Taiwania, 54(2): 152-158, 2009

Hyphomycetes from Taiwan: *Chaetendophragmia* and Allied Species

Jin-Liang Chen[(1)] and Shean-Shong Tzean[(2*)]

1. Department of Hospital and Health Care Administration, Chia-Nan University of Pharmacy and Science, Tainan 71710, Taiwan. Tel: 886-6-2664911 ext. 5001; Fax: 886-6-266-8619; Email: box831@mail.chna.edu.tw
2. Department of Plant Pathology and Microbiology, National Taiwan University, Taipei 10617, Taiwan.
** Corresponding author. Tel: 886-2-33664595; Fax: 886-2-2362-0639; Email: sst@ntu.edu.tw*

(Manuscript received 15 December 2008; accepted 19 January 2009)

ABSTRACT: Five hyphomycetous fungi: *Chaetendophragmia triangularia*, *Chlamydomyces palmarum*, *Coronospora dendrocalami*, *Corynespora cassiicola* and *Cylindrocarpon fusifrome* on decaying leaves or stems were newly recorded from several localities of Taiwan overtime using single or mass spore isolation technique. The morphological traits were closely examined, diagnosed and illustrated, and its distinguished characters for identification and comparison with conspecies of varied geographic regions were also briefly discussed.

KEY WORDS: Hyphomycetes, mitosporic fungi, taxonomy, biodiversity, Taiwan.

INTRODUCTION

In traditional classification scheme, fungi without accessed sexual stage usually were being classified in the Sub-phylum Deuteromycotina. Mainly based on the macro- and micro-morphological characteristics, Saccardo and allied workers categorized the members of this group of fungi into four Classes: Hyphomycetes, Blastomycetes, Coelomycetes and Agonomycetes (mycelia sterile) (Saccardo, 1880, 1886; Talbot, 1971). Of the Hyphomycetes, Moniliales is the key order which encompassed anamorphic fungi with sporulating structures born on the discrete conidiophores or aggregated synnemata or cushion-shaped sporodochia (Barnett and Hunter, 1998). Furthermore, Moniliales were further divided into two families: Moniliacece and Dematiaceae, the latter characterized with pigmented mycelium, conidiophores or conidium (Barnett and Hunter, 1998). Actually, except for the morphological features, the conidiogenesis patterns defined and implemented by Hughes (1953), Subramanian (1962), Tsubaki (1958) and Barron (1968) were extremely valuable for more rapid and precise distinction and classification of Hyphomycetes. The themes, in terms of macro-sporulating structure and conidiogenesis characteristics for taxonomic systematics, later have been extended and applied to Coelomycetes by Sutton (1980). More recently, the phylogenetic relatedness of these fungi imperfect with respect to their Ascomycetes or Basidiomycetes counter partners were being established via the molecular systematic approaches derived from the genetic evolutionary hierarchy (Loutozoni et al., 2004). Evidently, by combination of the genotypic and phenotypic traits, the biological entity for each taxon in nature will be established eventually.

In our laboratory, survey and construct the inventory of the anamorphic fungi originated from Taiwan to illustrate their biodiversity has been setup as one our long-term goals since the early 1980 onwards. A series of papers in this regard was published and documented in the more recently published "Fungal Flora of Taiwan" (Tzean et al., 2005). Our major approach for identification of the members of the mitosporic fungi were primarily based on the system proposed by the eminent mycologists mentioned above (Hughes, 1958; Subramanian, 1962; Tsubaki, 1958; Barron, 1968).

In this paper, we report five newly recorded hyphomycetes: *Chaetendophragmia triangularia* Matsushima, *Chlamydomyces palmarum* (Cook) Mason, *Coronospora dendrocalami* M. B. Ellis, *Corynespora cassiicola* (Berk. & Curt.) Wei and *Cylindrocarpon fusifrome* Matsushima isolated from the decayed leaves and stems in several habitats of Taiwan overtime, using the single or mass spore techniques. The collection, identification and preservation of the anamorphic fungi may not only enrich and enlighten our understanding of their biodiversity, but also provide the precious microbial resources for potential application for the betterment of human welfare.

MATERIALS AND METHODS

Samples collected from various decayed vegetations from several locations in Taiwan were incubated in moist chambers (plastic boxes, 30 x 20 x 12 cm, with three layers of moistened papers) to facilitate the sporulation of the fungi associated on the collected samples. The axenic cultures were obtained by single or mass spores isolation technique. The

臺灣大學學術期刊資料庫

isolation was performed under a stereomicroscope using a sterile micro-glass needle to move and spread the spores to adequate place on the 3% water agar plate, and also separated the possible contaminants. The agar disc bearing single or mass spores but visualized to be identical were excised and transferred to oat meal agar (OMA), V8 juice agar or corn meal agar (CMA) slants or plates depending for their nutrient preference. The practice served for isolation and also for identification purpose. For soil-borne hyphomycetes, soil samples collected from varied niches were sprinkled onto water agar plates, incubated at room temperature for adequate period of time to allow the growth of hyphae or limited sporulation. Pure cultures were secured by the same single or mass spores isolation techniques aforementioned, or by single hyphal-tip isolation techniques, which was also performed under a stereomicroscope with a sterile sharp scalpel. Details of morphological characteristics and conidiogenesis were illustrated and photographed with an Olympus light microscope (BH-2) built with a drawing tube. The taxonomic systems of Barron (1968), Barnett and Hunter (1998), Ellis (1971), Hughes (1953), Kendrink (1971), Saccardo (1880), Subramanian (1962) and Tubaki (1958) were followed for identification. Dried voucher specimens were deposited in the Department of Plant Pathology and Microbiology, National Taiwan University, Taipei, Taiwan, R.O.C., for further comparative study purpose.

TAXONOMIC TREATMENTS

Chaetendophragmia triangularia Matsushima, 1971. Microfungi of the Solomon Islands & Papua-New Guinea. p. 12. Figs. 1 & 3A-C

Colonies growing slowly on Corn Meal Agar obtaining a diameter 8 mm in 42 days at 25°C, dense, yellowish brown; reverse yellowish brown; Mycelium immersed, composed of branched, septate, smooth, hyaline to pale yellowish brown, 1.0-3.0 µm wide hyphae. Conidiophores macronematous, mononematous, simple, straight or flexuous, smooth, middle yellowish brown, paler towards the apex, 18.0-288.0 x 4.0-5.5 µm, often elongated-proliferation. Conidiogenous cells monoblastic, percurrent. Conidia obclavate, 21.2-52.0 x 5.0-9.0 µm, 4-6-septate, smooth, pale yellowish brown, truncated up to 3.2-5.0 µm wide and remained conspicuous scar at the base, apical cell acicular-form, rostrum, smooth, hyaline, 24.0-52.8 µm long, 1.1-2.4 µm, lateral appendages of 0-2, acicular-form, narrow, smooth, hyaline, 22.0-56.0 x 0.8-2.4 µm.

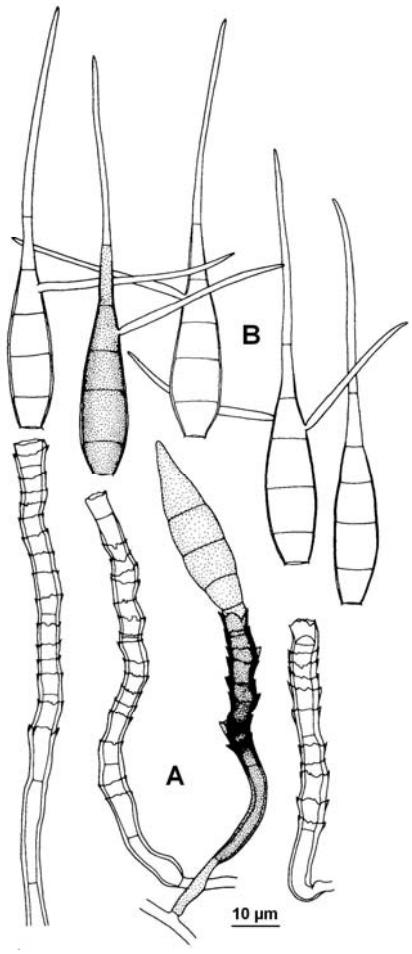


Fig. 1. *Chaetendophragmia triangularia.* A: Conidiophores. B: Conidia. Bar = 10 µm.

Specimens examined: Taiwan, Huisun, Nantou Pref., decayed leaves of *Phyllostachys pubescens*, Feb. 10 1993. leg. J.L. Chen. TNTU 1048.

Distribution: Taiwan, Papua New Guinea.

Notes: The genus *Chaetendophragmia* was established by Mastushima (1971), thereafter about eleven allied species have been described (CABI Bioscience Databases, 2008). *Chaetendophragmia triangularia* was originally recorded from rotten leaves of *Castanopsis* sp. in Papua New Guinea by Matsushima (1971). It was easily recognized by its simple, brown conidiophores with monoblastic, percurrent conidiogenous cells, and obclavate conidia with acicular-form apical cell and lateral appendages. The Taiwanese's isolate was comparable to those of Papua New Guinea's collection by Matsushima in shape, pigmentation and ontogeny of its conidia, and monoblastic, percurrent conidiogenous cells. However, the conidia in the former (up to 104.8 µm) were longer than in the latter (up to 84.0 µm).

臺灣大學學術期刊資料庫

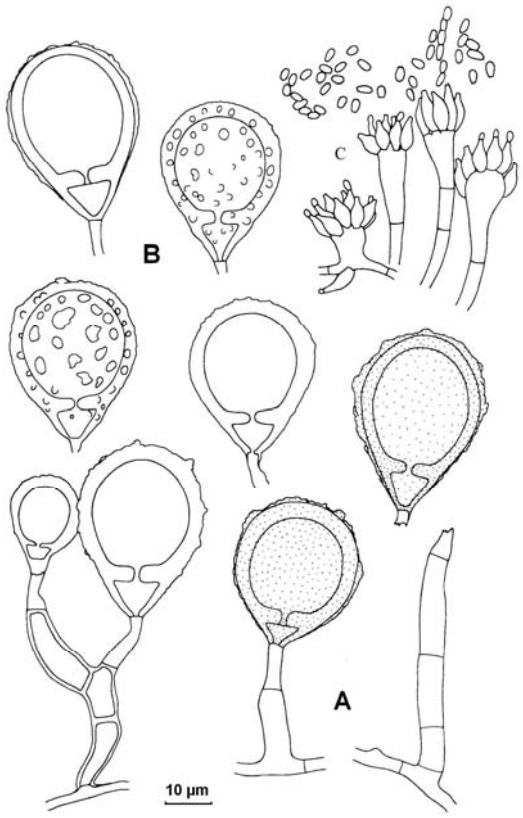


Fig. 2. *Chlamydomyces palmarum*. A: Conidiophores. B: Conidia. C: Aspergilli-form, phialidic state. Bar = 10 µm.

Chlamydomyces palmarum (Cook) Mason, 1928. Mycol. Pap. 2: 37-39. Figs. 2 & 3D-E

Colonies diameter on V8 Jucie Agar larger than 90 mm in 14 days, 25°C, effuse, granulate, somewhat floccose at the center, yellowish brown; reverse yellowish brown. Mycelium mostly superficial, partly immersed, composed of branched, septate, smooth to rugose, hyaline to pale brown, 1.4-17.0 µm wide hyphae. Conidiophores semimacronematous to macronematous, mononematous, simple or branched, often tappering towards the top, septate, smooth, hyaline to pale brown, 20.0-100.0 x 7.0-9.0 µm. Conidiogenous cells monoblastic. Conidia solitary, pyriform or obovoid, 1-septate, 26.0-57.0 x 22.0-36.0 µm, apical cell is large, very roughened to verrucose, yellowish brown to orange brown, basal cell small, smooth to roughened, hyaline to yellowish brown or orange brown, rhizolytic often attached with a narrow conidiophore remains at the base. Aspergilli-synamorph present; stipe smooth to finely roughened, hyaline to pale brown, 10.0-80.0 x 2.8-7.0 µm; vesicle 4.4-15.6 µm wide; phialides ampulliform, 8.0-12.8 x 3.2-4.5 µm, with a long narrow collar up to 4.0 µm long, 1.6 µm wide; conidia catenate, ellipsoidal or obovoid, often truncate at the base, smooth, hyaline, 2.4-4.0 x 1.5-2.8 µm.

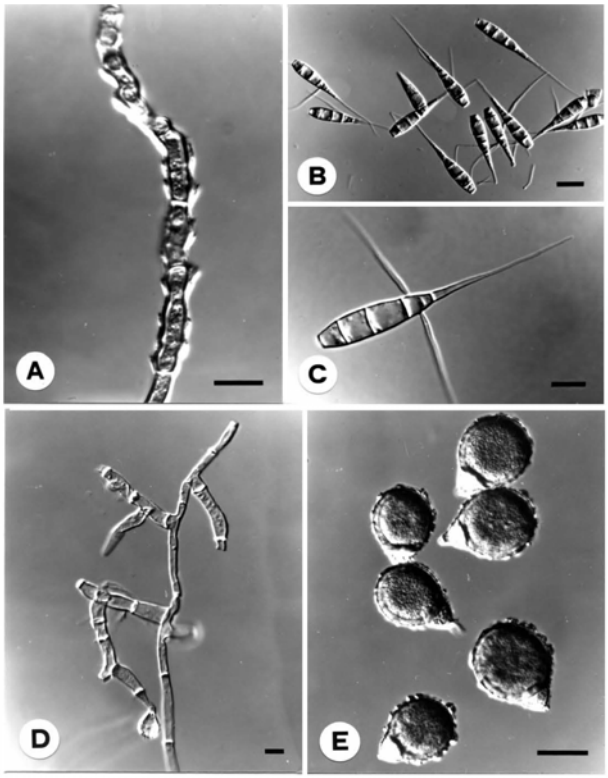


Fig. 3. *Chaetendophragmia triangularia* (A-C). A: Conidiophores, upper portion. B-C: Obclavate conidia with acicular form apical cell and lateral appendages. Bars A, C = 10 µm; Bar B = 20 µm. *Chlamydomyces palmarum* (D-E). D: Conidiophores with monoblastic conidiogenous cells. E: Pyriform conidia with verrucose walled. Bars D-E = 10 µm.

Specimens examined: Taiwan, Tainan Pref., rotten stems, Mar. 30 1991. leg. J. L. Chen. TNTU 981.

Distribution: Taiwan, China, Venezuela, India, Ghana, Somalia, U.S.A., Papua New Guinea.

Notes: Since the establishment of the genus *Chlamydomyces* by Bainier in 1907, thereafter three allied species have been described (CABI Bioscience Databases, 2008). *Chlamydomyces palmarum* was first recorded by Mason (1928), who treated *Trichobasis palmarum* Cooke as a basionym, and transferred it to the genus *Chlamydomyces* Bainier as *C. palmarum* (Cook) Mason. *C. palmarum* is easily distinguished by its monoblastic conidiogenous cells and pyriform conidia with 1-septate and verrucose walled. Our isolate from Taiwan resembles the type species of *C. palmarum* in the shape and pigmentation in conidia, but differs in having larger conidia. This is a common species.

臺灣大學學術期刊資料庫

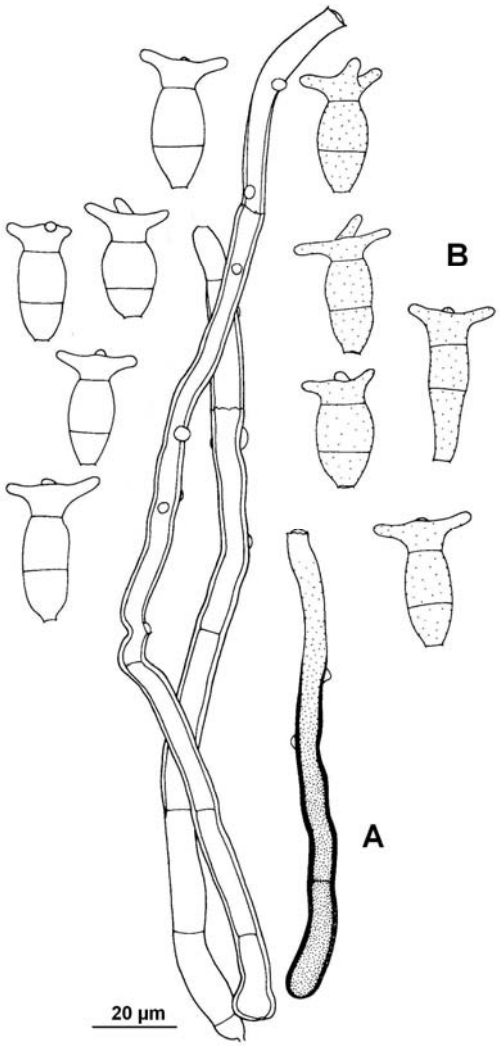


Fig. 4. *Coronospora dendrocalami.* A: Conidiophores. B: Conidia. Bar = 20 µm.

Coronospora dendrocalami M. B. Ellis, 1971. Mycol. Pap. 125: 16-17. Figs. 4 & 5A-C

Colonies growing slowly on Oat Meal Agar, obtaining diameter approximately 64 mm in 80 days at 25°C, thin and inconspicuous, hyaline or with olive brown spot scattered; reverse hyaline to olive brown. Mycelium sparse, immersed, composed of branched, septate, smooth, hyaline to subhyaline, 1.6-3.6 µm wide hyphae. Conidiophores macronematous, mononematous, often fasciculate, rarely single, straight or curved, septate, smooth or near so, brown, thick-walled, paler or thinner towards the apex, 136.0-272.0 x 5.4-9.2 µm. Conidiogenous cells polyblastic, sympodial, cicatrized, sometimes percurrent proliferation. Conidia acropleurogenous, ellipsoidal or clavate, 2-septate, smooth, pale brown,

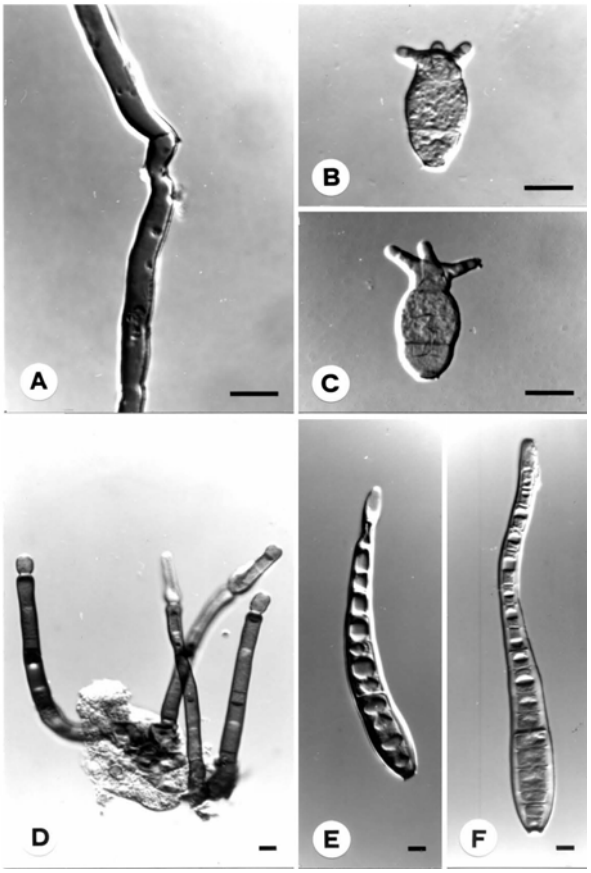


Fig. 5. *Coronospora dendrocalami* (A-C). A: Part of conidiophore. B-C: Clavate conidia with 3-short-horn-like projections at the apical cell. Bars A-C = 10 µm. *Corynespora cassiicola* (D-F). D: Simple conidiophores with monoblstic conidiogenous cells. E-F: Conidia obclavate, with pseudoseptate. Bars D-F = 10 µm.

26.8-37.3 x 9.6-14.1 µm, often swollen, broadly oblong to clavate, crown-shaped, with 3-short-horn-like projections at the apex, basal scar up to 3.2-4.1 µm wide.

Specimens examined: Taiwan, Huisun, Nantou Pref., rotten leaves of *Phyllostachys pubescens*, Feb. 10 1993. leg. J.L. Chen. TNTU 1069.

Distribution: Taiwan, Myanmar, Burma.

Notes: The genus *Coronospora* was established by Ellis in 1971 to accommodate a single species, *C. dendrocalami* M. B. Ellis, on leaves of *Dendrocalamus strictus* from Burma. Currently, there were three additional species being described (CABI Bioscience Databases, 2008). *Coronospora dendrocalami* was characterized by macronematous conidiophores with polyblastic, sympodial, cicatrized conidiogenous cells, and ellipsoidal or clavate conidia often with 3-short horn-like projections at the apical cell. The Taiwanese's isolate was very similar to the type species of *C. dendrocalami* in shape and pigmentation of its

臺灣大學學術期刊資料庫

conidiophores and conidia, but the conidiophores in the latter (up to 400.0 μm) were much longer than those in the former (up to 272.0 μm).

Corynespora cassiicola (Berk. & Curt.) Wei, 1950. Mycol. Pap., 34: 5. Figs. 5D-F & 6

Colonies in habitat effuse, brownish grey, hairy. Mycelium immersed (on V8 Jucie Agar: Mycelium partly superficial, partly immersed; hyphae branched, sepate, smooth to verruculose, subhyaline to brown, 1.6-8.8 μm wide. Conidiophores macronematous, mononematous, single or crowded, simple, straight or flexuous, septate, smooth or finely roughened, pale brown to brown or dark brown, 86.0-182.0 x 8.4-11.0 μm, often cylindrical proliferations and swollen up to 15.0 μm wide at the base. Conidiogenous cells monotretic, integrated, percurrent. Conidia brone in chains or solitary, obclavate, occasinoally cylindrical, mostly curved, rarely straight, (5)8-19 pseudosepta, smooth, subhyaline to pale brown, often middle brown and with a dark brown scar up to 5.0-9.0 μm wide at the base, 72.0-210.0 x 14.0-20.0 μm.

Species examined: Taiwan, Penghu County, decaying leaves of *Phaseolus vulgaris* L., 21 July 1993. leg. J.L. Chen. TNTU 1112.

Distribution: Taiwan, Ghana, Jamaica, Gold Coast, Sudan Malaya, Nigeria, Belgian Congo, India, Tanganyika, Trinidad.

Notes: This fungus was originally recorded by Wei (1950), who treated *Helminthosporium cassiicola* from leaves of some *Cassia* in Cuban as a basionym, and transferred it to the genus *Corynespora* Güssow as *C. cassiicola* (Berk. & Curt.) Wei. It was easily recognized by its monotretic, percurrent conidiogenous cells and obclavate, curved conidia with numerous pseudosepta and dark brown scar at the base. The Taiwanese's isolate was similar to the type species of *C. cassiicola* in shape and pigmentation of its conidiophores and conidia, but the conidiophores in the latter (up to 850.0 μm) were much longer than those in the former (up to 182 μm). This is a cosmopolitan species.

Cylindrocarpon fusiforme Matsushima, 1971. Icones Microfungorum A Matsushima Lectorum (I). p. 44. Figs. 7 & 8

Colonies diameter on Oat Meal Agar larger than 70 mm in 28 days at 25°C, effuse, plane, yellowish white to yellowish brown; reverse yellowish white to yellowish brown. Mycelium partly immersed, partly superficial, composed of branched, septate, smooth,

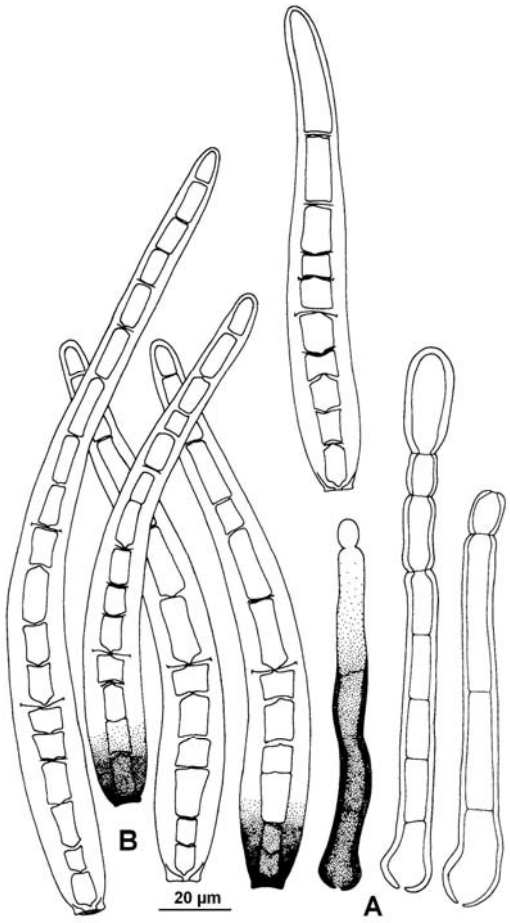


Fig. 6. *Corynespora cassiicola.* A: Conidiophores. B: Conidia. Bar = 20 μm.

hyaline, subhyaline to pale yellowish or yellowish brown, 1.2-7.0 μm wide hyphae. Conidiophores macronematous, mononematous, single, simple or branched, straight, septate, smooth, tapering, 212.0-408.0 x 3.6-7.2 μm. Conidiogenous cells monophialidic. Conidia solitary fusiform or elongated-fusiform, 3-5-septate, smooth, hyaline to subhyaline, 37.0-67.0 x 6.0-10.0 μm. Chlamydospore catenate, globose, ellipsoidal or pyriform, smooth or verrucose, subhyaline to reddish golden, 7.6-22.0 μm wide.

Species examined: Taiwan, Taipei County, Sanhsia, a decaying twig of bamboo, 10 Aug. 1993. leg. J.L. Chen. TNTU 1124.

Distribution: Taiwan, Japan.

Notes: The genus *Cylindrocarpon* was erected by Wollenweber (1913) to accommodate a single species, *C. Cylindroides* Wollenw., Thereafter one hundred and twelve allied species have been described (CABI Bioscience Databases, 2008). *Cylindrocarpon fusiforme* was originally recorded by Matsushima (1975) from

臺灣大學學術期刊資料庫

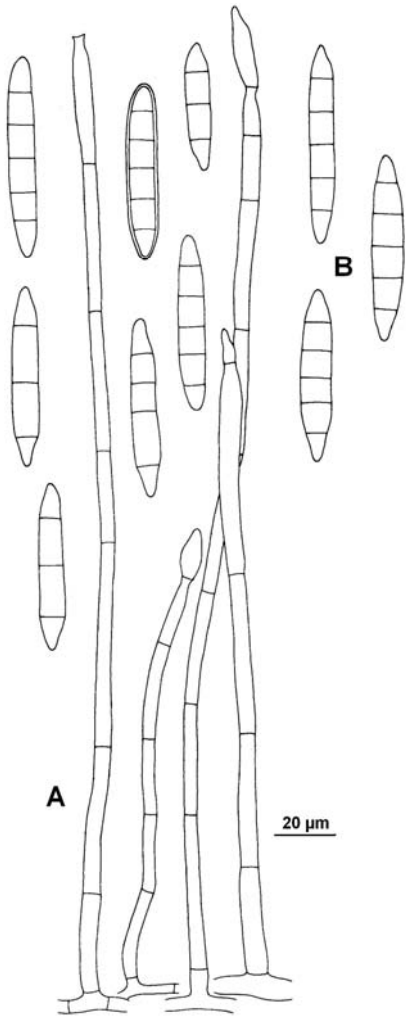


Fig. 7. *Cylindrocarpon fusifrome*. A: Conidiophores. B: Conidia. Bar = 20 µm.

forest soil in Japan. It was characterized by producing monophialidic conidiogenous cells and fusiform or elongated-fusiform conidia. Our isolate from Taiwan resembles the type species of *C. fusiforme* in the shape, size, pigmentation and septation in conidia, but the conidiophores were longer (up to 408.0 µm) compared to the latter on b/c (a piece of sterilized banana leaf on the corn meal agar)-culture (up to 250.0 µm).

ACKNOWLEDGEMENTS

The study was supported by grant (95-2621-B-002-015-MY3) from National Science Council (NSC), Executive Yuan, Taiwan, R.O.C. to S.S. Tzean. The authors are indebted for the long lasting support from the NSC.

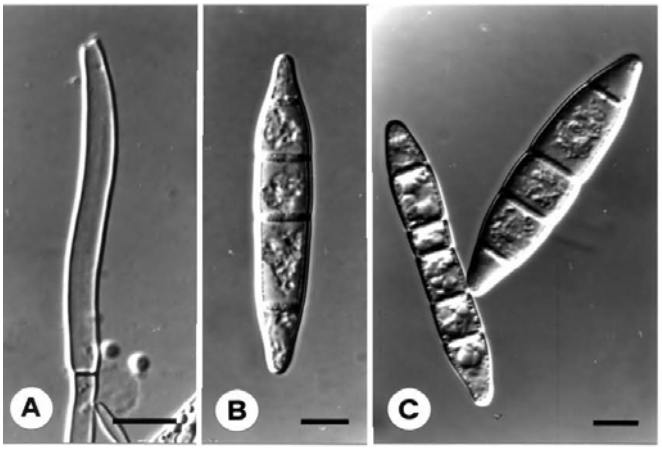


Fig. 8. *Cylindrocarpon fusifrome*. A: Conidiophore, the upper part. B-C: Conidia fusiform or elongated-fusiform, with 3-5-septate. Bars = 10 µm.

LITERATURE CITED

Barnett, H. L. and B. B. Hunter. 1998. Illustrated Genera of Imperfect Fungi. APS press, Minnesota, USA. 218pp.

Barron, G. L. 1968. The Genera of Hyphomycetes from Soil. Williams & Wilkins, Baltimore, Maryland, USA. 36pp.

CABI Bioscience Databases. 2008. *Index Fungorum.* [Online] Available: http://www.speciesfungorum.org/Names/Names.asp

Ellis, M. B. 1971. Dematiaceous Hyphmycetes X. Mycol. Pap. **125**: 1-30.

Hughes, S. J. 1953. Conidiophores, conidia and classification. Can. J. Bot. **31**: 577-659.

Hughes, S. J. 1958. Revisiones Hyphomycetum aliquot cum appendice de nomimibus rejiciendis. Can. J. Bot. **36**: 727-836.

Kendrick, B. (ed.). 1971. Taxonomy of Fungi Imperfecti. Univ. of Toronto Press, Toronto, Ontario, Canada. 309pp.

Lutozoni, F., F. Kaukk, C. J. Cox, D. McLanghlin, G.. Celio, B. Dentinger, M. Padamsee, D. Hibbett, T. Y. James, E. Baloch, M. Grube, V. Reeb, V. Hofstetter, C. Schoch, A. E. Arnold, J. Miadlikowska, J. Spatafora, D. Johnson, S. Hambleton, M. Crockett, R. Shoemarker, G. H. Sung, R. L Ücking, T. Lumbsch, K. O'Donnell, M. Binder, P. Diederich, D. Ertz, C. Gueidan, K. Hansen, R. C. Harris, K. Hosaka, Y. W. Lim, B. Matheny, H. Nishida, D. Pfister, J. Rogers, A. Rossman, I. Schmitt, H. Sipman, J. Stone, J. Sugiyama, R. Yahr and R. Vilgalys. 2004. Assembling the fungal tree of life: progress, classification, and evolution of subcellular traits. Amer. J. Bot. **91**: 1446-1480.

Mason, E. W. 1928. Annotated account of fungi received at the imperial bureau of mycology. Mycol. Pap. **2**: 1-43.

Matsushima, T. 1971. Microfungi of the Solomon Islands and Papua-New Guinea, Matsushima, Kobe, Japan. 78pp.

Matsushima, T. 1975. Icones Microfungorum A Matsushima Lectorum. Matsushima, Kobe, Japan. 209pp.

Saccardo, P. A. 1880. Conspectus generum italiae inferiorum nempe ad Sphaeropsideas, Melaconieas et Hyphomyceteas pertinentium, systemate sporologico dispositoru. Michelia **2**: 1-38.

臺灣大學學術期刊資料庫

Saccardo, P. A. 1886. Sylloge Fungosum Omnium Hucusque Cognitorum. Vol. IV. Hyphomyceteae. Published by the author, Pavia, Italy. 807pp.
Subramanian, C. V. 1962. The classification of the Hyphomycetes. Bull. Bot Surv. India **4**: 249-259.
Sutton, B. C. 1980. The Coelomycetes, CMI, Survey, England, UK. 696pp.
Talbot, P. H. B. 1971. Principles of Fungal Taxonomy, New York, USA. 273pp.
Tubaki, K. 1958. Studies on Japanese hyphomycetes V. Leaf and stem group, with a discussion of the classification of hyphomycetes and their perfect stages. Jour. Hattori Bot. Lab. **20**: 142-244.
Tzean, S.-S., W.-R. Hsieh, T.-C. Chang and S.-H. Wu. 2005. Fungal of Taiwan, National Science Council Press, Taipei, Taiwan. 2422pp.
Wei, C.-T. 1950. Notes on *Corynespora*. Mycol. Pap. **34**: 1-10.
Wollenweber, H. W. 1913. *Ramularia*, *Mycosphaerella*, *Nectria*, *Calonectria*, Phytopathology **3**: 225.

臺灣產絲孢綱不完全菌 *Chaetendophragmia* 和近似種之探討

陳珹篠[(1)]、曾顯雄[(2*)]

1. 嘉南藥理科技大學醫務管理系。717 台南縣仁德鄉二仁路一段 60 號，臺灣。
2. 國立臺灣大學植物病理學與微生物學系。106 台北市羅斯福路四段 1 號，臺灣。
* 通信作者。*Tel: 886-2-33664595; Fax: 886-2-2362-0639; Email: sst@ntu.edu.tw*

(收稿日期：2008 年 12 月 15 日；接受日期：2009 年 1 月 19 日)

摘要：本文詳細繪圖、描述五種臺灣產棲屬於不完全菌絲孢綱 (Hyphomycetes) 之新紀錄種真菌：*Chaetendophragmia triangularia*, *Chlamydomyces palmarum*, *Coronospora dendrocalami*, *Corynespora cassiicola* 以及 *Cylindrocarpon fusifrome*，並簡扼比較討論此類真菌之形態鑑定特徵，以及和分布於其它不同地域之同種真菌之異同。

關鍵詞：絲孢綱、不完全菌、分類學、生物多樣性、臺灣。

臺灣大學學術期刊資料庫