.

*Nuclear behavior.* Normal. Spores uninucleate, MS-mycelium uninucleate, SC-mycelium dikaryotic (studied from *Wu 9310-114*).

*Remarks.* General morphological characters of two specimens collected from temperate belt of Taiwan resemble those of *P. septentrionalis*. The only significant difference between Taiwanese specimens and those of other localities is in the host plants. Collections from the other regions of the world occur on gymnosperm (Eriksson et al., 1978; Ginns and Lefebvre, 1993) while two specimens from Taiwan were collected from angiosperm. Specimens *Wu 9310-114* and *Wu 880726-55* were intercompatible in this study.

**Studies on *Peniophora* specimens reported from Taiwan by Lin and Chen (1990)**

Lin and Chen (1990) described four species in *Peniophora* in their preliminary survey of corticioid fungi from Taiwan. All have clamped hyphae. I examined voucher specimens cited in their paper and conclude:

1. *Peniophora aurantiaca* (Bres.) Höhn. & Litsch.

*Specimen examined.* TAIWAN. TAITUNG: Pinglin, roadside between Orchid Valley and Mt. Suchuanglo, under the hardwood forest, alt. 400-500 m, 24 Jul 1975, S. Lin (NTU-2925).

*Remarks.* Specimen NTU-2925 is not *Peniophora aurantiaca*, but a species of *Hypochnicium*. Subiculum texture is loose. Hymenial surface is slightly grandinoid, due to the projecting encrusted cystidia. Subicular hyphae are nodose-septate, thick-walled. Spores are subglobose,

smooth,  $11.5-13 \times 10-11.5 \mu\text{m}$ , with  $0.5-1 \mu\text{m}$  thick walls, IKI-. This *Hypochnicium* species will be described in detail in a separate publication. Lin and Chen (1990) misspelt the specific epithet as “*aurantica*”.

#### 2. *Peniophora cinerea* (Pers.:Fr.) Cooke

*Specimen examined.* TAIWAN. TAIPEI: Chungho, Yuanntong Temple, roadside, under the broad-leaved forest, alt. 300 m, 25 Nov 1975, S. Lin (NTU-3903, 3396).

*Remarks.* General characters of these two specimens correspond with this species.

#### 3. *Peniophora incarnata* (Pers.:Fr.) P. Karst.

*Specimen examined.* TAIWAN. TAITUNG: Lanyu, Yehyiu, in the ditch of mountain, under the broad-leaved primary forest, alt. 50-300 m, 22 Aug 1975, S. Lin (NTU-3649).

*Remarks.* The specimen is *Hyphoderma variolosum* Boidin et al. The basidia have a median-constriction, typical of *Hyphoderma* basidia. The spores are about  $12.5 \times 4.7 \mu\text{m}$ . This measurement fits *H. variolosum* well. *Peniophora incarnata* is a temperate species, has pink basidiome, not white-gray of this specimen. In addition, *P. incarnata* has shorter spores ( $8-12 \times 3.5-5 \mu\text{m}$ , according to Eriksson et al., 1978). *Hyphoderma variolosum* has been recorded from Taiwan by Wu (1997), based on a specimen collected also from the tropical lowland in southern Taiwan.

#### 4. *Peniophora spathulata* S.H. Lin & Z.C. Chen

*Specimen examined.* TAIWAN. TAIPEI: Mt. Seven-star, roadside, under the hardwood forest, alt. 700 m, 6 Dec 1975, S. Lin (NTU-4304, holotype).

*Remarks.* The “spathulate cystidia” in the type specimen diagnostic for this species, do not deviate from the ordinary conical lamprocystidia that are fairly common in many species of *Peniophora*. Various features of the holotype of *Peniophora spathulata* resemble *P. cinerea*. I herein treat *P. spathulata* as a synonym of *P. cinerea*.

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# 臺灣產具扣子體菌絲的筍殼菌屬 (*Peniophora*) 種類研究

吳聲華

國立自然科學博物館植物學組

本文初步調查臺灣產具扣子體菌絲的筍殼菌屬 (*Peniophora*) 種類，計描述五種，即 *P. cinerea*，*P. ovalispora*，*P. pseudonuda*，*P. scintillans*，以及 *P. cf. septentrionalis*。除 *P. cinerea* 外，餘四種均為臺灣新記錄。本文並提供此五種之培養研究。本研究並對許多標本進行親和性試驗以確認其種別。

**關鍵詞：**親和性；皮殼菌科；培養研究；筍殼菌屬；臺灣；分類學。