

CHAPTER 4

DESCRIPTIONS AND ILLUSTRATIONS OF FUNGI ON DRACAENA AND PANDANUS

4.1 INTRODUCTION

The fungi observed on decaying (saprobies) and living leaves (pathogens) of *Dracaena lourouri*, *Pandanus amaryllifolius*, *P. odoratissimus* and *P. penetrans* are identified to genus or species level where possible. However, some were difficult to identify to species due to insufficient literature or quality of specimens especially in the rare taxa. The anamorphic fungi and ascomycetes identified in this study are organized in alphabetical order of genera. For each genus the name of the type is given and the genus is introduced, and then information on the species with photographic plates is provided. Species that are introduced as new are described through out the text and photomicrographs, known hosts and geographic distribution are provided. Notes are also provided on the taxonomy and distinctive features of each species with reference to published literature.

The anamorphic fungi discussed in this chapter with descriptions and illustration are *Canalisporium*, *Dictyochaeta*, *Ellisembia*, *Exerohilum*, *Memnoniella*, *Myrothecium*, *Paecilomyces*, *Periconia*, *Periconiella*, *Phaeostalagmus*, *Phialocephala*, *Sporidesmium*, *Stachybotrys*, *Trichothecium*, *Veronaea* and *Zygosporium*.

The ascomycetes discussed are:

Dothideales

Melanommataceae - *Astrosphaeriella*

Microthyriaceae - *Microthyrium*

Eurotiales

Trichocomaceae - *Emericella*

Halosphaeriales

Halosphaeriaceae - *Phaeonectriella*

Incertae Sedis

Hyponectriaceae - *Linocarpon*

Incertae Sedis - *Ornatispora*

Oxydothis

Magnaporthaceae - *Ophioceras*

Pseudohalonectria

Pleosporales

Phaeosphaeriaceae - *Paraphaeosphaeria*

Tubeufiaceae - *Tubeufia*

Sordariales

Chaetomiaceae - *Chaetosphaeria*

Chaetosphaeriaceae - *Melanochaeta*

Sordariaceae - *Sordaria*

Xylariales

Incertae Sedis – *Phomatospora*

4.2 DESCRIPTIONS AND PHOTOGRAPHIC FIGURES OF ANAMORPHIC FUNGI

Canalisporium Nawawi & Kuthub.

Type species: *Canalisporium caribense* (Hol.-Jech. & Mercado) Nawawi & Kuthub.

References: Holubová-Jechová and Mercado-Sierra 1984; Nawawi and Kuthubutheen 1989; Goh *et al.*, 1998; Goh and Hyde, 2000; Bussaban *et al.*, 2001a.

Conidia muriform, flattened. **Conidia cells** regularly arranged in rows with canals connecting the internal lumens.

Canalisporium was introduced to accommodate *Berkleasmiium caribense* Hol.-Jech. & Mercado and *B. pulchrum* Hol.-Jech. & Mercado (Holubová-Jechová and Mercado-Sierra, 1984; Nawawi and Kuthubutheen, 1989). The genus has been recently reviewed by Goh *et al.* (1998) and currently comprises seven species (Goh and Hyde, 2000).

No new species of *Canalisporium* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; McKenzie *et al.*, 2002). However, *C. caribense* is known to inhabit *Freycinetia* and *Pandanus*. *Canalisporium elegans* is known from a species of *Freycinetia* (Goh *et al.*, 1998; Whitton, 1999).

Canalisporium exiguum Goh & K.D. Hyde

Figure 4.1 (1-2)

Conidia 11.8-23.6 × 10-14.6 μm with 1 vertical septum, 2-4 horizontal septa, 2-celled in apical row.

Habitat/Known distribution: Known to inhabit submerged decaying wood from Australia (Goh and Hyde, 2000); dead leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai, Suthep Pui National Park, in rainforest Quinin Botanic Garden, on decaying leaves of *Pandanus penetrans*, 3 August 2003, *S. Thongkantha* S037-1, CMU26656; S037-2, CMU26657; 19 June 2004, *S. Thongkantha* S152, CMU 26812.

Notes: *Canalisporium exiguum* is characterized by 18-25 × 13-15 μm conidia with one column of vertical septa and 2-3(-4) rows of transverse septa (Nawawi and Kuthubutheen, 1989; Goh *et al.*, 1998; Goh and Hyde, 2000). Conidia of the current specimens are slightly shorter than those reported by Goh *et al.* (1998). *Canalisporium caribense*, a closely related species to *C. exiguum*, has larger conidia (21-51 × 15-29 μm) and is known to inhabit pseudostems of *Amomum siamense* in Thailand (Bussaban *et al.*, 2001).

Canalisporium variabile Goh & K.D. Hyde

Figure 4.1 (3)

Conidia 11.8-18.2 × 7.3-10.9 μm, 1 vertical septum, 2-4 horizontal septa, 1-3 celled in apical row.

Habitat/Known distribution: Known to inhabit wood submerged in creek and submerged decaying rachis of *Oraniopsis appendiculata*, Australia (Goh and Hyde, 2000); dead leaves of *Dracaena lourieri*, Thailand (this study).

Specimen examined: THAILAND: Chiang Mai, Chiang Dao National Park, in rainforest, on dead leaves of *Dracaena lourieri*, 1 November 2005, *S. Thongkantha* S196, CMU26872.

Notes: *Canalisporium variabile* is characterized by 22-35 × 15-23 μm conidia that are pale olivaceous to yellowish brown with 2-4(-5) rows of transverse septa, the majority with two columns of vertical septa, and some with a single column of septa, apex comprising a single cell or 2-3 cells (Goh and Hyde, 2000). Conidia size of the current specimens are smaller than those reported by Goh *et al.* (1998), but this is considered due to environmental variations.

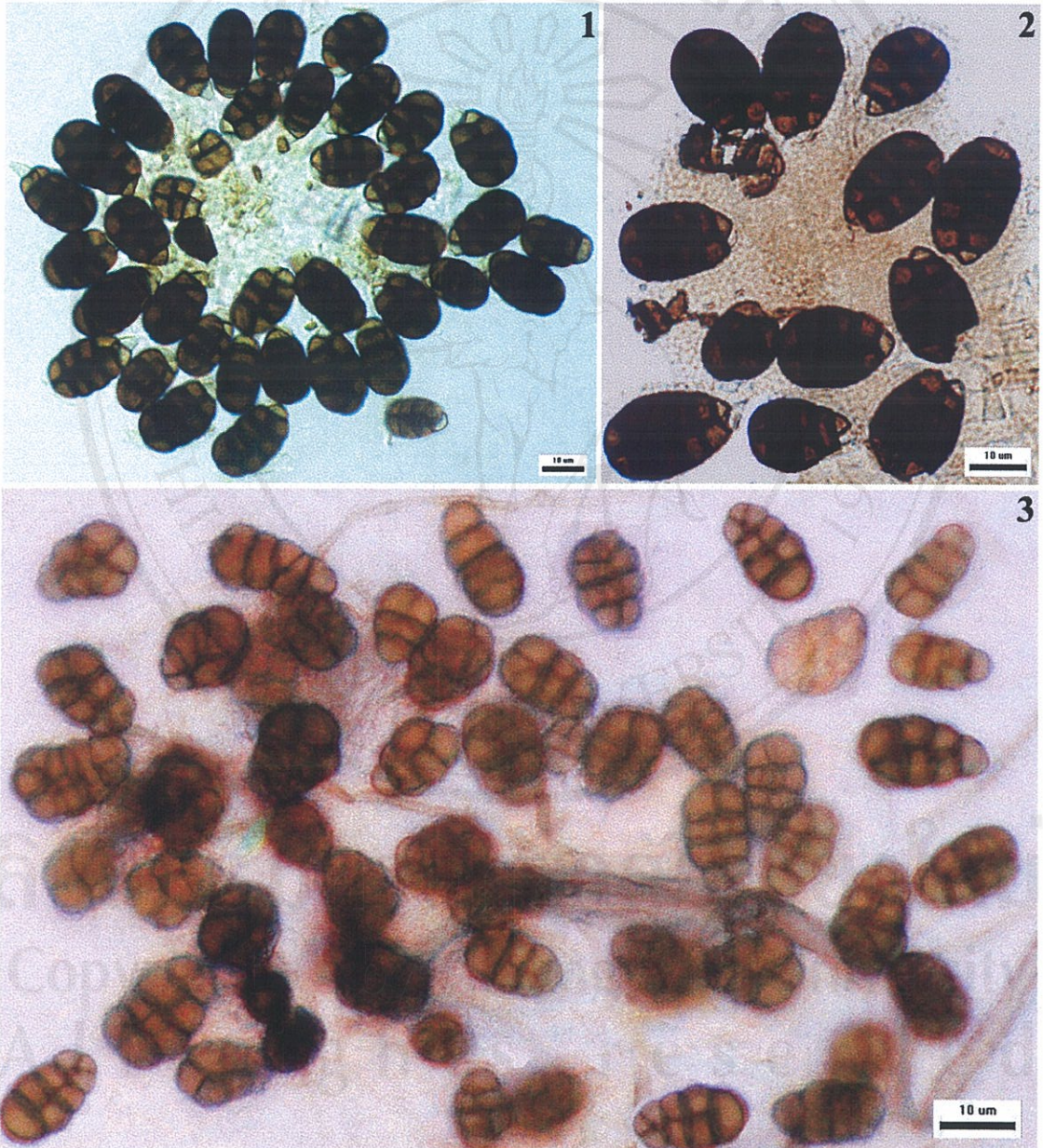


Figure 4.1 Conidiophores and conidia of *Canalisporium exiguum* (1-2). *C. variabile* (3). Scale bars = 10 μm.

***Dictyochaeta* Speg.**

Type species: *Dictyochaeta fuegiana* Speg.

References: Ellis, 1971, 1976; Gamundi *et al.*, 1977; Carris and Glawe, 1988; Arambarri and Cabello, 1989; Kuthubutheen and Nawawi, 1991a-d; Whitton *et al.*, 2000a.

Conidiophores mono- or polyphialidic, sympodially proliferating conidiogenous cells that often have conspicuous and flared collarettes, macronematous, mononematous, septate, pale brown to dark brown. **Conidia** typically falcate but can be ellipsoid, clavate, fusoid, or cylindrical, 0-1(3)-septate, hyaline, and with or without setulae.

Arambarri and Cabello (1989) transferred 21 species of *Codinaea* to *Dictyochaeta* based primarily cluster analysis of morphological similarity. However, they failed to provide a reference to basionyms, thus contravening Article 33.2 of the *International Code of Botanical Nomenclature*. Two of these 21 species, *D. heteroderae* (Morgan Jones) Carris and Glawe and *D. parva* (S. Hughes and W.B. Kendr.) Hol.-Jech. had been validly transferred by earlier authors (Carris and Glawe, 1988; Holubová-Jechová, 1988). The other 19 species of *Codinaea* have been transferred to *Dictyochaeta* by Whitton *et al.* (2000a). They also provided a key to species of *Dictyochaeta* described since 1991, or not included in the key of Kuthubutheen and Nawawi (1991a).

Recently, five new species of *Dictyochaeta* including *D. fimbriaspora*, *D. microcylindrospora*, *D. multisetula*, *D. renispora* and *D. seychellensa* have been described from members of the Pandanaceae (McKenzie and Hyde, 2002; Whitton *et al.*, 2000a).

***Dictyochaeta fertilis* (S. Hughes and W.B. Kendr.) Hol.-Jech.**

Figure 4.2

Conidia 17-20 × 2.8-3.5 μm.

Habitat/Known distribution: Known to inhabit decaying leaves of *Fagus sylvatica*, *Pandanus penetrans*, *Pandanus* sp., *P. tectorius*, *Rhopalostylis sapida*, wood and bark of *Fagus sylvatica*, *Filipendula ulmaria*, *Fraxinus excelsior*, *Quercus robur* and

Rubus fruticosus from Brunei, Hong Kong and Philippines (Whitton, 1999), Canada and Czechoslovakia (Holubová-Jechová, 1984), Malaysia (Kuthubutheen and Nawawi, 1991a-d), New Zealand (Hughes and Kendrick, 1968), Thailand (this study), U.K. (Ellis, 1971).

Specimen examined: THAILAND: Chiang Mai province, Muang Chiang Mai, Suthep Pui National Park, on decaying leaves of *Pandanus penetrans*, 19 January 2003, S. Thongkantha S046, CMU26669.

Note: *Dictyochaeta fertilis* is characterized by conidiophores that are solitary or in small groups often associated with setae. Conidia are $10\text{-}15 \times 2\text{-}3 \mu\text{m}$, fusiform, curve, hyaline, smooth, with a setula up to $10 \mu\text{m}$ long at each end (Ellis, 1976). The current specimens isolated from dead leaves of *Pandanus penetrans* best placed as *Dictyochaeta fertilis*. The species was also found on decaying leaves of *Freycinetia* sp., *Pandanus tectorius*, and *Pandanus* sp. by Whitton *et al.* (2000a).



Figure 4.2 Conidiophores and conidia of *Dictyochaeta fertilis*. Scale bars: 1 = 50 μm ; 2 = 10 μm

Ellisembia Subram.

Type species: *Ellisembia coronata* (Fuckel) Subram.

References: Subramanian, 1992, 1997; McKenzie, 1995; Goh and Hyde, 1999.

Colonies on natural substratum brown to black **Conidiophores** medium to dark reddish brown, solitary or rarely in groups. **Conidia** cylindrical-obclavate or obclavate, straight or flexuous, pseudoseptate, rounded at the apex, obconically truncate at the base, medium to dark reddish brown, smooth.

Ellisembia was introduced by Subramanian (1992) as a segregate of *Sporidesmium* to accommodate species having pseudoseptate conidia. Currently there are approximately 20 names in *Ellisembia* (Subramanian, 1997; McKenzie, 1995; Goh and Hyde, 1999), however there are at least 14 other species (examples in Matsushima, 1975; Dulymamode *et al.*, 1998e) that require generic reassessment and perhaps placement in *Ellisembia*. *Ellisembia palauensis* and *E. vaginata* have been described from *Freycinetia* sp. and/or *Pandanus* sp. (McKenzie, 1995; McKenzie and Hyde, 1996).

Ellisembia adscendens (Berk.) Subram.

Figure 4.3

Conidiophores 24-33 × 4.7-6.1 μm. **Conidia** 49-181.5 × 7.7-18.8 μm.

Habitat/Known distribution: Known to inhabit on submerged wood from Hong Kong (Goh and Hyde, 1999); on dead leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 19 January 2003, *S. Thongkantha* S045-1, CMU 26668; S048-2; 19 February 2003, *S. Thongkantha* S045-2.

Notes: Conidiophores of *Ellisembia adscendens* are solitary or rarely in groups of 2-3, sometimes arising from superficial hyphae, medium to dark reddish brown, 20-45 × 5-8 μm. Conidia cylindrical-obclavate, elongate, flexuous, broadly rounded at the apex, obconically truncate at the base, 150-500 × 14-17(-20) μm, medium to dark reddish brown, smooth (Goh and Hyde, 1999). The presence collection from dead leaves of *Pandanus penetrans* agrees with the description of *E. adscendens*, however, the very young conidia were found and measurable as 49 × 7.7 μm.

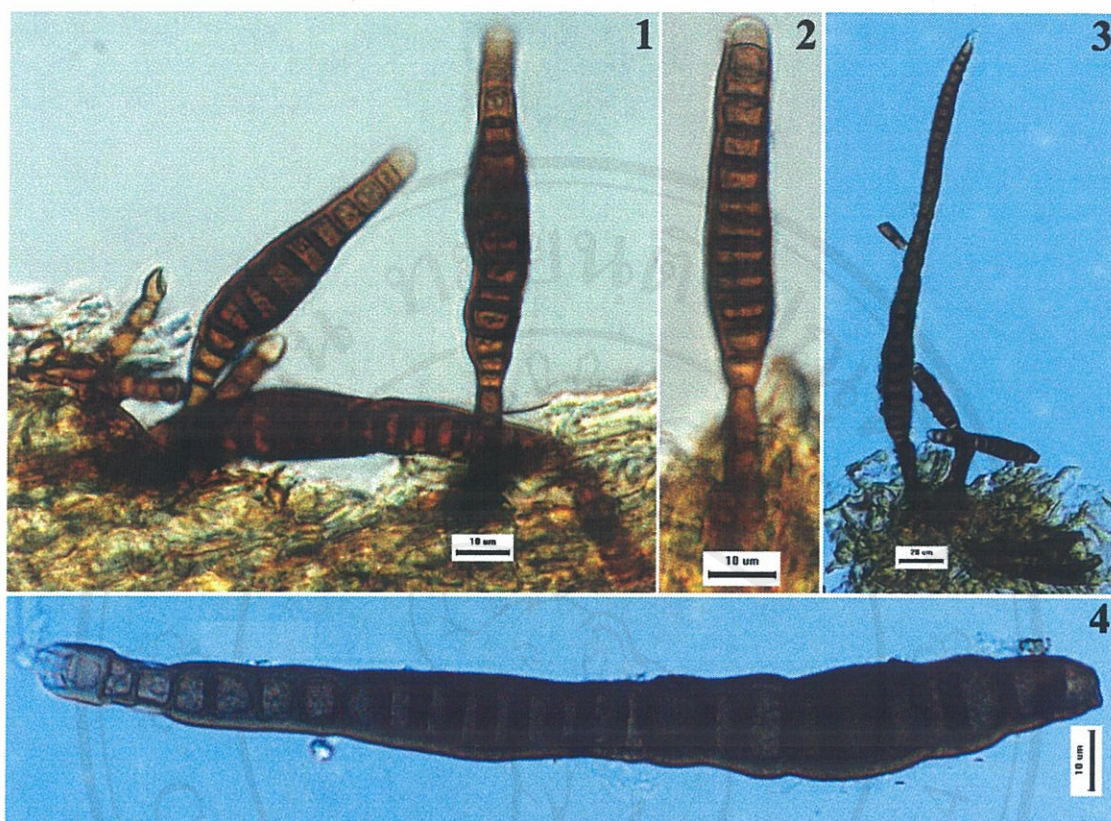


Figure 4.3 Conidiophores and conidia of *Ellisembia adscendens*. Scale bars = 10 µm.

Exserohilum Leonard & Suggs

Type species: *Exserohilum turcicum* (Pass.) Leonard & Suggs

References: Ellis 1971; 1976; Carmichael *et al.*, 1980; von Arx, 1981; Goh *et al.*, 1998; www.doctorfungus.org/imageban/index.htm.

Conidiophores macronematous, mononematous, straight or flexuous, brown, smooth. **Conidiogenous cells** polytretic, integrated, terminal, sympodial, cylindrical, cicatrized. **Conidia** straight, curved or slightly bent, ellipsoidal to fusiform and formed apically through a pore (poroconidia) on a sympodially elongating geniculate conidiophore, have a strongly protruding, truncate hilum and the septum above the hilum usually thickened and dark, the end cells often paler than the other cells and the walls often finely roughened, bipolar germination.

The genus *Exserohilum* may be differentiated from the closely related genera *Bipolaris* and *Drechslera* by forming conidia with a strongly protruding truncate hilum (i.e. exserted hilum). The hilum is defined as "a scar on a conidium at the point of attachment to the conidiophore". In *Drechslera* species, the hilum does not

protrude whereas in *Bipolaris* species the hilum protrudes only slightly (www.doctorfungus.org/imageban/index.htm). No new species of *Exserohilum* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996, 1997; Whitton, 1999; McKenzie *et al.*, 2002).

***Exserohilum* sp.**

Figure 4.4

Conidiophores 145-190 μm long, 5.5-6.3 μm wide. **Conidia** 36-58 \times 13.3-19.1 μm .

Habitat/Known distribution: Known to inhabit on decaying leaves of *Pandanus odoratissimus* from Thailand.

Specimen examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 6 December 2004, S. Thongkantha S 174-1, CMU 26844; S. Thongkantha S 174-2, CMU 26845.

Notes: The general characteristic of the current specimens isolated from *Pandanus odoratissimus* leaves agree with the description for species of *Exserohilum* (Goh *et al.*, 1998).



Figure 4.4 *Exserohilum* sp. 1. Appearance of conidiophores with conidia on the host surface. 2. Conidia. 3. Conidiophores and conidia. Scale bars: 1 = 200 μm ; 3 = 20 μm ; 2 = 10 μm .

Memnoniella Höhnel

Type species: *Memnoniella echinata* (Riv.) Galloway

References: Ellis, 1971, 1976; Matsushima, 1971; Barnett and Hunter, 1972.

Colonies effuse, black, velvety or powdery. **Mycelium** all immersed or partly superficial. **Stroma** none. **Setae** absent. **Conidiophores** macronematous mononematous, pale to mid grey, olivaceous or brown, smooth or minutely verruculose, often covered in part with dark granules, unbranched or occasionally forked, sometimes swollen at the apex. Conidiogenous cells monophialidic, discrete, in group up to 10 at the apex of the stipe, determinate, clavate, pyriform, cylindrical or ellipsoidal, usually with a small opening and no collarette. **Conidia** in chain, grey, dark brown or black, simple, spherical, subspherical sometimes slightly flattened in one plane or hemispherical, smooth or verrucose.

No new species of *Memnoniella* have been described from any members of the Pandanaceae (McKenzie and Hyde 1996; 1997; Whitton 1999; McKenzie *et al.*, 2002).

Memnoniella echinata

Figure 4.5 (1-6)

Conidiophores 42-77 × 3-3.5 μm, **Conidia** 4.7-5.6 μm diam.

Habitat/Known distribution: Common on dead plants, frequently isolated from paper and textiles and occasionally from soil; cosmopolitan. Known to inhabit on decaying leaves of *Pandanus odoratissimus* and *P. penetrans* from Thailand (this study).

Specimens examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 11 April 2004, *S. Thongkantha S 110-1*, CMU 26756; *S. Thongkantha S 110-2*; 6 December 2004, *S. Thongkantha S 110-3*, CMU 26757; Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 25 April 2004, *S. Thongkantha S123*, CMU 26771.

Notes: *Memnoniella echinata* is characterized by 50-100 × 3-4 μm conidiophores and conidia that are spherical or flattened dorsiventrally, 3.5-5 μm diam. The general characteristic of the specimens collected from decaying leaves of *Pandanus odoratissimus* and *P. penetrans* agree with the description for *M. echinata* (Ellis, 1971). Slightly larger conidia in the current specimens are possibly due to natural environment variation.

***Memnoniella* sp.**

Figure 4.5 (7-11)

Conidiophores 57-75 × 3.3-4 μm, **Conidia** with spherical or subspherical shape, 4.3-5.7 μm diam, **Conidia** 8.3-9.4 × 4.4-5 μm, oblong or elliptical.

Habitat/Known distribution: Known to inhabit on decaying leaves of *Pandanus odoratissimus*; Thailand (this study).

Specimens examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 6 December 2004, *S. Thongkantha S 183-1*, CMU 26756; *S. Thongkantha S 183-2*, CMU 26757.

Notes: The general characteristic of the specimens isolated from decaying leaves of *P. odoratissimus* best treat as species of *Memnoniella* sp. (Ellis, 1971; 1976).

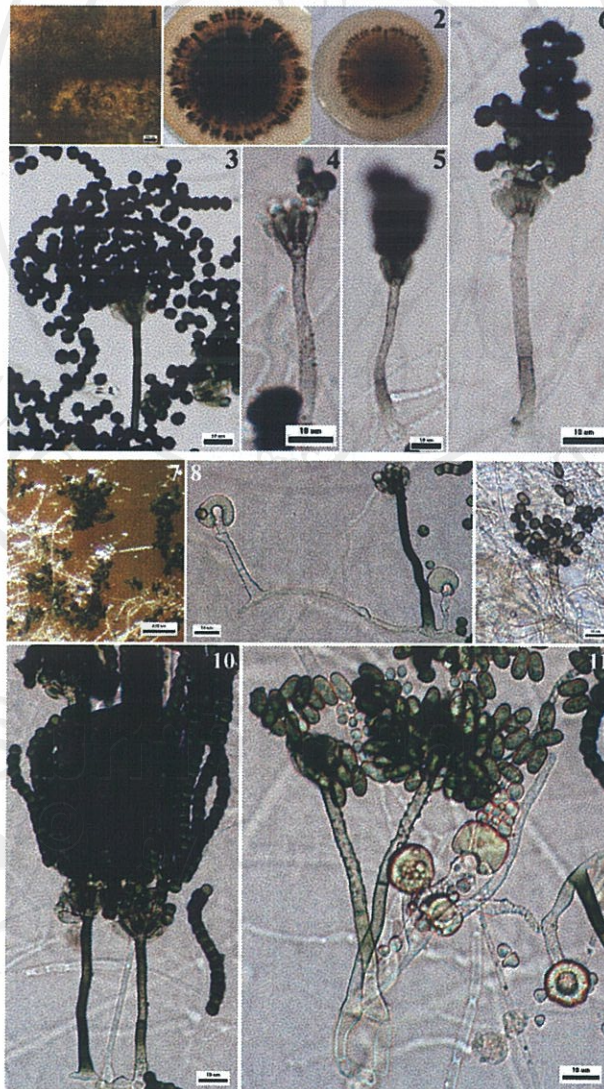


Figure 4.5 1-6. *Memnoniella echinata*. 1. Appearance on the host surface. 2. Upper and lower colony. 3-6. Conidiophores and conidia. 7-11. *Memnoniella* sp. 7. Culture surface on ½ strength PDA. 8-11. Conidiophores and conidia. Scale bars: 7 = 200 μm; 1 = 100 μm; 3-6, 8-11 = 10 μm.

Myrothecium Tode

Type species: *Myrothecium inundatum* Tode

References: Tode, 1790; Matsushima, 1971; Tulloch, 1972; Seifert *et al.*, 2003; Watanabe *et al.*, 2003.

Fruiting body consists of sporodochium with differentiated marginal hyphae. **Conidia** accumulate in a hyaline, olivaceous or black slimy head. The appearance of the fructifications is varied since sporodochia display different degrees of complexity. **Setae** sometimes present, hyaline or dark and arising from the basal stroma.

The genus *Myrothecium* was described by Tode (1790). Thirty-six available type materials were examined and compared with morphologically similar genera by Tulloch (1972). She also provides a key to 13 species accepted in *Myrothecium*. *Myrothecium dimorphum* Ts. Watanabe, which has straight hyaline setae and two kinds of conidia, was recently described and differentiated from other *Myrothecium* species with setose or hyphal sporodochia (Watanabe *et al.*, 2003). *Myrothecium acadense* Seifert & G. Sampson, which produces sporodochial conidiomata but apparently proliferates percurrently was also recently described based on studies of morphology and phylogenetic analysis of partial sequences of large subunit ribosomal DNA (Seifert *et al.*, 2003).

The closely related genus as *Solheimia* is characterized by synnemata and phialides, which produce single unicellular conidia with longitudinal ridges (Morris, 1967; Varghese and Rao, 1977; Bills *et al.*, 1994; Matsushima, 1995). The differentiation between *Solheimia* and other synnematous fungi, including *Myrothecium*, is based only on its unbranched conidiophores (Morris, 1967; Seifert, 1985). However, *Solheimia kamatii* Varghese & V.G. Rao has double dichotomously branched conidiophores (Varghese and Rao, 1977). Bills *et al.* (1994) examined the conidiomata and spore ornamentation and shape of *M. cinctum* (Corda) Sacc. and *S. costaspora* E.F. Morris growing on agar media and on autoclaved banana leaves, and found that all characters of these two fungi were very similar.

Myrothecium pandanicola Thongkantha & Bussaban, sp. nov. Figure 4.6 and 4.7

Colonies on natural substratum in the form of synnemata, scattered or in groups of 2–3, determinate, composed of black stipes, becoming dark olivaceous towards the black slimy head; **stipes** up to 850 μm high, 75 μm diam, cylindrical; **conidiophores** unbranched, synnematosus hyphae ca. 4 μm wide, parallel, straight, septate, verruculose, dark olivaceous. **Conidiogenous cells** monophialidic, smooth, hyaline or dark olivaceous. **Conidia** 14–28 \times 2–4.5 μm (\bar{x} = 22 \times 3.7 μm , n = 50), unicellular, fusiform, apex acute, narrowly truncate at the base, dark olivaceous, with 6–7 straight or mostly curved ridges.

Colonies on PDA reaching 4 cm diam after 14 days, a cottony tuft in the center velvety at the outside, white to pale yellow from below, edge regular, not staining agar, not sporulating within 2 months; on CMA reaching 6 cm diam after 14 days, velvety, yellowish white, edge regular, produce synnemata and spores only when sterile plant tissue included.

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus penetrans*, Thailand.

Specimens examined: Thailand, Chiang Mai province, Muang Chiang Mai, Suthep-Pui National Park, on dead leaves of *Pandanus penetrans*, 21 July 2001, *S. Thongkantha* (PDD 74134 – holotype, living culture in BCC 9829, ICMP14540); 6 July 2001, *S. Thongkantha* (PDD 74133 – paratype); 19 January 2003, *S. Thongkantha* S038-1, CMU26658; 20 July 2003, *S. Thongkantha* S038-2, CMU26659.

Notes: *Myrothecium pandanicola* is similar to *M. cinctum* in having striate spores. *Myrothecium pandanicola*, however, has distinctly longer conidia than those of *M. cinctum* (14–28 \times 2–4.5 μm vs. 9–12 \times 3–3.7 μm) (Figure 4.17). The mean length to width ratio for the conidia of *M. pandanicola* is 6: 1, compared to 3: 1 for *M. cinctum*. *Myrothecium pandanicola* also has fewer longitudinal ridges (6–7 vs. 7–9 for *M. cinctum*). The morphological separation of *M. pandanicola* and *M. cinctum* was strongly supported by the molecular data of ITS rDNA sequences analyses (Bussaban, 2005).



Figure 4.6 *Myrothecium pandanicola* sp. nov. (from holotype). 1. Synnemata on host surface, 2-3. Conidia with ridges clearly visible, 4. Synnemata, 5. Squash mount of synnema, 6. Conidiogenous cells with developing conidia. Scale bars: 1 = 200 µm; 2-6 = 10 µm.

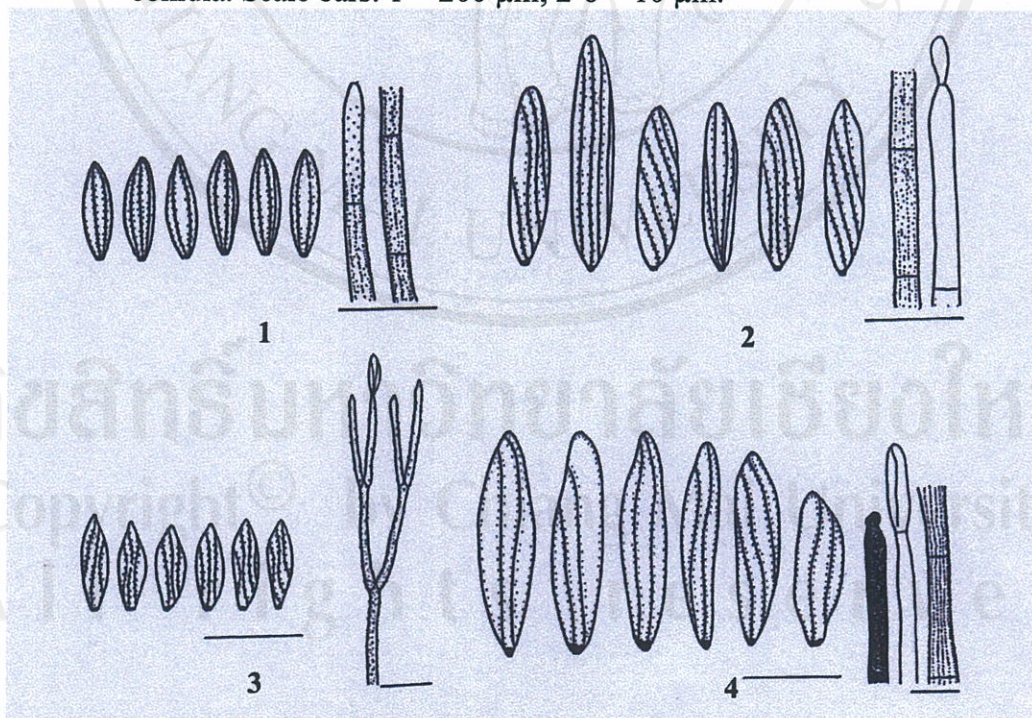


Figure 4.7 Diagrammatic representation of conidiophores, conidiogenous cells and conidia of *Myrothecium cinctum* isolated from Zingiberaceae (1), *Licuala longicalycata* (2), *Musa acuminata* (3) and *M. pandanicola* from *Pandanus penetrans* (4). Scale bars = 10 µm.

Paecilomyces* Bain*Type species:** *Paecilomyces variotii* Bain.**References:** Matsushima, 1971; Barnett and Hunter, 1972; Liang *et al.*, 2005.

Conidiophores penicillate, branched. **Conidia** in chains, 1-celled, ovoid to fusoid, hyaline.

Species of *Paecilomyces* occur on various organic substrates, for example, the type species can cause destruction of wood, leather, wood chips, books, cotton yarn and jute (Zhang *et al.*, 1998; Liang *et al.*, 2005). Some species are important entomopathogens and can induce insect diseases (e.g. insect pests such as *Aphis gossypii*, *Tetranychus viennensis*) that may prove useful for development of new insecticides (Zhang *et al.*, 1998). *Paecilomyces fulvus* and *P. crustaceus* are thermophilic, with optimum growth temperatures of 45°C and 55°C, respectively (Samson, 1974). Some thermophilic species can produce very useful bioactive compounds (Liang *et al.*, 2005). Conidiophores and branches of *Paecilomyces* species are more divergent than in *Penicillium* (Barnett and Hunter, 1972). Twenty eight species of the genus were investigated by Liang *et al.* (2005) and they also provided a taxonomic key to these species.

Paecilomyces iriomoteanus Matsush. has been described from *Pandanus tectorius* var. *liukiensis* (McKenzie and Hyde, 1996).

Paecilomyces variotii

Figure 4.8

Conidia are hyaline to pale brown, $3.7-4.5 \times 2.6-3.1 \mu\text{m}$.

Habitat/Distribution: Known to inhabit soil (Matsushima, 1971), dead plants (Barnett and Hunter, 1972), and decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimen examined: THAILAND, Phayao province, Phukamyao, Huaykaew District, Kardthee Village, along the brook, on decaying leaves of *Pandanus penetrans*, 27 April 2004, S. Thongkantha S146, CMU26803.

Notes: The current specimen is best treated as the common species *Paecilomyces variotii*. The general characteristics are similar to those recorded by Matsushima (1971) and Liang *et al.* (2005), who reported conidia measuring $4-7.5 \times 1.8-2.5 \mu\text{m}$ and $3-6(-12) \times 1.5-3 \mu\text{m}$, respectively. Although, there is a little difference in size of conidia, this is assumed to be due to natural variation.

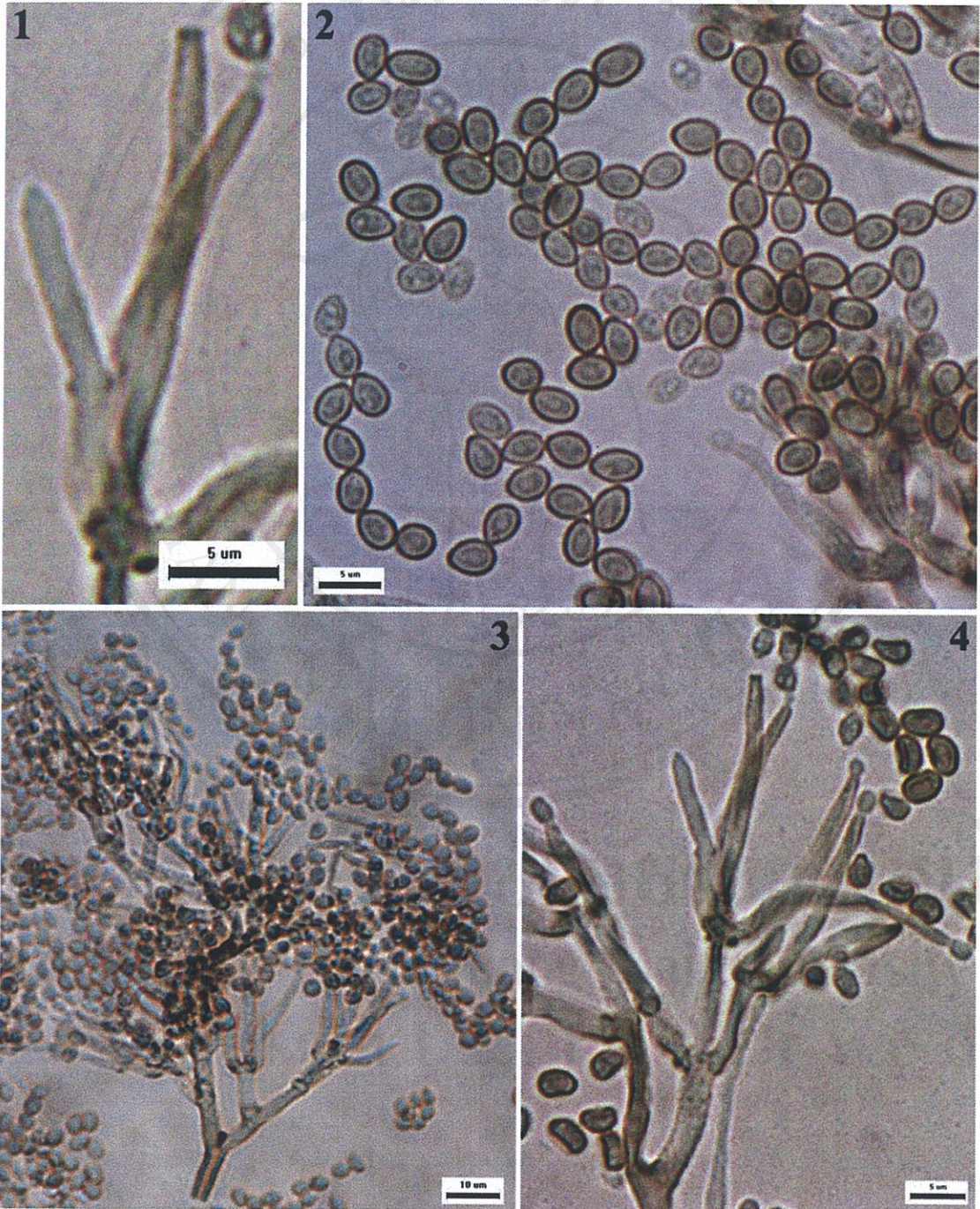


Figure 4.8 Conidiophores and conidia of *Paecilomyces variotii*. Scale bars: 3 = 10 μm ; 1-2, 4 = 5 μm .

Periconia Tode

Type species: *Periconia lichenoides* Tode

References: Mason and Ellis, 1953; Ellis, 1971, 1976; Barnett and Hunter, 1972; von Arx, 1981.

Conidiophores macronematous, mononematous, typically erect, smooth, septate. **Conidiogenous cells** elliptical to spherical, discrete and borne on side branches or directly from the conidiophore. **Conidia** borne in irregular chain, elliptical to spherical, brown, verruculose or echinulate.

Seventeen species of *Periconia* with a key to species and 9 species were treated by Ellis (1971) and Ellis (1976) respectively. No new species of *Periconia* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; McKenzie *et al.*, 2002). *Periconia echinochloae*, *P. lateralis*, *P. minutissima*, and *P. narsapurensis* are known to inhabit decaying leaves of *P. tectorius* (Whitton, 1999). *Periconia venezuelana* has been found on dead leaves of *Pandanus furcatus* from Hongkong and *P. simplex* from Philippines (Whitton, 1999).

Periconia cookie Mason & M.B. Ellis

Figure 4.9 (1-5)

Conidia 11.2-16.8 μm diam.

Habitat/Known distribution: Common on dead herbaceous stems from Europe (Ellis, 1971); on decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai province, Muang Chiang Mai, Suthep Pui National Park, on decaying leaves of *Pandanus penetrans*, 19 January 2003, *S. Thongkantha S050*, CMU26674; 19 February 2003, *S. Thongkantha S068*, CMU 26697.

Note: *Periconia cookie* conidia are 13-16 μm diam, spherical, brown (Ellis, 1971). The general characters of the present specimens key to those of *P. cookie*.

***Periconia minutissima* Corda**

Figure 4.9 (6-7)

Conidia 3.3-5.2 μm diam.

Habitat/Known distribution: Common and widely distributed on dead stems, sticks, leaves and other plant parts, usually close to or on the ground from Cuba, Europe, Ghana, Kenya, Lebanon, New Zealand, Pakistan, Sierra Leone, Sudan, Tanzania and Zambia (Ellis, 1971); on decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai province, Muang Chiang Mai, Suthep Pui National Park, on decaying leaves of *Pandanus penetrans*, 19 January 2003, *S. Thongkantha* S056-1, CMU26680; *S. Thongkantha* S056-2.

Note: *Periconia minutissima* is characterized by conidiophores that are terminated by short branches which give rise to the conidiogenous cells. The conidia are spherical, verruculose, brown, 4-7 μm diam. A conidiophores character of this species is similar to *P. atra* Corda (5-9 μm diam conidia) but conidia size is smaller. Due primarily to the conidial diameter, the current specimens best treated as *P. minutissima* (Ellis, 1971).

***Periconia* sp.**

Figure 4.9 (8-16)

Conidia 4.7-7.1 μm diam.

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus tectorius*, Australia, Hongkong; *P. odoratissimus*, Thailand.

Specimen examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 6 December 2004, *S. Thongkantha* S 179-1, CMU 26851; *S. Thongkantha* S 179-2, CMU 26852.

Note: The general characteristics of the current specimens isolated from decaying leaves of *Pandanus odoratissimus* key out to species of *Periconia* (Mason and Ellis, 1953; Ellis, 1971, 1976).

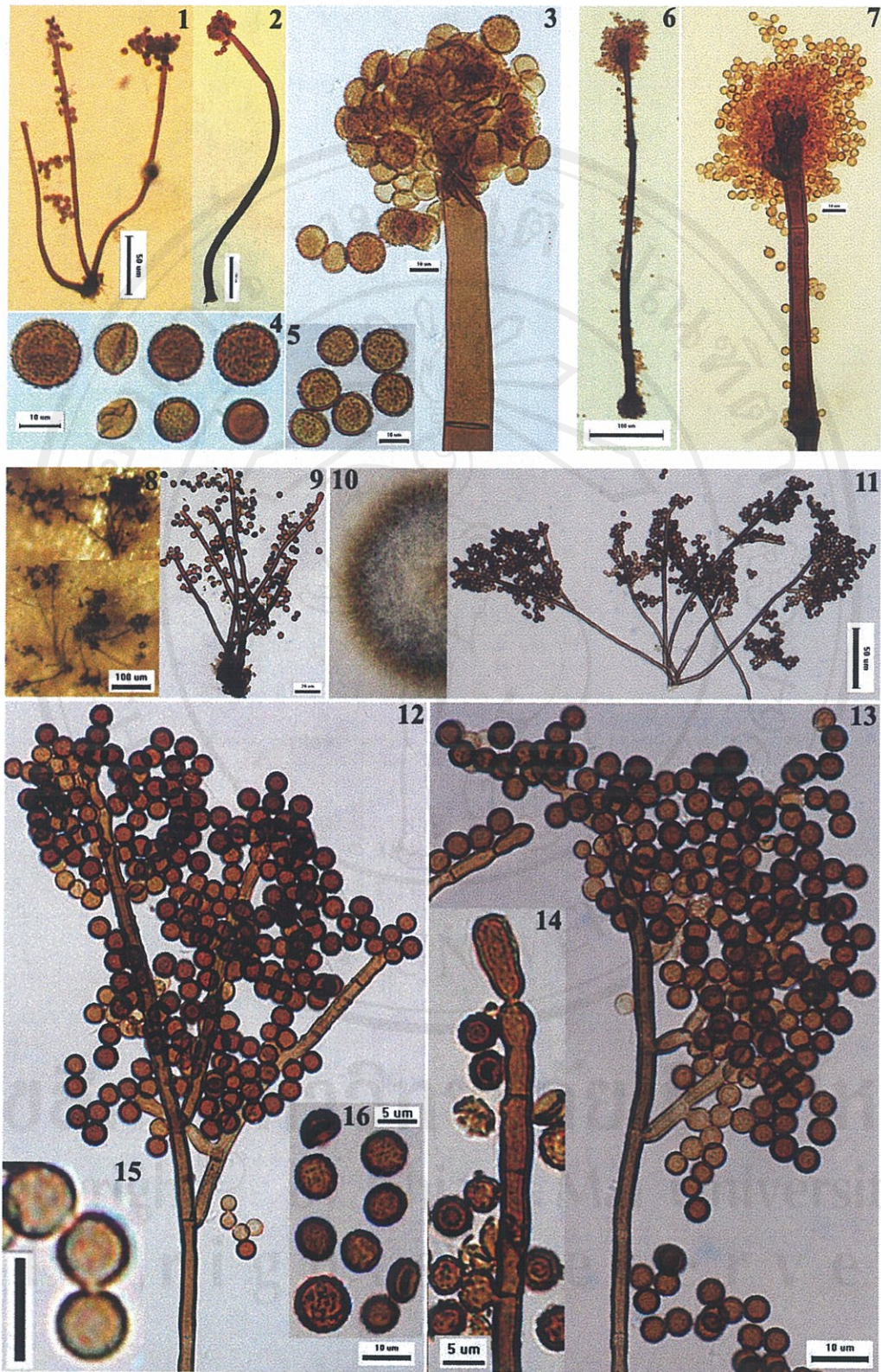


Figure 4.9 Conidiophores and conidia of 1-5. *Periconia cookie* 6-7. *P. minutissima*. and 8-16. *Periconia* sp. 8. Appearance of conidiophores and conidia on the host surface. Colony on $\frac{1}{2}$ strength PDA. 9, 11, 12-14. 10. Conidiophores and conidia. 15-16. Conidia. Scale bars: 2, 6, 8 = 100 μm ; 1, 11 = 50 μm ; 3-5, 7, 12-13, 15 = 10 μm ; 14, 16 = 5 μm .

Periconiella* Sacc.**Type species:*** *Periconiella velutina* (Wint.) Sacc.***References:*** Ellis, 1971; von Arx, 1981.

Conidiophores macronematous, each composed of an erect, straight or flexuous, brown to dark blackish brown, smooth or verruculose stipe and a more or less complex head of branches bearing conidia. **Conidiogenous cells** polyblastic, integrated and terminal on stipe and branches or discrete, sympodial, cylindrical, cicatrized, scars often numerous and pronounced. **Conidia** simple, 1-celled or with a few transverse septa, solitary or occasionally in short chains, hyaline or rather pale olive or olivaceous brown, smooth or verruculose, cylindrical rounded at the apex and truncate at the base, ellipsoidal, obclavate or obovoid.

The *Dictionary of the Fungi* accepts 23 species of *Periconiella* (Kirk *et al.*, 2001). No new species of *Periconiella* have been described from any members of the Pandanaceae (McKenzie and Hyde 1996; 1997; Whitton 1999; McKenzie *et al.*, 2002).

***Periconiella daphniphylli* M.B. Ellis**

Figure 4.10

Conidia $6.2 \times 3 \mu\text{m}$.***Habitat/Known distribution:*** Known to inhabit on *Daphniphyllum* from Ceylon (Ellis, 1971); on dead leaves of *Pandanus penetrans* from Thailand (this study).***Specimen examined:*** THAILAND: Chiang Mai province, Muang Chiang Mai, Suthep Pui National Park, on decaying leaves of *Pandanus penetrans*, 19 January 2003, S. Thongkantha S166, CMU26833.***Notes:*** The conidiophores and conidia shape and size of the fungi isolated from decaying leaf of *Pandanus penetrans* similar to the description for *P. daphniphylli* of Ellis (1971) that has $3.5\text{-}5.5$ (4.6) \times $2\text{-}2.5$ (2.2) μm conidia. Slightly different in conidia size are considered to be due to natural variation.

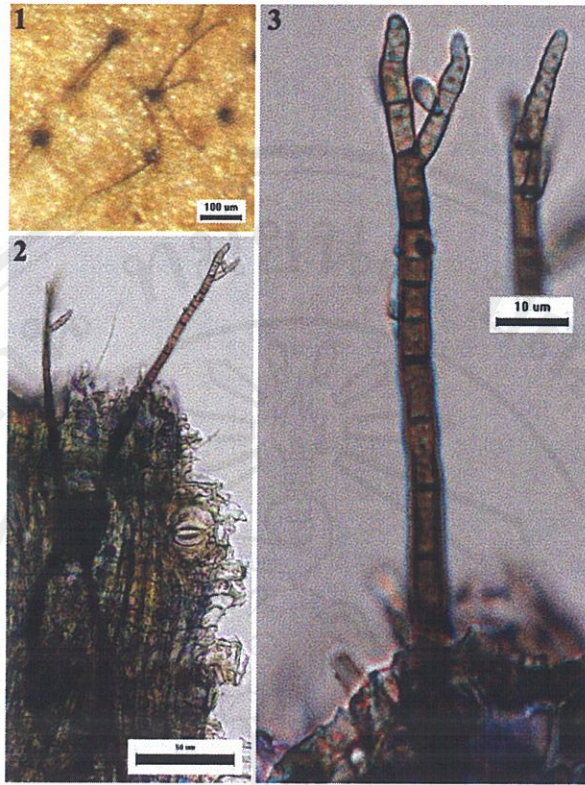


Figure 4.10 *Periconiella daphniphylli* 1. Appearance on the host surface. 2. Conidiophores and conidia. Scale bars: 1 = 100 µm; 2 = 50 µm; 3 = 10 µm.

***Phaeostalagmus* W. Gams**

Type species: *Phaeostalagmus cyclosporus* (Grove) W. Gams.

References: Gams and Holubova-Jechova, 1976; von Arx, 1981.

Colonies darkly pigmented and very slow growing. **Conidiophores** stipes dark brown, erect, with mesotonous or acrotonous branching, giving rise either to whorls of phialides or a series of branches which eventually terminate in verticillate phialides; phialides flask-shaped, pigmented, with a pronounced flaring collarete. **Conidia** aggregated in slimy head at the apex of the phialides, hyaline, ellipsoidal, ovoidal to cylindrical, 1-celled.

The genus *Phaeostalagmus* is presented by Gams and Holubova-Jechova (1976) with the combination of *P. cyclosporus* (*Stachylidium cyclosporum* Groves) and *P. tenuissimus* (Corda) W. Gams (*Verticillium tenuissimus* Corda). Both of them have darker conidiophores and even very slow-growing vegetative hyphae than those of some brown conidiophores species of *Verticillium* (e.g. *V. albo-atrum*, *V.*

theobromae) that are still have a mucedinaceous character in their hyaline, spreading vegetative hyphae. The phialides have a distinct, dark, flaring collarette which distinguishes them from the otherwise similar *Stachylidium* (Gams and Holubova-Jechova, 1976). No new species of *Phaeostalagmus* have been described from any members of the Pandanaceae (McKenzie and Hyde 1996; 1997; Whitton 1999; McKenzie *et al.*, 2002).

Phaeostalagmus cyclosporus

Figure 4.11

Conidiophores 349-500 × 8.6-11.7 μm. **Conidia** 3.8-4.8 × 1.5-1.9 μm.

Habitat/Known distribution: Known to inhabit on dead wood and bark of *Acer*, *Alnus*, *Betula*, *Castanea*, *Corylus*, *Fagus*, *Fraxinus*, *Ilex*, *Prunus*, *Quercus*, *Rhododendron*, *Sambucus* and *Ulex* from Europe (Gams and Holubova-Jechova, 1976); on decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimen examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 20 July 2003, *S. Thongkantha S148-1*, CMU 26805; *S. Thongkantha S148-2*, CMU 26806.

Notes: *Phaeostalagmus cyclosporus* is characterized by conidiophores axis bearing several branches which are repeatedly verticillately branched again and 1.5-3 × 1-2 μm conidia (Gams and Holubova-Jechova, 1976). Conidia of the current specimen isolated from *Pandanus penetrans* are longer than those reported by Gams and Holubova-Jechova (1976) considered being due to natural variation.

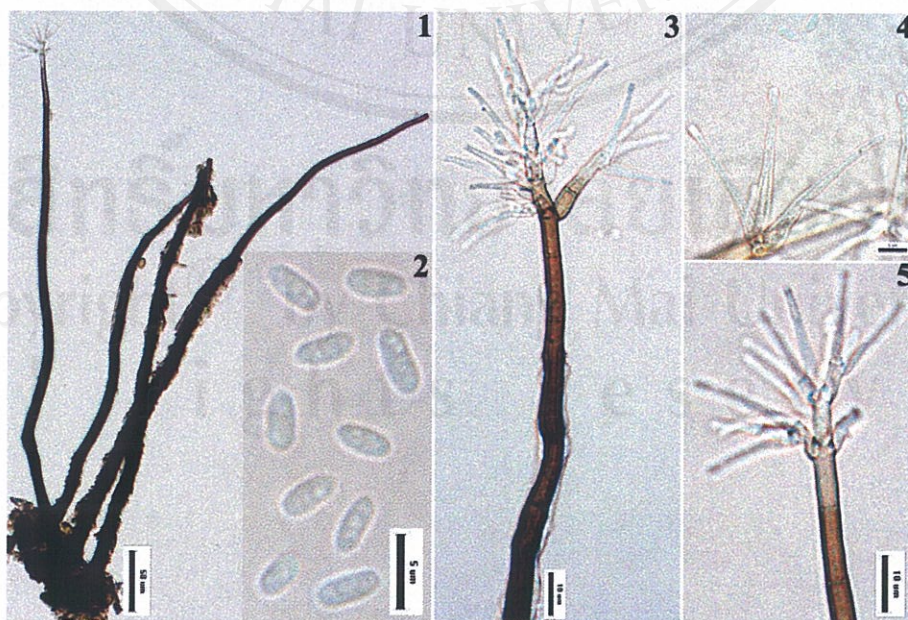


Figure 4.11 Conidiophores and conidia of *Phaeostalagmus cyclosporus*. Scale bars: 1 = 50 μm; 3, 5 = 10 μm; 2, 4 = 5 μm.

***Phialocephala* W.B. Kendr.**

Type species: *Phialocephala dimorphospora* W.B. Kendr.

References: Ellis, 1971, 1976.

Conidiophores macronematous, mononematous, composed of a stout, erect, straight, mid to dark blackish brown, smooth stipe and a more or less complex head made up of several series of branches, the ultimate ones bearing penicillately arranged conidiogenous cells. **Conidia** often in chains and aggregated in slimy head, simple, cylindrical with truncate ends, ellipsoidal or subspherical, hyaline to pale olive or olivaceous.

No new species of *Phialocephala* have been described from any members of the Pandanaceae (McKenzie and Hyde 1996; 1997; Whitton 1999; McKenzie *et al.*, 2002).

***Phialocephala bactrospora* W.B. Kendr.**

Figure 4.12 (1-2)

Conidiophores up to 1.3 mm long. **Conidia** 5.1-7.7 × 1.7-1.9 µm.

Habitat/Known distribution: Known to inhabit wood of *Populus* and *Tilia* from Europe, N. America; on decaying leaves of *Pandanus penetrans* from Thailand.

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 3 October 2002, *S. Thongkantha S025*, CMU 26642; 25 April 2004, *S. Thongkantha S125*, CMU 26773.

Notes: *Phialocephala bactrospora* is characterized by a conidiophore stipe up to 1 mm long, and conidia that are hyaline, cylindrical, mostly 4-7 × 1-1.5 µm (Ellis, 1971). The present specimens isolated from decaying leaves of *Pandanus penetrans* fit the description for *P. bactrospora*, although the conidia are slightly wider than those reported by Ellis (1971).

***Phialocephala* sp.**

Figure 4.12 (3-9)

Conidia 7.3-10(-13.8) × 2.6-3.5 µm.

Habitat/Known distribution: Known to inhabit dead leaves of *Pandanus penetrans*, Thailand.

Specimen examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaf of *Pandanus penetrans*, 1 September 2004, *S. Thongkantha S163*, CMU 26831.

Notes: The general characteristic of the present specimen key out to the genus *Phialocephala* (Ellis, 1971).

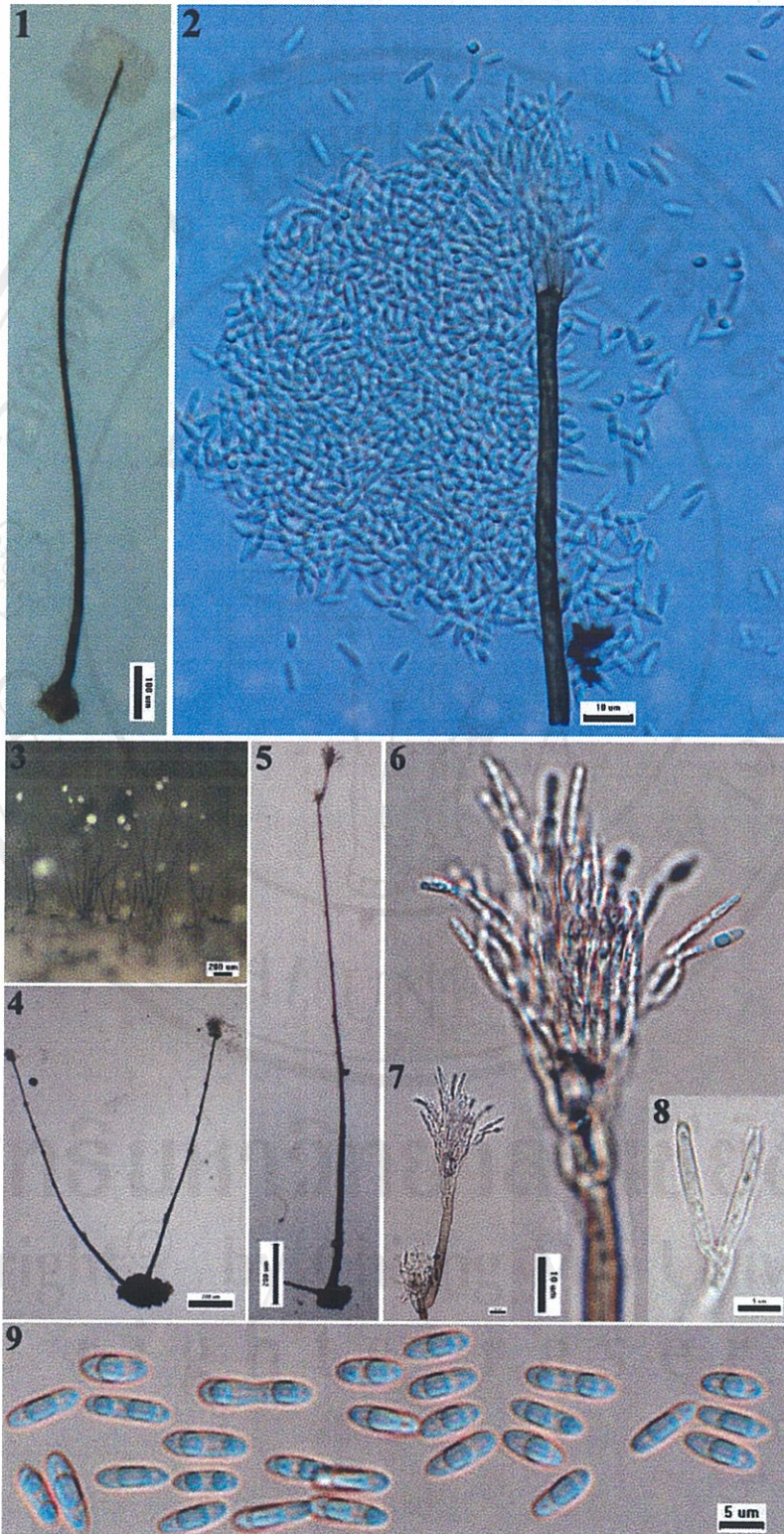


Figure 4.12 Conidiophore and conidia of 1-2. *Phialocephala bactrospora*. 3-9. *Phialocephala* sp. Scale bars: 3-5 = 200 µm; 1 = 100 µm; 2, 6-7 = 10 µm; 8-9 = 5 µm.

Sporidesmium Link

Type species: *Sporidesmium atrum* Link.

References: Ellis, 1971, 1976; Matsushima, 1975; McKenzie, 1995; Subramanian, 1992, 1997; Dulymamode *et al.*, 1998e; Goh and Hyde, 1999.

Conidiophores macronematous, mononematous, mid to dark brown, straight. **Conidia** simple, solitary, dry, straight, curved or occasionally sigmoid, cylindrical, fusiform, obclavate, obpyriform, subhyaline, straw-coloured or pale to dark brown, olivaceous brown or reddish brown, smooth or verruculose, septate.

McKenzie (1995) described *Sporidesmium freycinetine* from *Freycinetia wilderi*, a member of Pandanaceae while *S. paradecorosum* was described from a species of *Pandanus* (McKenzie *et al.*, 2002).

Sporidesmium ghanaense M.B. Ellis

Figure 4.13

Conidiophores 60-120 × 4.5-7.0 μm. **Conidia** 27-38 × 8.5-14 μm.

Habitat/Known distribution: On dead petioles of *Raphia* from Ghana and Sierra Leone (Ellis, 1976); on decaying leave of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai province, Muang Chiang Mai, Suthep Pui National Park, on decaying leaves of *Pandanus penetrans*, 19 January 2003, *S. Thongkantha S047-1*; 24 April 2004, CMU 26670; *S. Thongkantha S047-2*, CMU 26671.

Notes: *Sporidesmium ghanaense* is characterized by 40-130 × 3-6 μm conidiophore, with 0-3 annellations, brown. Conidia are smooth, wide at base, with two dark brown cells in middle, other cells paler, 31-53 × 10-14 μm (Ellis, 1976). The current collections from *Pandanus penetrans* agree with the description for *S. ghanaense*.

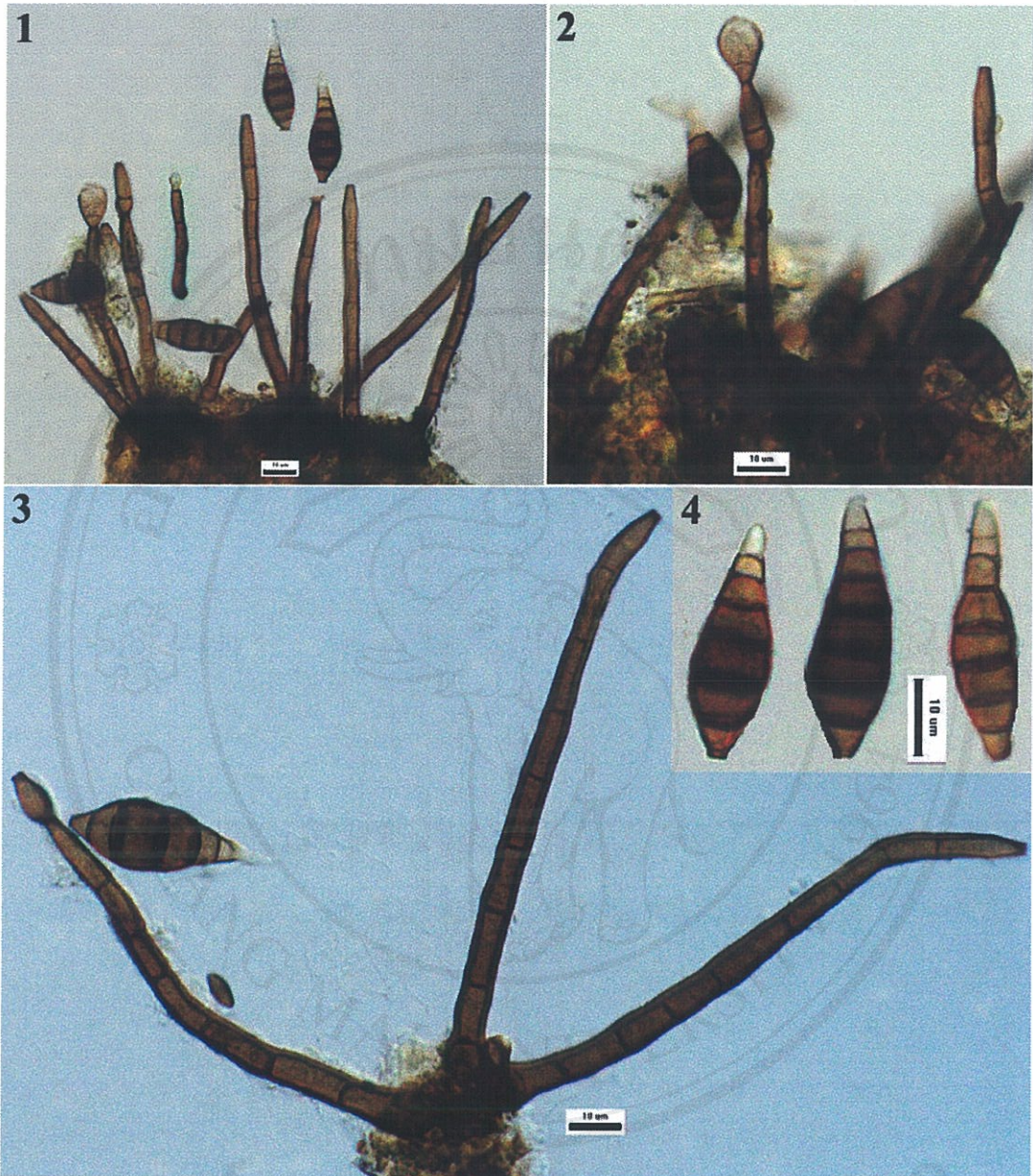


Figure 4.13 Conidiophores and conidia of *Sporidesmium ghanaense*. Scale bars = 10 µm.

Stachybotrys Corda

Type species: *Stachybotrys chartarum* (Ehrenb.) S. Hughes

References: Ellis, 1971; Jong and Davis, 1976; Fell and Hunter, 1979; Matsushima, 1980; McKenzie, 1991a; Whitton *et al.*, 2001.

Conidiophores macronematous, mononematous, straight or flexuous, smooth or verrucose or variously encrusted with dark granules, hyaline or pale coloured and

give rise to a single whorl of discrete, clavate, phialidic conidiogenous cells. **Conidia** are usually produced in a dark slimy mass, typically dark in color but can be hyaline, 1-celled, smooth or variously granulate, cylindrical, ellipsoid, reniform, or spherical.

Stachybotrys was introduced with the single species *S. atra*, now known as *S. chartarum* (Jong and Davis, 1976). Several species of *Stachybotrys* have been described from *Freycinetia* spp. including *S. breviusculus*, *S. freycinetiae*, *S. kapitiae*, *S. nephrodes* and *S. waitakeriae* (McKenzie and Hyde, 1996; Whitton *et al.*, 2001). *Stachybotrys parvispora* is known to occur on species of *Freycinetia* in Pacific Islands (McKenzie, 1991a), while *S. chartarum*, *S. dichroa* and *S. nephrospora* are known from *Pandanus* species (Tabaki, 1975; Whitton, 1999). *Stachybotrys bisbyi* is known from both of *Freycinetia* and *Pandanus* species. No species of *Stachybotrys* have been found from *Pandanus* species in this study, but three species were collected from *Dracaena lourieri*.

Stachybotrys chartarum (Ehrenb.) S. Hughes

Figure 4.14 (1-4)

Conidiophores up to 120 long. **Conidia** 8.6-10 × 5.2-7.6 µm.

Habitat/Known distribution: Known to inhabit decaying plant parts of *Abies balsamea*, *Acacia koa*, *Acer* sp., *A. saccharum*, *Actinidia callosa*, *Albizia lebbek*, *Carpinus caucasica*, *Cirsium* sp., *Crotalaria juncea*, *Digitalis* sp., *Dracaena lourieri*, *Fagus orientalis*, *Fragaria* sp., *Gossypium hirsutum*, *Juglans regia*, *Juncus roemerianus*, *Metrosideros collina*, *Morus* sp., *Pandanus* sp., *Phaseolus vulgaris*, *Phoenix dactylifera*, *Picea* sp., *Pinus* sp., *Populus* sp., *Pyrus* sp., *Quercus rubescens*, *Ribes nigrum*, *Tragopogon dubius*, *T. pratensis*. Canada (Sutton, 1973), Cuba (Mercado Sierra *et al.*, 1997), Hawaii (Baker *et al.*, 1979; Raabe *et al.*, 1981), India (Lenné, 1990), Japan (Matsushima, 1975), Saudi Arabia (Abdel-Hafez, 1984), Taiwan (Matsushima, 1980), Thailand (this study), UK (Dennis, 1986), USA (Shaw, 1973; Fell and Hunter, 1979), Vanuatu (Whitton *et al.*, 2001).

Specimen examined: THAILAND: Chiang Mai Province, Chiang Dao, Chiang Dao National Park, in rainforest at Ban Thum Village, on dead leaves of *Dracaena lourieri*, 12 July 2002, *S. Thongkantha S001-1*, CMU 26621; 1 November 2005, *S. Thongkantha S001-2*.

Notes: The general morphology of the current samples collected from decaying leaves of *Dracaena lourieri* at Chiangdao National Park best fit *S. chartarum* as reported by Ellis (1971). *Stachybotrys chartarum* is characterized by conidia that are broadly

ellipsoidal to subspherical, $8-11 \times 5-10 \mu\text{m}$, dark blackish brown to black and verrucose (Ellis, 1971).

Stachybotrys theobromae Hansf.

Figure 4.14 (9-12)

Conidia $21.2-23.7 \times 15-18.7 \mu\text{m}$.

Habitat/Known distribution: Known to inhabit dead plant parts of *Chlorophora*, *Hura*, *Persea* and *Theobroma* from Ghana, Malaysia, New Guinea, Nigeria, Papua, Sierra Leone, Trinidad (Ellis, 1971); on decaying leaves of *Dracaena* from Thailand (this study).

Specimen examined: THAILAND: Chiang Mai Province, Chiang Dao, Chiang Dao National Park, in rainforest at Ban Thum Village, on dead leaves of *Dracaena lourieri*, 1 November 2005, *S. Thongkantha* S195-1, CMU 26623; *S. Thongkantha* S195-2, CMU 26871.

Notes: *Stachybotrys theobromae* is characterized by ellipsoidal conidia with a small projecting papilla at the base, black and smooth when mature, $20-28 \times 14-17 \mu\text{m}$ (Ellis, 1971). The current samples isolated from dead leaves of *Dracaena lourieri* have conidial dimensions and morphology of conidia similar to those of *S. theobromae* reported by Ellis (1971).

Stachybotrys sp.

Figure 4.14 (5-8)

Conidiophores are macronematous, mononematous, unbranched, erect, straight or curved, smooth, typically hyaline towards the base, up to $100 \mu\text{m}$ long and $2.5-3.3$ wide. **Conidiogenous cells** are monophialidic, discrete, terminal, determinate, clavate, hyaline, $7.7-8.3 \times 2.7-3.3 \mu\text{m}$. **Conidia** aggregated in slimy, $4.7-6.3 \times (2.5)2.8-3.6 \mu\text{m}$, ellipsoid to broadly ellipsoid, 2-3 guttulate, pale colour to pale brown with a dark colour at the edge.

Habitat/Known distribution: Known to inhabit decaying leaves of *Dracaena lourieri*.

Specimens examined: THAILAND: Chiang Mai Province, Chiang Dao, Chiang Dao National Park, in rainforest at Ban Thum Village, on dead leaves of *Dracaena lourieri*, 1 November 2005, *S. Thongkantha* S017-1, CMU 26622; *S. Thongkantha* S017-2—S017-3 (2 collections).

Notes: There are a few species of *Stachybotrys* that have broadly ellipsoid conidia of the dimensions seen in the present specimens. In *S. cylindrospora* the conidia are ellipsoid but larger ($13-16 \times 4-6 \mu\text{m}$ vs. $4.7-6.3 \times 2.5-3.6 \mu\text{m}$) with a rough wall. The

conidia of *S. waitakeriae* are morphologically similar to the current specimen, but are verrucose, without guttules and larger ($14.5\text{--}19 \times 8\text{--}11 \mu\text{m}$) (Whitton *et al.*, 2001). Guttulate conidia are also found in *S. aurantia* and *S. bisbyi* conidia but they are colourless and larger ($9.5\text{--}15 \times 4\text{--}9 \mu\text{m}$ and $10\text{--}16 \times 4\text{--}5 \mu\text{m}$, respectively).

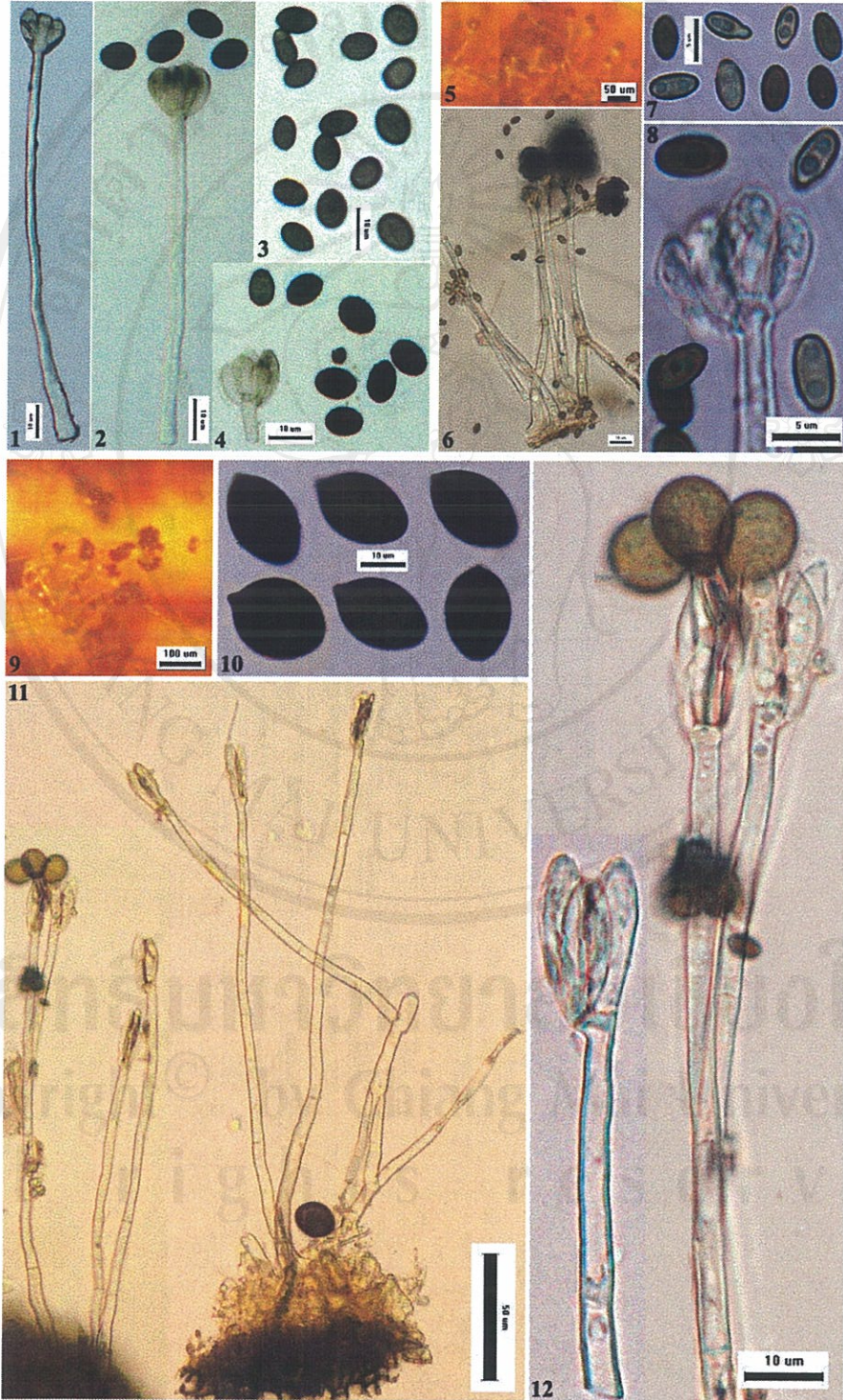


Figure 4.14 Conidiophores and conidia of 1-4. *Stachybotrys chartarum*, 5-8. *Stachybotrys* sp. and 9-12. *S. theobromae*.

Trichothecium Link

Type species: *Trichothecium roseum* Link

References: Matsushima, 1971; Barnett and Hunter, 1972; von Arx, 1981.

Conidiophores bearing conidia apically, either singly or successively by slight growth of conidiophore apex, held together in group or chains but not end to end, long and slender, simple, septate, hyaline. **Conidia** 2-celled, smooth, ovoid to ellipsoid, hyaline or brightly colored.

Species of *Trichothecium* are saproic or weakly parasitic and widespread with about five species. No new species of *Trichothecium* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002). However, in this study *T. roseum* was found on decaying leaves of *Dracaena lourieri* from Chiangdao National Park and *Pandanus penetrans* from Suthep Pui National Park.

Trichothecium roseum Link

Figure 4.15

Conidia 16.2-25(-27.9) × 10-15.2 μm.

Habitat/Known distribution: On rotten *Cocos nucifera* leaf from Japan (Matsushima, 1971); on decaying leaves of *Dracaena lourieri* and *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, in rainforest, on decaying leaves of *Pandanus penetrans*, 19 February 2003, *S. Thongkantha S066*, CMU26695; Chiang Mai Province, Chiang Dao, Chiang Dao National Park, in rainforest at Ban Thum Village, on dead leaves of *Dracaena lourieri*, 1 November 2005, *S. Thongkantha S191*, CMU 26867.

Notes: Conidia of the current samples are slightly wider than those of *Trichothecium roseum* recorded by Mutsushima (1971) that had 16-25 × 8-10 μm conidia. No difference in the general morphologically characteristics were observed. Therefore, the present specimens are best placed in *T. roseum*.

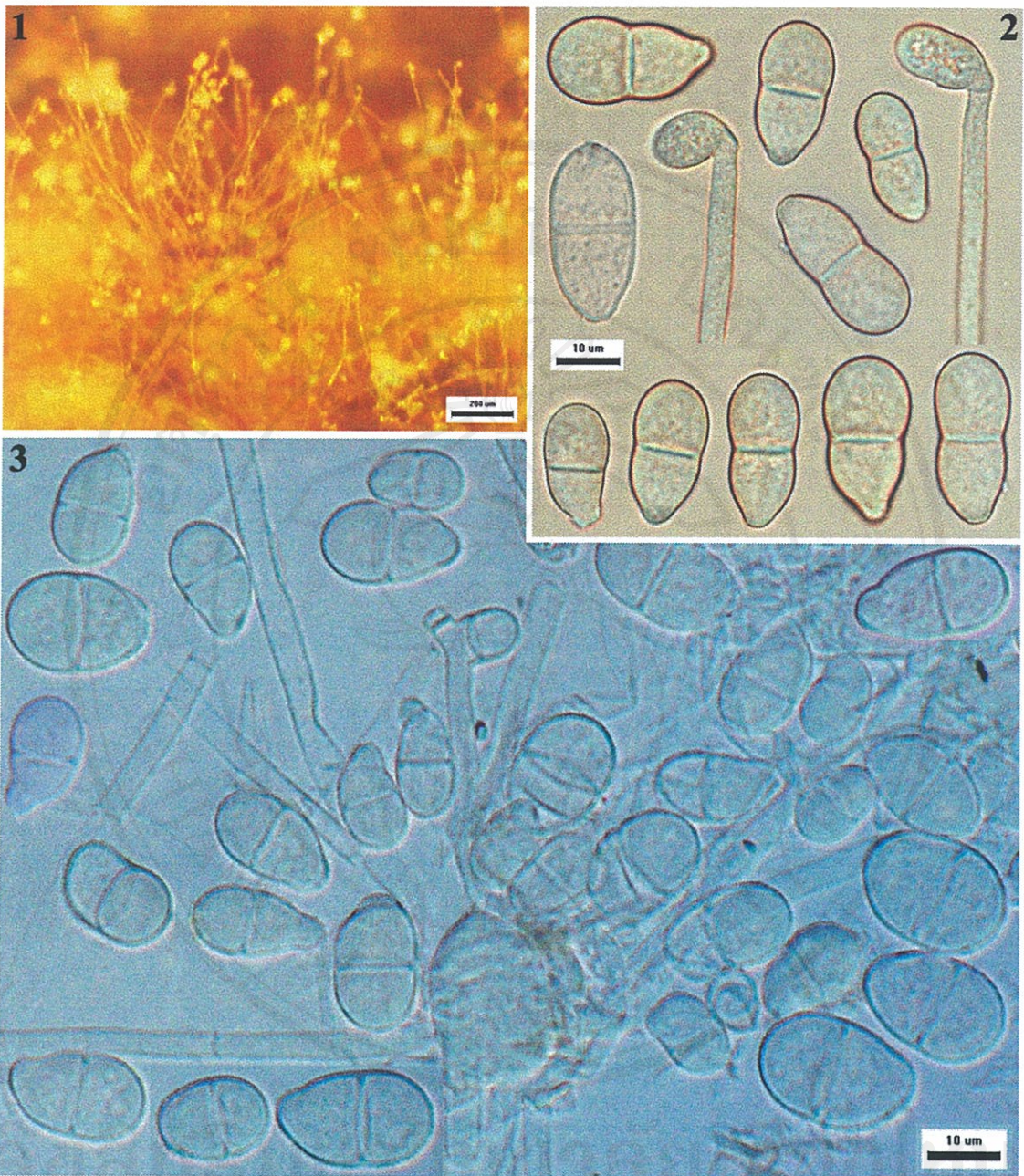


Figure 4.15 *Trichothecium roseum*. 1. Appearance of *T. roseum* on the host surface. 2-3. Conidiophores and conidia. Scale bars: 1 = 200 μm; 2-3 = 10 μm.

Veronaea Ciferri & A.M. Conte

Type species: *Veronaea botryosa* Cif. & A.M. Conte

References: Ellis, 1971, 1976; von Arx, 1981; Kiffer and Morelet, 2000.

Conidiophores macronematous, mononematous, straight or flexuous, unbranched or occasionally loosely branched, smooth, pale to mid brown or olivaceous brown. **Conidiogenous cells** polyblastic with flat and small scars,

integrated, terminal often becoming intercalary, cylindrical, sympodial. **Conidia** usually colourless, pale brown or olivaceous brown, solitary, aseptate to a few septa, smooth or minutely verruculose, ellipsoidal or fusiform, round at the apex truncate at the base.

Ellis (1971, 1976) included eight species, but some of them have been transferred to *Ramichloridium* by de Hoog (1977). No new species of *Veronaea* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002).

Veronaea botryosa

Figure 4.16

Conidiophores 145-175 × 3.3-3.6 μm. **Conidia** 7.5-11.8 × 2.8-4.7 μm.

Habitat/Known distribution: Known to inhabit olive slag, Italy (Ellis, 1971); decaying leaf of *Pandanus odoratissimus*, Thailand (this study).

Specimens examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 11 April 2004, S. Thongkantha S 115-1, CMU 26762; S. Thongkantha S 115-2.

Notes: The current specimens isolated from *Pandanus odoratissimus* leaves are best treated as *V. botryosa*. The 5-12 × 2-4 μm conidia and general characteristics are similar to those reported by Ellis (1971).

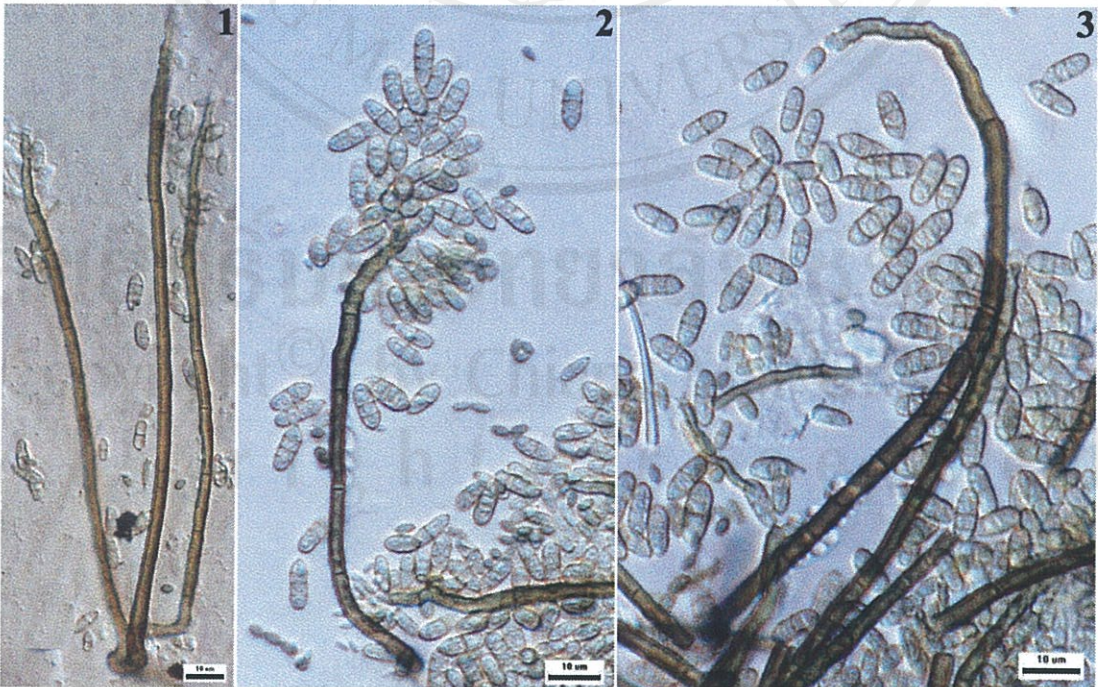


Figure 4.16 Conidiophores and conidia of *Veronaea botryosa*. Scale bars: 1 = 10 μm.

Zygosporium Mont.

Type species: *Zygosporium oscheoides* Mont.

References: Hughes, 1951; Ellis, 1971, 1976; Matsushima, 1971, 1975, 1980; Sutton, 1978; Kiffer and Morelet, 2000; Whitton *et al.*, 2003.

Vesicular conidiophores macronematous, micronematous, mononematous, unbranched or branched, curved, brown, smooth or minutely echinulate, swollen vesicles often on short or long stalks, upper part of stipe frequently sterile. **Conidiogenous cells** usually monoblastic, discrete, determinate, ampulliform or ellipsoidal, often curved and tapering to a point, thin-walled, colourless or pale, borne in pairs, 3 or 4 on the dark brown vesicles. **Conidia** solitary, acrogenous, simple, ellipsoidal, spherical or subspherical, smooth, verruculose or verrucose, 1 celled, hyaline to brown.

Zygosporium species is differentiated by morphological characters of setiform conidiophores, vesicular conidiophores, conidiogenous cells and conidia (Ellis, 1971, 1976; Whitton, 1999; Whitton *et al.*, 2003). The structures which produce vesicular conidiophores at the side are correctly termed **setiform conidiophores** and they are produced in various species of the genus, for example *Z. geminatum* S. Hughes, *Z. majus* Piroz., *Z. minus* S. Hughes, *Z. oscheoides* Mont. However, setiform structures which do not produce vesicles or true setae are found in some species such as *Z. echinosporum* Buntin & E.W. Mason and *Z. deightoni* M.B. Ellis (Ellis, 1976; Hughes, 1951).

Zygosporium pandanicola Whitton, McKenzie & K.D. and *Z. vanuatum* Whitton, McKenzie & K.D. Hyde have been described and illustrated from decaying leaves of *Pandanus simplex* and *Pandanus* sp., respectively (Whitton *et al.*, 2003). In addition *Z. echinosporum*, *Z. gibbum* (Sacc., M. Rousseau & Bommer) S. Hughes, *Z. minus* and *Z. oscheoides* are known to occur on decaying leaves of *Pandanus* species in the tropics (Matsushima, 1980; Whitton, 1999).

Zygosporium bioblitz McKenzie, Thongkantha & S. Lumyong, sp. nov.

Figure 4.17 (8-10)

Coloniae effusae. Mycelium partim internum et externum, ex hyphis pallide brunneae vel hyalinae, laevibus, septatis, ramosis, 1.5–2.5 μm crassis. **Setiforma conidiophora** 40–75 μm longa, 2–3 μm lata ad basim, 1–1.75 μm lata ad apicem, interdum inflata usque ad 3 μm crassa, solitaria, erecta, recta vel paulo flexuosa, laevia, 3 septata, brunnea, cellula apicem pallidae brunnea vel hyalina, crassitunicata. **Vesicula conidiophora** lateralem ad suprabasalis, complectens de tres cellula; cellula ad stipitis, cylindrica, brunnea, crassitunicata, laevia, 4.5–8.5 \times 2–3 μm ; cellula vesicula atrobrunnea vel nigrea, crassitunicata, laevia, inflata, introrsus curvati, 8–10.5 \times 3.5–5.5 μm ; cellulae conidiogenae enatus vel cellula vesiculae, monoblasticae, discretae, determinatae, inflatae, ampulliformae, introrsus curvatae, laeviae, pallide brunneae, 5–7 \times 3–4.5 μm . **Conidia** 14–21 \times 7.5–11 μm , solitaria, sicca, ellipsoidea vel ovata, crassitunicata, brunnea, cum costis longitudinalibus vel verrucosa.

Etymology: holotype specimen collected during Auckland BioBlitz 2006, a 24-hour effort to record all known species of organisms from a selected urban area.

Holotype: PDD 87915, New Zealand.

Colonies effuse to compact, forming a thin, irregular shaped patch on the substrate surface, black. Mycelium mostly superficial, pale brown to hyaline, smooth, septate, branched, 1.5–2.5 μm diam, slightly thickened walls, giving rise to setiform conidiophores. **Stroma** none. **Hyphopodia** absent. **Setiform conidiophores** 40–75 μm long, 2–3 μm wide near the base, 1–1.75 μm wide near apex, sometimes apex swollen to 3 μm , solitary, erect, straight or slightly flexuous, tapered from the base, narrowing towards the apex, smooth, 3 septate, brown except for the apical cell which is significantly paler in pigmentation, thickened walls and septa, apical cell obtuse, upper section of the setiform conidiophore sterile, first cell gives rise to a single vesicular conidiophore, basal cell concolorous with the lower parts of the setae, and it branches in two directions becoming part of the mycelium and connecting the conidiophores with each other. **Vesicular conidiophores** arise on the side of the first

cell of the setiform conidiophore, consisting of three cell types; a cylindrical, brown, thick walled, smooth stalk cell, $4.5\text{--}8.5 \times 2\text{--}3 \mu\text{m}$; a dark brown to black, thick walled, smooth, swollen, inwardly and upwardly curved vesicular cell $8\text{--}10.5 \times 3.5\text{--}5.5 \mu\text{m}$, the inner curvature of the vesicular cell is paler in pigmentation than the rest of the cell; and 2 conidiogenous cells. **Conidiogenous cells** arise directly from the vesicular cell of the conidiophore, monoblastic, discrete, determinate, swollen, ampulliform, outwardly and upwardly curved, smooth, very pale brown, tapered towards the apex, apex obtuse, $5\text{--}7 \times 3\text{--}4.5 \mu\text{m}$. **Conidia** $14\text{--}21 \times 7.5\text{--}11 \mu\text{m}$, solitary, dry, ellipsoidal to oval, with a protruding cylindrical, truncate base, rounded apex, aseptate, brown, thick walled, covered by brown, raised, flattened ornamentation, often arranged in ridges.

Habitat/Known distribution: Known to inhabit decaying leaves of *Cortaderia selloana* in New Zealand and *Dracaena lourieri* in Thailand.

Specimens examined: New Zealand, Auckland, Henderson, Shona Reserve, bank of Opanuku Stream, on decaying leaves of *Cortaderia selloana* (Schult. & Schult.f.) Asch. & Graebn., 25 March 2006, E. H. C. McKenzie (PDD 87915 - holotype); Thailand, Chiang Mai, Chiang Dao National Park, on dead leaves of *Dracaena lourieri* Gagnep., 14 June 2003, S. Thongkantha S085-1 (CMU 26715); *ibid.*, 1 November 2005, S. Thongkantha S085-3 (CMU 26716).

Notes: Whitton *et al.* (2003) reviewed the genus *Zygosporium* and provided a key to the 15 accepted species. Most species possess conidia that are either smooth or echinulate but three, *Z. geminatum*, *Z. pacificum* Whitton, and *Z. pandanicola* Whitton, have tuberculate conidial ornamentation similar to that of *Z. bioblitzi*. These three species, and six others, also produce a dark, curved vesicular cell from the side of a setiform conidiophore, in a manner comparable to *Z. bioblitzi*. However, *Z. bioblitzi* is readily distinguished from *Z. geminatum*, *Z. pacificum*, and *Z. pandanicola*. The ellipsoidal conidia of *Z. geminatum*, which invariably adhere in pairs (Hughes, 1951), measure $20\text{--}30 \times 8\text{--}11 \mu\text{m}$ and are longer than the conidia of *Z. bioblitzi*. Both *Z. geminatum* and *Z. bioblitzi* have a flat basal scar about $2 \mu\text{m}$ wide, but that of *Z. bioblitzi* noticeably protrudes. The conidia of *Z. pandanicola* are spherical, in contrast to the ellipsoidal conidia of *Z. bioblitzi*. The conidia of *Z.*

pacificum are elliptical and measure $11-16 \times 6.5-7.5 \mu\text{m}$. This is smaller than the conidia of *Z. bioblitzii*, although the swollen vesicular cell of *Z. pacificum* is $19-28 \times 8-12.5 \mu\text{m}$, much larger than the vesicular cell of *Z. bioblitzii*.

***Zygosporium oscheoides* Mont.**

Figure 4.17 (1-5)

Setiform conidiophores $33.3-44.5 \times 2.2-2.7 \mu\text{m}$. **Vesicular conidiophores** 1 stalk cell, $3.4-5.5 \times 2.7-3.4 \mu\text{m}$, vesicular cell $10.9-12.7 \times 5.3-6.6 \mu\text{m}$. **Conidiogenous cells** 2 per vesicle, $3.5-4.8 \times 2.6-4.1 \mu\text{m}$. **Conidia** spherical to ellipsoidal, smooth, $5-10 \times 3.7-9.3 \mu\text{m}$.

Habitat/Known distribution: Brazil, Congo, Guernsey, India, Jamaica, Samoa, Sri Lanka, Vanuatu and Venezuela (Ellis, 1971); Cuba (Holubová-Jechová and Mercado Sierra, 1986; Hughes, 1951); Ghana, Mauritius, Seychelles, Sierra Leone, St Helena, Togo and Uganda (Hughes, 1951); Hawaii (Raabe *et al.*, 1981); Japan (Matsushima, 1971, 1975); Malaysia (Peregrine and Ahmad, 1982); Mexico (Mercado and Heredia, 1994); New Zealand (Hughes, 1978); Papua New Guinea (Matsushima, 1971; Shaw, 1984); Peru (Matsushima, 1993); Philippines (Teodoro, 1937); Tanzania (Matsushima, 1980); U.K. (Dennis, 1986), U.S.A. (Hughes, 1951; Morgan-Jones, 1974; Sutton, 1978); Thailand (this study); Vietnam (Whitton, 1999).

Specimens examined: THAILAND: Chiang Mai province, Muang Chiang Mai, Suthep Pui National Park, in rainforest Quinin Botanic Garden, on decaying leaves of *Pandanus penetrans*, 19 January 2004, *S. Thongkantha S073-1*; 24 April 2004, *S. Thongkantha S073-2*, CMU26702; on decaying leaves of *Pandanus amaryllifolius*, 10 August 2005, *S. Thongkantha S209*, CMU 26885.

Notes: *Zygosporium oscheoides* is a common species of the genus (Ellis, 1971), and is characterized by setiform conidiophores that are pale at the apex and slightly swollen. The vesicular conidiophores arise from just above the basal septum and give rise to two pale conidiogenous cells that produce ellipsoid, smooth to minutely verruculose, $7-12 \times 4-7 \mu\text{m}$ conidia. The current specimens show little difference from the description reported by Ellis (1971) for *Z. oscheoides*: the slight difference in conidial size is interpreted to be due to natural variation.

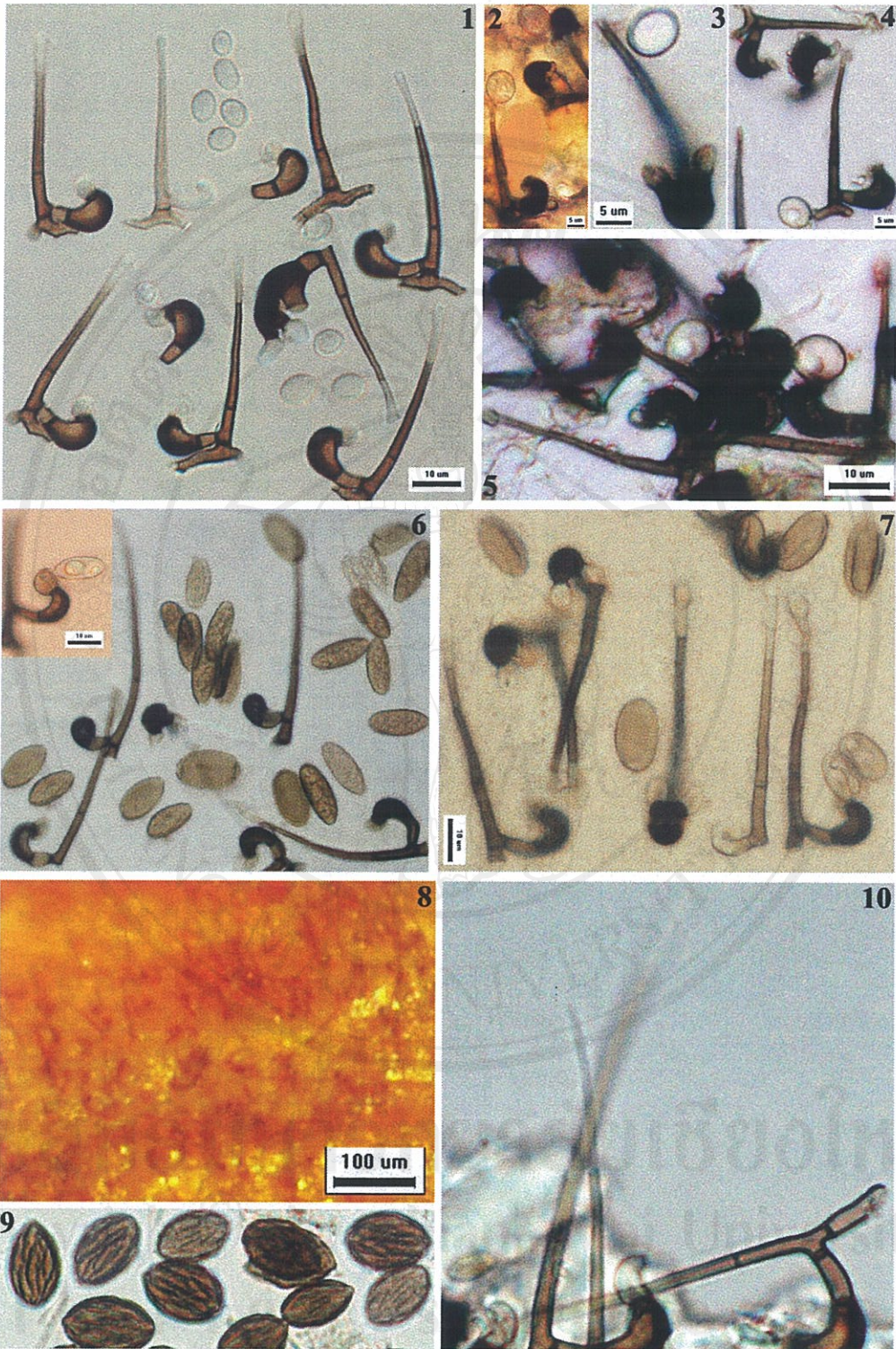
Zygosporium vanuatum Whitton, McKenzie & K.D. Hyde Figure 4.17 (6-7)

Setiform conidiophore 55.3-73 × 2.3-2.9 μm. **Vesicular conidiophore** 1 stalk cell, 5.9-8.2 × 3.5-4.7 μm, vesicular cell 12.9-16.5 × 5.3-5.9 μm. **Conidiogenous cells** 2 per vesicle, 5.9-7 × 4.7-7 μm. **Conidia** ellipsoidal to ovoid, 15.3-20 × 6.5-9.4 μm.

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus* sp., Vanuatu (Whitton *et al.*, 2003); *Dracaena lourieri*, Thailand (this study).

Specimens examined: THAILAND: Chiang Mai, Chiang Dao National Park, in rainforest, on dead leaves of *Dracaena loureiri*, 14 June 2003, S. Thongkantha S096-1, CMU26737; S096-2, CMU26738.

Notes: *Zygosporium vanuatum* is characterized by setiform conidiophores that are typically straight, sometimes curved or flexuous. The vesicular conidiophores arise at the base of the first cell of the setiform conidiophore, and 2 pale conidiogenous cells produce ellipsoid, both ends rounded, coarsely verrucose with raised and flattened ornamentation, pale brown, 11-16 × 6.5-7.5 μm conidia. The current specimens show little difference from the description reported by Whitton *et al.* (2003) for *Z. vanuatum*: the slight difference in conidial size is interpreted to be due to natural variation.



4.3 DESCRIPTIONS AND PHOTOGRAPHIC PLATES OF ASCOMYCETES

Astrosphaeriella Syd. & P. Syd.

(Melanommataceae: Dothideales)

Type species: Astrosphaeriella stellata (Pat.) Sacc.

References: Hawksworth, 1981; Fröhlich and Hyde, 1995, 2000; Hyde and Fröhlich, 1997; Hyde *et al.*, 2000.

Ascomata single, scattered or rarely 2-3 joined, conspicuous, immersed and subepidermal, at maturity covered by epidermis except at the ostiole, or the host tissues rupture and in some remain as scales around the base. **Ostiole** central and minutely papillate, rounded or slit-like. **Hamathecium** composed of numerous narrow (1 μm wide) trabeculae embedded in a gelatinous matrix. **Asci** bitunicate with an ocular chamber, some with a faint ring, cylindrical or cylindric-clavate, or narrowly obclavate, pedicellate, 8-spored. **Ascospores** 2-3 seriate, elongate-fusiform, mostly straight, often tapering towards the apices, 2-6-celled, euseptate, hyaline or reddish-brown, concolourous, some with lighter end cells, wall smooth, verrucose or with striations, often with mucilaginous sheath or appendages.

Astrosphaeriella species occur on palms, bamboo and grasses in the tropics (Hawksworth, 1981; Hyde and Fröhlich, 1997; Fröhlich and Hyde 2000; Hyde *et al.*, 2000). No new species of *Astrosphaeriella* have previously been described from any members of the Pandanaceae (McKenzie and Hyde, 1996, 1997; Whitton, 1999; McKenzie *et al.*, 2002).

Astrosphaeriella tornata (Berk. & M.A. Curtis) D. Hawksw. & Boise Figure 4.18

Ascomata 444-1111 μm diam. (mostly 889-1000) μm diam, arising singly, 114-151 \times 10-13.6 μm , immersed only at the base, black, carbonaceous. **Asci** cylindrical, pedicellate, with an ocular chamber. **Ascospores** (27.5)32.5-54 \times 5-7.3 μm , 2 seriate, broadly fusiform, reddish-brown, with paler end cells, 3-5-septate, smooth-walled.

Habitat/Known distribution: Known to inhabit palm petiole from French, Guiana and Surinam (Hyde and Fröhlich, 1997); decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, in rainforest Medicinal Plant Garden, on dried sheets of *Pandanus penetrans*, 25 April 2003, *S. Thongkantha* S126-1, CMU 26774; S126-2 CMU 26775; S126-3—S126-5 (3 collections); 9 April 2004, *S. Thongkantha* S126-6, CMU 26776; *S. Thongkantha* S126-7, CMU 26777.

Notes: The characteristic of the current specimens identified from bark of *Pandanus penetrans* fit the description for *Astrosphaeriella tornata* of Hyde and Fröhlich (1997). The species is characterized by ascospores that are broadly fusiform, 3-5-septate, reddish-brown, with paler end cells, slightly constricted at the septa, narrow at the ends (Hyde and Fröhlich, 1997). The ascospores of the specimens in this study are slightly shorter and narrower ($32.5\text{-}54 \times 5\text{-}7.3 \mu\text{m}$ vs. $46\text{-}56 \times 6\text{-}8 \mu\text{m}$) possibly due to natural variations. *Astrosphaeriella tornata* is similar to two species *A. trochus* and *A. versuvius* and there is confusion surrounding their characters. *Astrosphaeriella versuvius* has smaller 3-septate ascospores. In *A. tornata* and *A. trochus* ascospores mainly exceed $50 \mu\text{m}$ and are 5-septate (Hyde and Fröhlich, 1997).

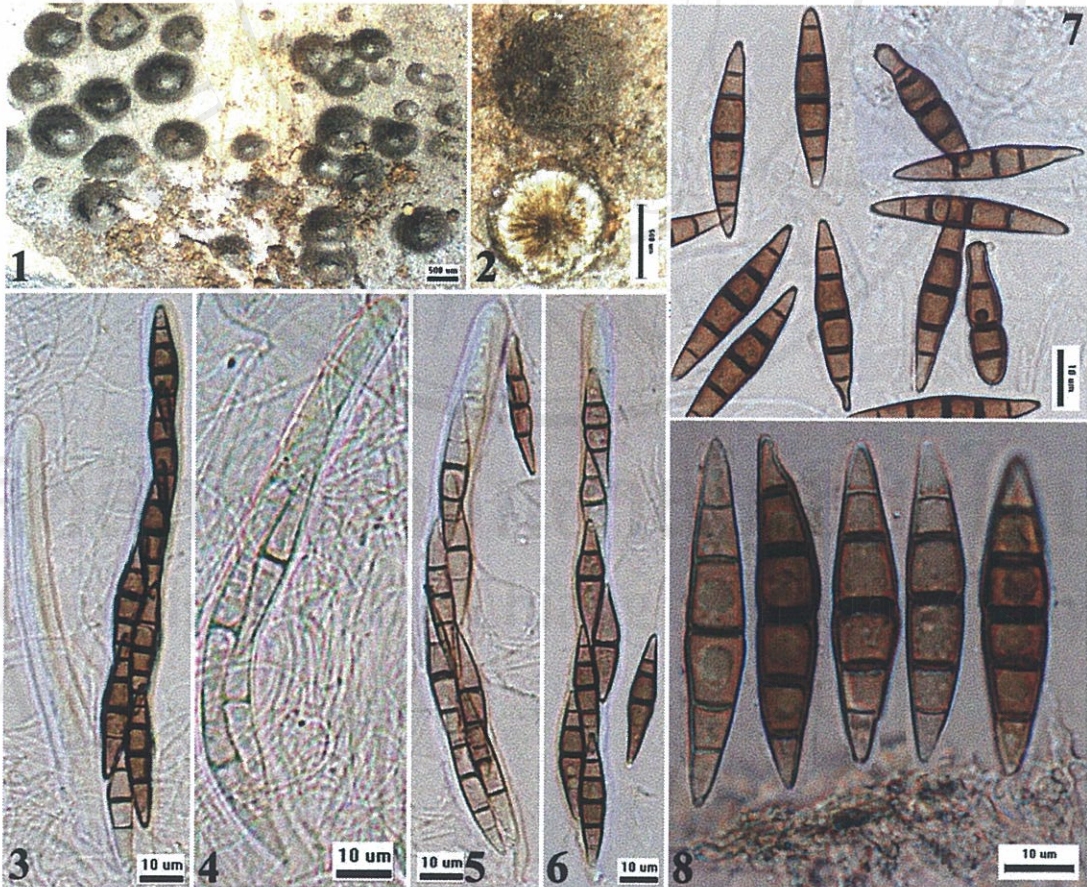


Figure 4.18 *Astrosphaeriella tornata* 1-2. Appearance of ascomata on the host surface. 3-6. Asci and trabecular pseudoparaphyses. 7-8. Ascospores. Note the paler end cell. Scale bars: 1-2 = 500 μm; 3-8 = 10 μm.

Chaetosphaeria (Berk. & Broome) Tul. & C. Tul.

(Chaetosphaeriaceae: Sordariales)

Type species: Chaetosphaeria innumera (Berk. & Broome) Tul. & C. Tul.

References: Hyde *et al.*, 1999a, 2000; Fröhlich and Hyde, 2000.

Ascomata superficial, conical, globose, subglobose or pyriform, brittle, brown to black, often with setae, solitary or mostly clustered. **Papilla** central and short, periphysate. **Peridium** relatively thin, comprising two strata, an outer layer of brown thick-walled, angular to globose cells and inner layer of thin-walled compressed hyaline cells. **Paraphyses** hypha-like, tapering distally, not embedded in a gelatinous matrix. **Asci** cylindrical to cylindrical-clavate with short pedicellate, apically rounded, often J-, discoid, refractive apical ring. **Ascospores** uniseriate, overlapping uniseriate or rarely biseriate, ellipsoidal to fusiform, 1-4-celled, euseptate, hyaline, smooth or verrucose.

The history and taxonomy of *Chaetosphaeria* is discussed by Booth (1957) and Gams and Holubova-Jechova (1976). The conidial states (including: *Catenularia*, *Chalara*, *Chloridium*, *Cryptophiale*, *Custingophora*, *Cylindrotrichum*, *Dictyochoeta*, *Menispora*, *Phialophora* and *Zanclospora*) are particularly important for differentiating species with very similar perfect states (Hyde *et al.*, 1999b). *Bertia* and *Niesslia* are the most similar genera to the genus. This genus is a widespread, contains 22 species (Fröhlich and Hyde, 2000). *Chaetosphaeria aotearoae* has been described from wood and bark of *Freycinetia banksii* (McKenzie and Hyde, 1996).

Chaetosphaeria sp.

Figure 4.19

Ascomata 180 μm diam. **Asci** 54.5-66.3 \times 5.5-7.7 μm . **Ascospores** hyaline, 1-celled, ellipsoidal and 8-10 \times 4-5 μm . **Paraphyses** 3.1-3.6 μm at the widest.

Habitat/Known distribution: Known to inhabit dead leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 1 September 2004, *S. Thongkantha S162-1*, CMU 26829; *S. Thongkantha S162-2*, CMU 26830.

Notes: The general characteristic of the present specimens agree with the description for species of *Chaetosphaeria* (Hyde *et al.*, 1999a).

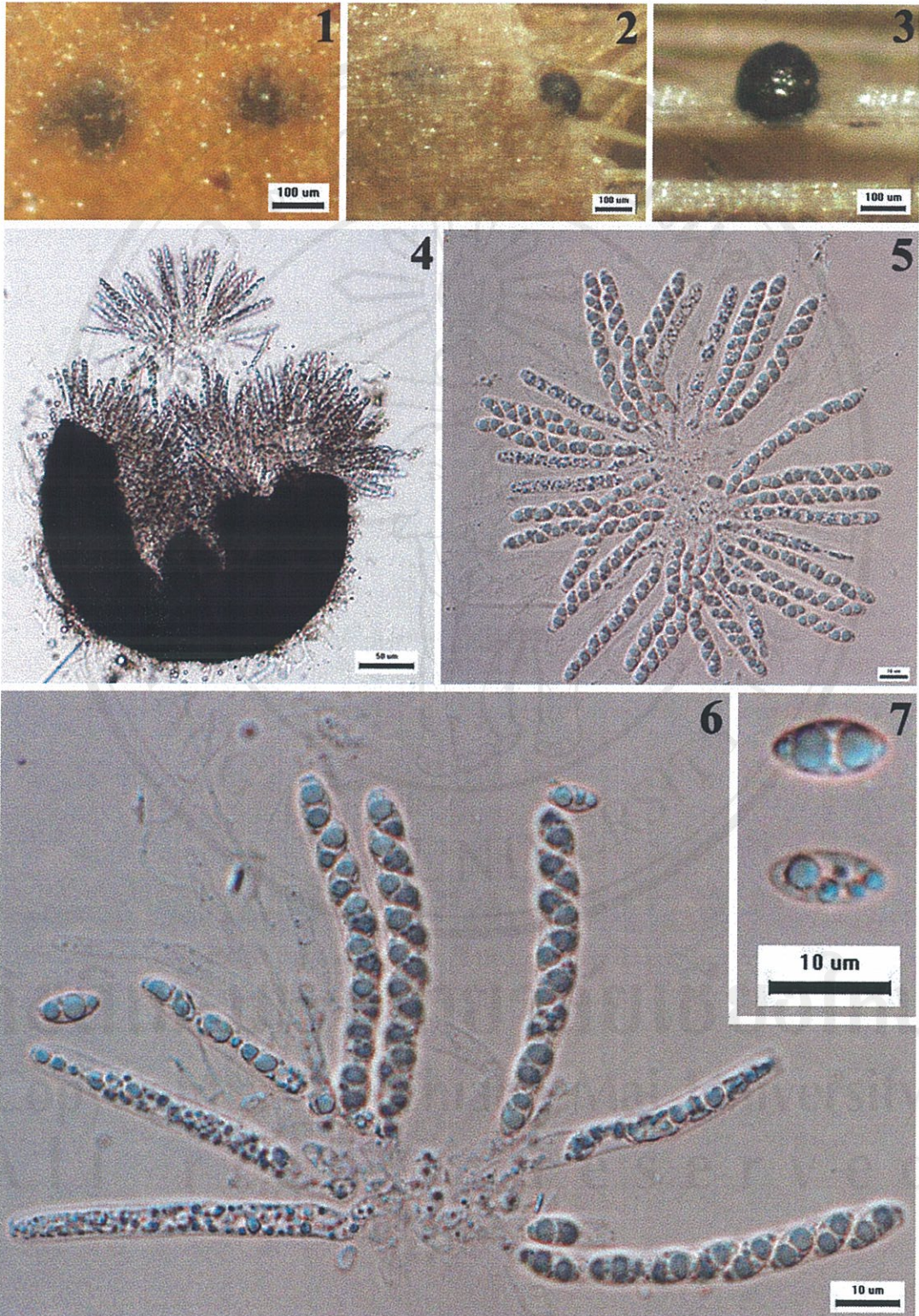


Figure 4.19 *Chaetosphaeria* sp. 1-3. Appearance of ascomata on the host surface. 4. Ascoma with asci masses. 5-6. Asci and paraphyses. 7. Ascospores. Scale bars: 1-3 = 100 μm; 4 = 50 μm; 5-7 = 10 μm.

Emericella Berk. & Br.

(Trichocomaceae: Eurotiales)

Type species: *Emericella varicolor* Berk. & Br.

References: von Arx, 1981; Hanlin, 1998.

Ascomata cleistothecium, globose, scattered or gregarious, formed on surface of substrate, yellow-brown, light brown or reddish-purple, often obscured by one to several layers of hülle cells. Hülle cells are hyaline to yellowish or brownish in color, globose to irregular in shape, with very thick walls and small lumina and formed from slender hyphae. **Asci** globose, scattered throughout centrum, 8-spored, with evanescent walls. **Ascospores** 1-celled, globose in face view, lenticular in end view, surrounded by one or more equatorial crests or flanges, orange-red to blue-violet or reddish purple, smooth or ornamented.

No new species of *Emericella* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002).

Emericella nidulans

Figure 4.20

Ascomata yellowish, 58–84 μm diam. **Ascospores** 3–3.4 μm diam.

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus tectorius*, Australia, Hongkong; decaying leaves of *Pandanus odoratissimus* from Thailand (this study).

Specimen examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 11 April 2004, S. Thongkantha S180-1, CMU 26853; S. Thongkantha S180-2.

Notes: The general characteristic of the specimens isolated from *Pandanus odoratissimus* leaves fit the description and illustrated for species of *Emericella nidulans* (von Arx, 1981; Hanlin, 1998).

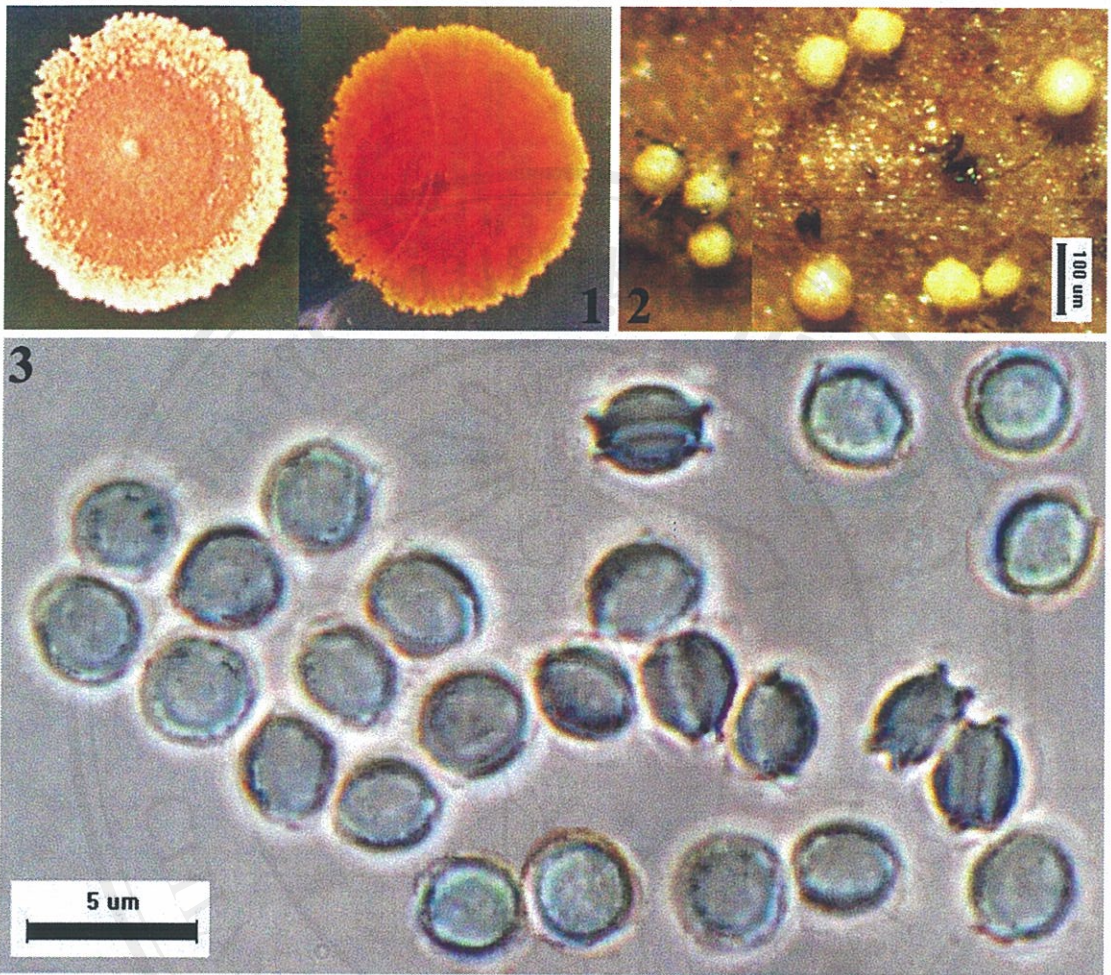


Figure 4.20 *Emericella nidulans*. 1. Colony on $\frac{1}{2}$ strength PDA. 2. Appearance of ascomata on the host surface. 3. Ascospores. Scale bars: 2 = 100 μm ; 3 = 10 μm .

Linocarpon Syd. & P. Syd.

(Hyponectriaceae: Incertae Sedis)

Type species: *Linocarpon pandani* (Syd. & P. Syd.) Syd. & P. Syd.

References: Walker, 1980; Hyde, 1988, 1992a, 1997; Dulymamode *et al.*, 1998c; Hyde and Alias, 1999; Fröhlich and Hyde, 2000; Poonyth *et al.*, 2000; Thongkantha *et al.*, 2003.

Ascomata form beneath a circular, raised, typically black, dome-shaped clypeus, shiny. **Asci** cylindrical to clavate, truncate or round at the apex, unitunicate with a small J- apical ring. **Ascospores** generally elongate, filiform or cylindrical,

smooth, hyaline, sometimes appendaged. Species of *Linocarpon* are distinguished primarily through ascospore morphology and dimensions. Ascospore shape, the presence/absence of a gelatinous appendage/s, and the morphology of appendages being of primary importance. Most *Linocarpon* ascospores are aseptate, with one appendage, or bipolar appendages.

Walker (1980), in a review of scolecospored genera of ascomycetes, discussed the current taxonomic status of species referred to *Linocarpon* and accepted five species. During an investigation into microfungi which inhabit the mangrove palm *Nypa fruticans*, Hyde (1988) discussed three species, *L. appendiculatum* K.D. Hyde being a new species, *L. nipae* (Henn.) K.D. Hyde a new combination, and *L. pandani* (Syd. & P. Syd.) Syd. & P. Syd. Hyde (1992a) revised *Linocarpon*, accepted 10 species and introduced *L. bipolaris* K.D. Hyde and *L. longisporum* K.D. Hyde. Barr (1993) in a revision of taxa introduced by Ellis proposed *L. hamasporum* (Ellis & Everh.) M.E. Barr. Hyde (1997) introduced 11 species and one new combination and produced a key to all 23 accepted species. Dulymamode *et al.* (1998c) discussed four species of *Linocarpon* from *Pandanus* spp. in Madagascar, three being new to science. Hyde and Alias (1999) introduced *L. angustatum* K.D. Hyde & Alias from *Nypa fruticans* in Malaysia. Fröhlich and Hyde (2000) introduced four new species from various palm hosts.

Ten species of *Linocarpon* have been described from *Pandanaceae* substrates: *L. appendisporum*, *L. breve* K.D. Hyde, *L. elaeidis* Petr., *L. falciformisporum* K.D. Hyde, *L. fasciatum* Dulymamode, P.F. Cannon & Peerally, *Linocarpon lammiiae* Whitton, K.D. Hyde & McKenzie, *L. livistonae* (Henn.) K.D. Hyde, *L. pandani*, *L. pandanicola* K.D. Hyde, *L. spathulatum* Dulymamode, P.F. Cannon & Peerally and *L. sulcatum* Dulymamode, P.F. Cannon & Peerally from *Pandanus* spp., and *L. freycinetiae* (Rehm) K.D. Hyde from a *Freycinetia* sp. (Hyde 1992a, 1997; Dulymamode *et al.*, 1998c; Thongkantha *et al.*, 2003).

Linocarpon lammiiae Whitton, K.D. Hyde & McKenzie

Figure 4.21

Ascomata 77-138.5 µm diam. Asci 80-82.7 × 18.7-24 µm. Ascospores 55-59 × 4.2-5 µm.

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus tectorius*, Australia and Hongkong (Thongkantha *et al.*, 2003); *P. odoratissimus*, Thailand.

Specimens examined: THAILAND, Rayong Province, Nang Rum Beach, on decaying leaves of *Pandanus odoratissimus*, 11 April 2004, *S. Thongkantha S101-1*, CMU 26743; *S101-2*, CMU 26744; 6 December 2004, *S. Thongkantha S101-3*.

Notes: *Linocarpon lammliae* is characterized by short, acicular ascospores that have a rounded apex, taper to an acute base and have no gelatinous appendage. The morphological ascospores of the current specimen are most similar to *L. lammliae* reported by Whitton (1999) and Thongkantha *et al.* (2003).

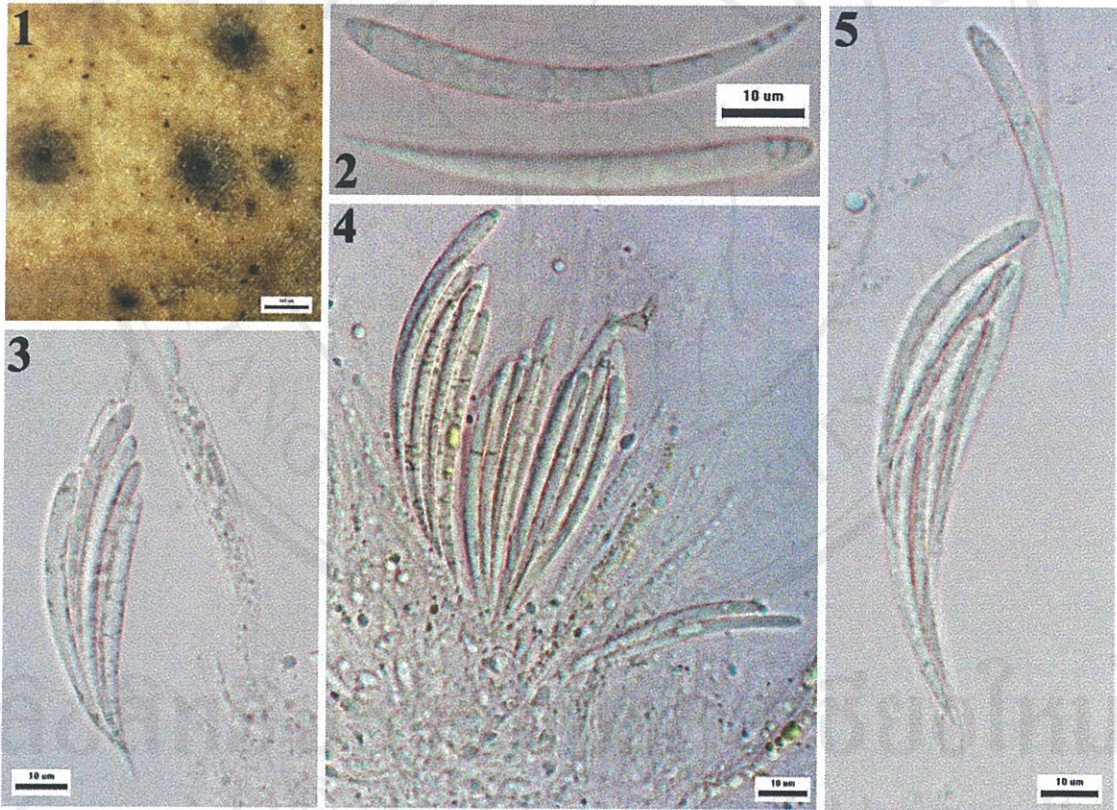


Figure 4.21 *Linocarpon lammliae*. 1. Stromata on host surface. 2. Ascospores. 3-5. Asci and paraphyses. Scale bars: 1 = 500 μm; 2-5 = 10 μm.

Linocarpon siamensis Thongkantha, sp. nov.

Figure 4.22

Stroma raised, shiny, dome-shaped, developing beneath brown or black spots on the host surface, 575–825 × 650–875 μm, with a minute central black dot, solitary, ascoma pigmentation variable, sometimes being black and shiny, sometimes non-

pigmented, in vertical section 850–950 μm wide, 140–240 μm high, hemispherical, with a flattened base. **Ostiole** central, raised, stromatised. **Clypeus** variable, surrounding the ostiolar papillae, lenticular. Peridium thin, comprising a few layers of brown-walled, compressed cells. **Paraphyses** 3.1–12.3 μm at the widest point, filamentous, smooth, septate, apex broadly rounded or obtuse, flexuous, hyaline, tapering towards the apex, surrounded by a gelatinous matrix. **Asci** 100–156 \times 7.7–9.3 μm , 8-spored, cylindrical, pedicellate, rounded or truncate apex, with a J- ring. **Ascospores** 59–71 \times 3.1–3.3 μm , arranged in a single overlapping fascicle, filiform, hyaline, often slightly curved or straight, containing numerous refringent, septum-like bands, gelatinous cap-like or pad-like appendages at both ends (Figure 4.22).

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus penetrans*, Thailand.

Specimens examined: THAILAND, Chiang Mai, Doi Suthep-Pui National Park, on decaying leaves of *Pandanus penetrans*, 21 July 2001, *S. Thongkantha PQ 010*, PDD 74300 (holotype); 31 July 2001, *S. Thongkantha PQ 010/1*, PDD 74301.

Notes: *Linocarpon siamensis* is characterized by filiform ascospores, with pad-like appendages at both ends. A similar species, *L. appendisporum*, is differentiated from *L. siamensis* by the morphology of the mucilaginous appendages. Other species of this genus with blunt appendages at each end are *L. breve* K.D. Hyde, *L. pandanicola* and *L. zingiberacicola* K.D. Hyde. The ascospores of *L. siamensis* are longer than *L. breve* (34–45 \times 2.2–2.6 μm), but shorter than those of *L. pandanicola* (72–100 \times 2.6–3.2 μm) and *L. zingiberacicola* (102–120 \times 2.4–3 μm). *Linocarpon alpiniae* K.D. Hyde, *L. clavatum* K.D. Hyde and *L. falciformisporum* have similar shaped ascospores to *L. siamensis*, but are shorter and slightly wider (*L. alpiniae* 56–64 \times 3.5–4.5 μm , *L. clavatum* 33–42 \times 2.5–4.5 μm , *L. falciformisporum* 41–45 \times 4–5.5 μm) and each have a minute mucilaginous appendage, evident at only one end of the ascospore (Table 4.1).

Linocarpon suthepensis Thongkantha, sp. nov.

Figure 4.23

Stroma slightly raised, grayish-black areas 300–485 μm diam, with pronounced black papilla, typically gregarious; in vertical section 500–650 μm wide, 162–280 μm high, lenticular, black, developing deep inside leaf tissues. **Ostiole** central, raised. **Clypeus** lenticular. **Peridium** thin, comprising a few layers of brown-walled compressed cells. **Paraphyses** 4.6–7.7 μm at the widest point, filamentous, smooth, septate, obtuse, flexuous, hyaline, tapering towards the apex. **Asci** 77–92.5 \times 6.1–7.7 μm , 8-spored, cylindrical, pedicellate, apex rounded or truncate, with a J-apical ring. **Ascospores** 18.5–30.8 \times 2.3–3.1 μm , multiseriate, cylindrical, hyaline, straight or slightly curved, often containing numerous refringent septum-like bands, with a basal, arrow-like appendage.

Habitat/Known distribution: Known to inhabit decaying leaves of *Pandanus penetrans*, Thailand.

Specimen examined: THAILAND: Chiang Mai, Doi Suthep Pui National Park, in rainforest, on dead leaves of *Pandanus penetrans*, 21 July 2001, *S. Thongkantha PQ 011*, PDD 74602 (holotype); 31 July 2001, *S. Thongkantha PQ 011/1*, PDD 74416; 19 Jan 2003, *S. Thongkantha S044-HKM*.

Notes: *Linocarpon suthepensis* is characterized by short ascospores that have a round apex with an arrow-like appendage at the base. Other species of *Linocarpon* with short ascospores and an appendage at only one end are *L. clavatum* and *L. falciformisporum*. *Linocarpon suthepensis* differs in having shorter ascospores (*L. clavatum* 33–42 \times 2.5–4.5 μm , *L. falciformisporum* 41–45 \times 4–5.5 μm) and for *Linocarpon* species, a unique appendage morphology. Appendages of *L. clavatum* and *L. falciformisporum* are mucilaginous and veil-like, respectively. Ascospores of *L. suthepensis* are shorter than *L. appendisporum* (60–76 μm) and *L. breve* (34–45 μm), which have appendages at both ends of the ascospores (Table 4.1).

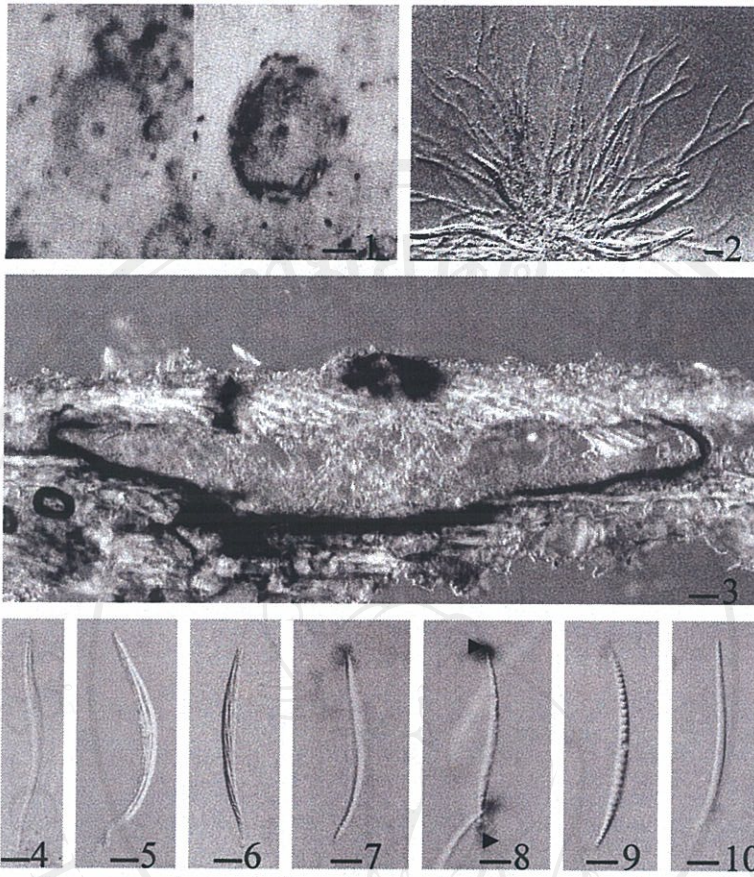


Figure 4.22 *Linocarpon siamensis* (from holotype). 1. Stromata on host surface. 2. Paraphyses. 3. Section of stroma. 4-6. Asci. 7-10. Ascospores. Note the bipolar appendages (arrowed). Scale bars: 1, 2 = 200 μm ; 3 = 20 μm ; 4-6 = 20 μm ; 7-10 = 10 μm .

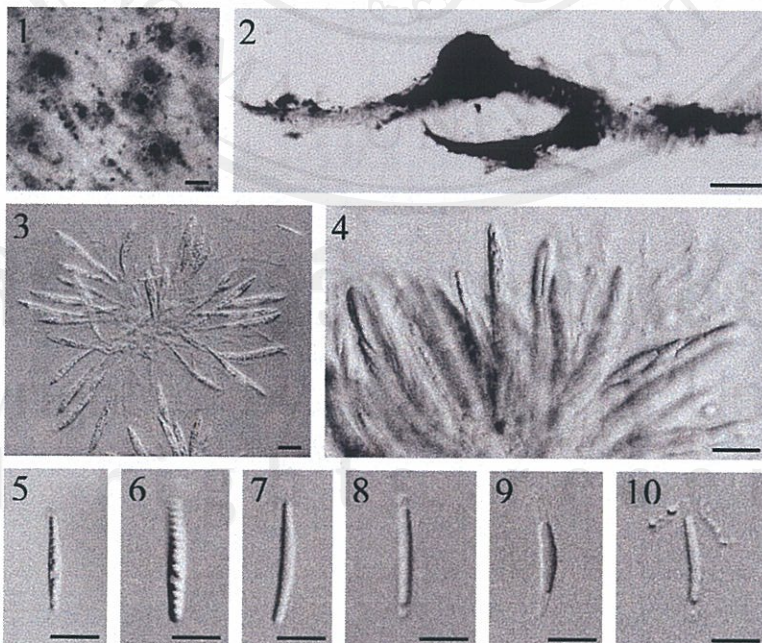












Figure 4.23 *Linocarpon suthepensis* (from holotype). 1. Stromata on host surface. 2. Section of stroma. 3. Asci and paraphyses. 4. Asci with J- apical ring. 5-10. Ascospores. Note the apical appendages. Scale bars: 1 = 200 μm ; 2 = 100 μm ; 3 = 20 μm ; 4-10 = 10 μm .

Table 4.1 Synopsis of ascospore and appendages of *Linocarpon* spp. for comparison with new taxa (Thongkantha *et al.*, 2003).

<i>Linocarpon</i> spp.	Host	Ascospore size (μm)	Ascospore shape	Appendage form
<i>L. alpiniae</i> K.D. Hyde	<i>Alpinia</i> sp.	56-64 × 3.5-4.5		minute drop, at both ends
<i>L. appendisporum</i> K.D. Hyde	<i>Pandanus</i> sp.	60-76 × 2.8-4		mucilage which spread in water, at both ends
<i>L. breve</i> K.D. Hyde	<i>Pandanus</i> sp.	34-45 × 2.2-2.6		collar-like, at both ends
<i>L. clavatum</i> K.D. Hyde	<i>Pinanga</i> sp. and <i>Eugeissona</i> sp.	33-42 × 2.5-4.5		mucilaginous appendage, at one end
<i>L. falciformisporum</i> K.D. Hyde	<i>Pandanus</i> sp.	41-45 × 4-5.5		veil-like, at one end
<i>L. lammiae</i> Whitton	<i>P. tectorius</i>	53-76 × 4.5-7		absent
<i>L. pandanicola</i> K.D. Hyde	<i>Pandanus</i> sp.	72-100 × 2.6-3.2		small pad, at both ends
<i>L. siamensis</i> Thongkantha	<i>P. penetrans</i>	59-71 × 3.1-3.3		cap-like or a pad-like, at both ends
<i>L. suthepensis</i> Thongkantha	<i>P. penetrans</i>	18.5-30.8 × 2.3-3.1		arrow-like, at one end
<i>L. zingiberacicola</i> K.D. Hyde	Unidentified Zingiberaceae	102-120 × 2.4-3		mucilage, at both ends

Scale bars = 10 μm

KEY TO SPECIES OF *LINOCARPON* KNOWN FROM THE PANDANACEAE

(Thongkantha *et al.*, 2003).

1. Ascospores cylindrical or filiform4
1. Ascospores swollen towards the apex, tapering to a narrow base2
 2. Ascospores 76–107 x 3–4 μm , basal appendage 3–4.5 x 1–1.5 μm ; asci 92–170 x 12–20 μm , cylindrical *L. sulcatum*
 2. Ascospores wider3
3. Ascospores 66–89 x 4–6 μm , short (6 x 2 μm) gelatinous appendage at base; asci 110–170 x 12–16 μm , cylindrical *L. spathulatum*
3. Ascospores 53–76 x 4.5–7 μm , appendages absent; asci 97–133 x 13.5–26 μm , clavate *L. lammiae*
4. Ascospores < 60 μm long5
4. Ascospores > 60 μm long8
5. Ascospores with appendages6
5. Ascospores 28–32 x 2.5–3 μm , appendages absent; asci 54–82 x 7–10 μm , cylindric-clavate *L. freycinetiae*
6. Ascospores 34–45 x 2.2–2.6 μm , collar-like appendage at each end; asci 104–138 x 4.5–6 μm , cylindrical *L. breve*
6. Ascospore appendages basal, never bipolar7
7. Ascospores 33–42 x 2.5–4.5 μm , mucilaginous appendage, becoming sickle-shaped or veil-like in water; asci 112–140 x 8–10 μm , cylindrical *L. falciformisporum*
7. Ascospores 18.5–31 x 2.3–3.1 μm , arrow-like appendage; asci 77–92.5 x 6.1–7.7 μm , cylindrical *L. suthepensis*
8. Ascospore appendages absent9
8. Ascospore appendages bipolar or basal10
9. Ascospores 62–80 x 2–4 μm ; asci 100–140 x 8–10 μm , cylindrical *L. pandani*
9. Ascospores 84–110 x 2.5–3.5 μm ; asci 110–178 x 8–14 μm cylindrical *L. fasciatum*
10. Ascospore appendages basal11
10. Ascospore appendages bipolar12
11. Ascospores 70–104 x 1.6–2.3 μm , appendage mucilaginous; asci 100–140 x 6–12 μm , cylindrical *L. livistonae*
11. Ascospores 72–97 x 3–4 μm , appendage mucilaginous; asci 116–148 x 9–13 μm , cylindrical *L. elaeidis*
12. Ascospore 72–100 x 2.6–3.2 μm , appendages pad-like; asci 160–190 x 8–10 μm , cylindrical *L. pandanicola*
12. Ascospores typically shorter13
13. Ascospores 59–71 x 3.1–3.3 μm , appendages pad-like; asci 100–156 x 7.7–9.3 μm , cylindrical *L. siamensis*
13. Ascospores 60–76 x 2.7–4 μm , appendages gelatinous, spreading in water; asci 100–150 x 8–10 μm , cylindrical *L. appendisporum*

Melanochaeta* (*Sporoschisma* Berk. & Broome)*(Chaetosphaeriaceae: Sordariales)****Type species:** *Melanochaeta hemipsila* (*Sporoschisma mirabile* Berk. & Broome).**References:** Goh *et al.*, 1997; Fröhlich and Hyde, 2000; Hyde *et al.*, 2000.

Ascomata superficial, globose, coriaceous, brown-black, covered with hairs or capitate hyphae, solitary. **Ostiole** central, papillate, periphysate. **Paraphyses** up to 4 µm wide, hypha-like. **Asci** cylindrical or cylindric-clavate, unitunicate with a J-discoid, refractive apical ring. **Ascospores** overlapping uniseriate or biseriate, fusiform or broadly cylindrical, central cells brown, end cells hyaline or pale brown.

Conidiophores macronematous, darkly pigmented, flask shaped with a swollen venter. **Conidia** in chain, pigmented, often vesicoloured, 1-5 septate, thick walled and smooth or verruculose. **Sterile setae** sometimes present.

Melanochaeta is similar to *Chaetosphaeria*, but differs in the swollen apices of its setae, the brown pigmentation of its ascospores and *Sporoschisma* anamorph. *Sporochisma* has similarities to *Sporoschismopsis*. *Sporoschisma mirabile* and its teleomorph in name *Chaetosphaeria aotearoae* (*M. aotearoae*) were described from wood and bark of *Freycinetia banksii* (McKenzie and Hyde, 1996). *Sporoschisma nigroseptatum* was reported to occur on *Pandanus tectorius* from Japan and Hong Kong, *P. furcatus* and *P. nepalensis* from Hong Kong by Whitton (1999).

***Melanochaeta hemipsila* (*Sporoschisma saccardoii* E.W. Mason & Hughes)**

Figure 4.24

Ascomata 384 µm diam, setose, black. **Asci** 135-187.5 × 12.5-16.6 µm. **Ascospores** 31-53.7 × 5.1-8.5 µm, 3-5 septate, olivaceous, brown when matured, with hyaline at both end cells. **Conidia** 38.1-41.8 × 8.6-12.5 µm, 5 septate, brown.

Habitat/Known distribution: Known to inhabit dead plant material, including wood from tropic countries (Hyde *et al.*, 2000); decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dead leaves of *Pandanus penetrans*, 3 October 2003, *S. Thongkantha S027-1*, CMU 26644; *S. Thongkantha S027-2*, CMU 26645; 20 July 2003; *S. Thongkantha S158-1*, CMU 26821; *S. Thongkantha S158-2*, CMU 26822; *S. Thongkantha S158-3*, CMU 26823.

Notes: The general characteristic of the present collections from *Pandanus penetrans* leaves have no taxonomically significant different with the description for *Melanochaeta hemipsila* and its anamorph (*Sporochisma saccardoii*) that reported by Goh *et al.* (1997).

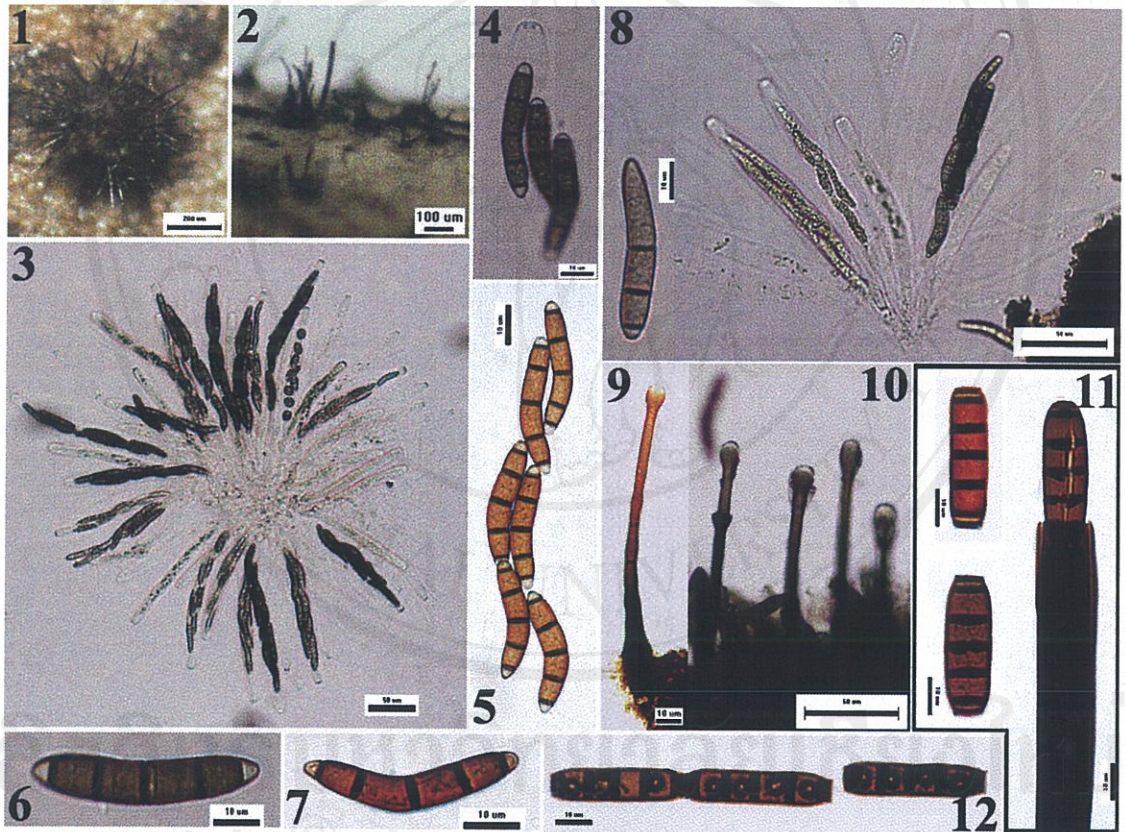


Figure 4.24 1-8. *Melanochaeta hemipsila*. 1-2. Appearance of ascomata and *Sporochisma* anamorph on the host surface. 3, 8. Asci and paraphyses. 4. Apical ring. 5-7. Ascospores. 9-12. *Sporochisma saccardoii* 9-10. Setae. 11. Conidiophore and conidia. 12. Conidia. Scale bars: 1 = 200 μm ; 2 = 100 μm ; 3, 10 = 50 μm ; 4-9, 11-12 = 10 μm .

Microthyrium* Desm.*(Microthyriaceae: Dothideales)*****Type species:* *Microthyrium microscopicum* Desm.*****References:* Hyde *et al.*, 2000.**

Ascomata flattened (thyriothecium), superficial. **Asci** 8-spored, oblong or obclavate, bitunicate with a narrow ocular chamber. **Ascospores** overlapping biseriate, ellipsoid-fusoid, 2-celled, euseptate, hyaline, smooth, with narrow appendages or cilia from the tip and/or mid regions.

Microthyrium is similar to *Micropeltis* and *Seynesiella*, but ascospores are brown in *Seynesiella*, and in *Micropeltis* the appendages are subapical and lateral and the ascomata have a 'basal' plate. *Microthyrium* species are saprobic on leaves, cones, twigs or herbaceous substrates. This genus is widespread comprising at least 50 species. No new species of *Microthyrium* have been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002).

***Microthyrium* sp. 1**

Figure 4.25

Ascomata 150-208 μm diam. **Asci** 28-33.6 \times 6.8-8.2 μm . **Ascospores** 8.7-11.2 \times 1.9-2.6 μm .

Habitat/Known distribution: Known to inhabit decaying leaves of *Dracaena lourieri*, Thailand.

Specimen examined: THAILAND: Chiang Mai Province, Chiang Dao, Chiang Dao National Park, in rainforest at Ban Thum Village, on dead leaves of *Dracaena lourieri*, 12 July 2002, S. Thongkantha S007-1, CMU 26629; S007-2.

***Microthyrium* sp. 2**

Figure 4.26

Ascomata 304 μm diam. **Asci** 66.7-90.7 \times 8.9-10.7 μm . **Ascospores** 20-22.2 \times 4.4-5 μm .

Habitat/Known distribution: Known to inhabit dead leaves of *Pandanus penetrans*, Thailand.

Specimen examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 19 January 2003, *S. Thongkantha* S048-1, CMU 26630; S048-2; 30 August 2003, *S. Thongkantha* S048-3, CMU 26672; S048-4.

Notes: The general characteristic of these fungi from *Pandanus penetrans* leaves fit the description for *Microthyrium* (Hyde *et al.*, 2000). Because it is a large genus and insufficient references are available to distinguished, I cannot isolate them to species level.

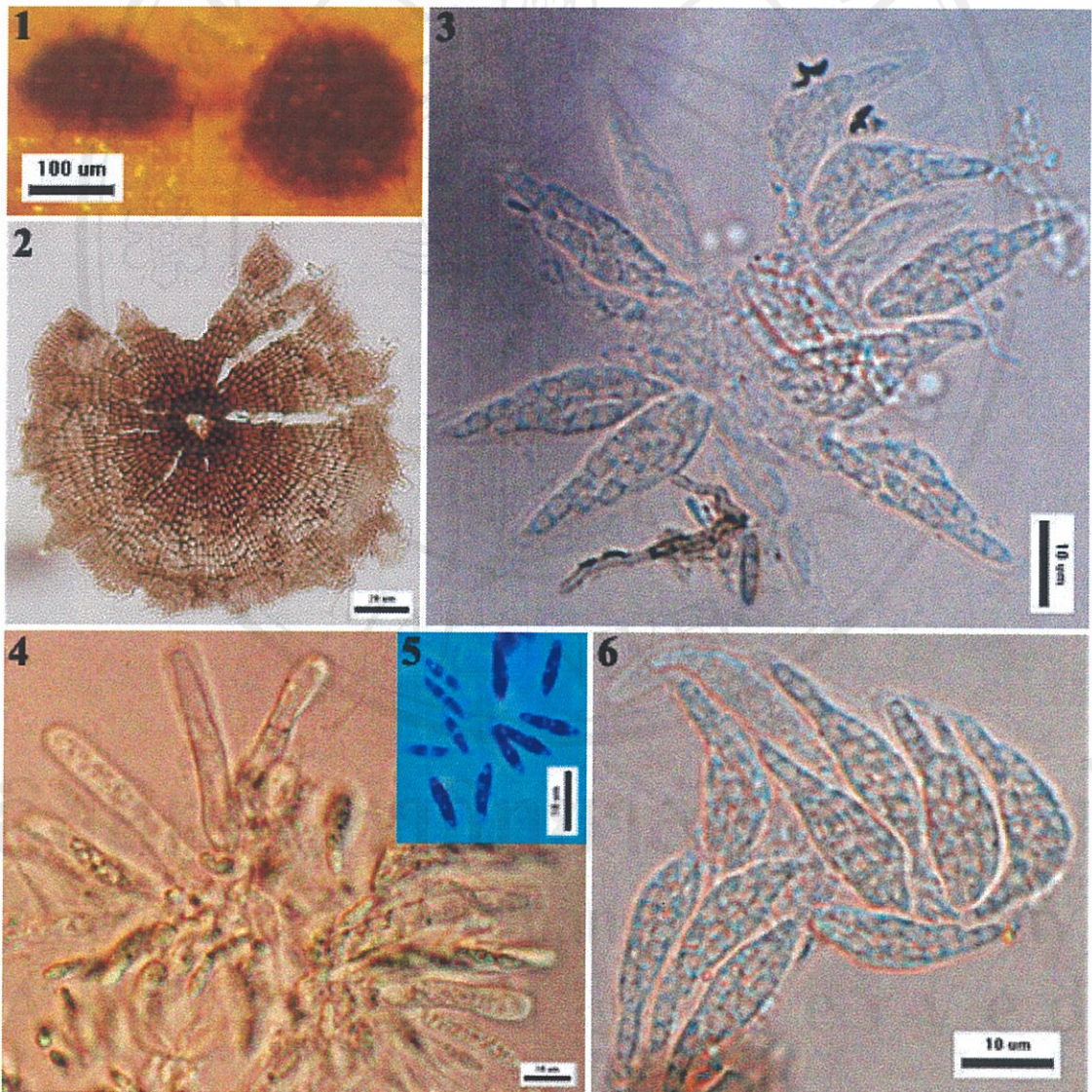


Figure 4.25 *Microthyrium* sp. 1. 1. Appearance of ascomata on the host surface. 2. Ascoma. 3-4, 6. Asci. 5. Ascospores. Scale bars: 1 = 100 µm; 2 = 20 µm; 3-6 = 10 µm.

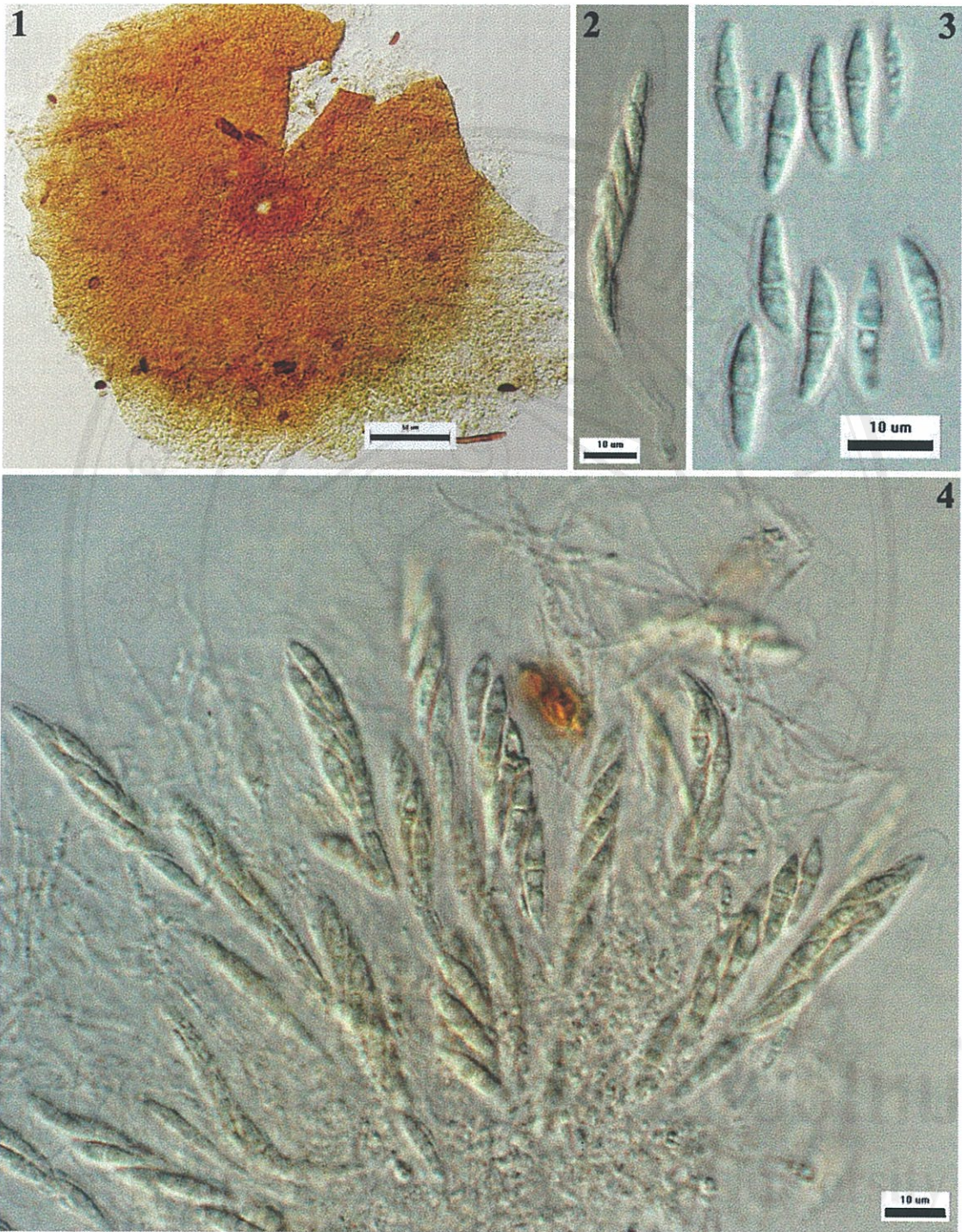


Figure 4.26 *Microthyrium* sp. 2. 1. Ascoma. 2. Ascus. 3. Ascospores. 4. Asci and pseudoparaphyses. Scale bars: 1 = μm 50; 2-4 = 10 μm .

Ophioceras Sacc.

(Magnaporthaceae: Order Incertae Sedis)

Type species: *Ophioceras dolichostomum* (Berk. & M.A. Curtis) Sacc.

References: Teng, 1934; Conway and Barr, 1977; Walker, 1980; Shearer 1989; Hyde, 1992b; Hanlin, 1998; Shearer *et al.*, 1999; Fröhlich and Hyde, 2000; Hyde *et al.*, 2000; Tsui *et al.*, 2001.

Ascomata solitary or gregarious, immersed or superficial, globose, subglobose or ellipsoidal, typically with long necks, carbonaceous, brown or black. **Necks** brittle, composed of textura intricata with hyphae arranged in rows and fanning out obliquely. **Peridium** thick, blackened except at the apex of the necks, composed of textura angularis. **Paraphyses** broad at the base, hypha-like, tapering distally, apically free, and not embedded in gelatinous matrix. **Asci** unitunicate with a J-, thimble-shaped subapical ring, cylindrical, 8-spored. **Ascospores** hyaline singly or light yellowish-brown in mass, filiform, multi-celled, euseptate.

Based on morphological characters *Ophioceras* is similar to *Pseudohalonestria* (Shearer 1989; Hyde *et al.*, 1999c; Tsui *et al.*, 2001). These two genera often occur in aquatic habitats and dead plant material (Luo *et al.*, 2004; Tsui and Hyde, 2004). *Ophioceras* differs from *Pseudohalonestria* in having dark brown to black membranous ascomata (Hanlin, 1998; Hyde *et al.*, 2000). In both genera, asci become detached from the ascogenous hyphae and lie free in the ascomatal cavities. The phylogenetic relationships of these genera with other member of Magnaporthaceae have been investigated and results are reported in chapter 5.

Most of approximately 30 species of *Ophioceras* are saprobes and known from various habitats (Table 4.2). No species of *Ophioceras* have previously been described or reported from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002). During the current study one undescribed species of *Ophioceras* inhabited decaying leaves of *Dracaena lourieri*. The new species is described and illustrated.

Table 4.2 Species of *Ophioceras* found on various habitats.

Species of <i>Ophioceras</i>	Habitat	References
<i>Ophioceras arcuatissporum</i> Shearer, J.L. Crane & W. Chen	Fresh water	Shearer <i>et al.</i> (1999)
<i>O. bambusae</i> Hohn	-	<i>Saccardo's Syll. fung.</i> 22: 306
<i>O. cecropiae</i> E. Müll.	-	<i>Index of Fungi</i> 3: 362
<i>O. commune</i> Shearer, J.L. Crane & W. Chen	Fresh water	Shearer <i>et al.</i> (1999)
<i>O. corni</i> Richon	-	<i>Saccardo's Syll. fung.</i> 20: 242; 22: 307
<i>O. diaphoroides</i> Sacc. & Paol.	-	<i>Saccardo's Syll. fung.</i> 9: 938 (1891); 15: 233; 20: 242
<i>O. dolichostomum</i> (Berk. & M.A. Curtis) Sacc.	<i>Quercus</i> sp. wood, submerged wood	Conway and Barr (1977), Hyde (1992b)
<i>O. friesii</i> (Mont.) Sacc.	-	<i>Saccardo's Syll. fung.</i> 2: 359 (1883)
<i>O. fusiforme</i> Shearer, J.L. Crane & W. Chen	Fresh water	Shearer <i>et al.</i> (1999)
<i>O. guttulatum</i> K.M.Tsui, H.Y.M.Leung, K.D. Hyde & Hodgkiss	Submerged wood	Tsui <i>et al.</i> (2001)
<i>O. hongkongense</i> K.M.Tsui, H.Y.M.Leung, K.D. Hyde & Chen	Submerged wood	Tsui <i>et al.</i> (2001)
<i>O. hyptidis</i> Henn.	-	<i>Saccardo's Syll. fung.</i> 11: 353; 12: 482; 17: 852
<i>O. hystrix</i> (Ces.) Sacc.	-	<i>Saccardo's Syll. fung.</i> 2: 359 (1883)
<i>O. indicus</i> S.P. Lal	-	<i>Kavaka</i> 15:7 (1989)
<i>O. leptosporum</i> (S.H. Iqbal) J. Walker	Submerged wood	Walker (1980)
<i>O. longisporum</i> (Ellis) Sacc.	-	<i>Saccardo's Syll. fung.</i> 2: 360 (1883); 12: 482.
<i>O. macrocarpum</i> (Sacc.) Sacc.	-	<i>Saccardo's Syll. fung.</i> 2: 359; XII: 482.
<i>O. majusculum</i> Penz. & Sacc.	-	<i>Saccardo's Syll. fung.</i> 14: 616 (1897); 20: 242.
<i>O. miyazakiense</i> Matsush.	-	<i>Index of Fungi</i> 7: 439
<i>O. ohiense</i> Ellis & Everh.	-	<i>Saccardo's Syll. fung.</i> 11: 353; 12: 482
<i>O. palmae</i> K.M.Tsui, H.Y.M.Leung K.D. Hyde & Hodgkiss	Saprophyte of palm	Tsui <i>et al.</i> (2001)
<i>O. parasiticum</i> Teng	On <i>Xylaria</i> , <i>Hypoxilon</i>	Teng (1934)
<i>O. petrakii</i> Tilak, S.B. Kale & S.V.S. Kale	Parasite of <i>Boerlagella</i>	Tilak, S.B. Kale & S.V.S. Kale (1969)
<i>O. sambuci</i> Pass.	-	<i>Saccardo's Syll. fung.</i> 9: 938 (1981); 12: 482
<i>O. sorghi</i> Sacc.	-	<i>Index of Fungi</i> 2: 195
<i>O. tambopataense</i> Matsush.	-	<i>Index of Fungi</i> 7: 439
<i>O. tenuisporum</i> Shearer, J.L. Crane & W. Chen	Fresh water	Shearer <i>et al.</i> (1999)
<i>O. therryanum</i> (Sacc. & Roum.) Sacc.	-	<i>Saccardo's Syll. fung.</i> 2: 360 (1883); 12: 482; 20: 242
<i>O. tjibodense</i> Penz. & Sacc.	-	<i>Saccardo's Syll. fung.</i> 14: 617; 15: 233
<i>O. venezuelense</i> Shearer, J.L. Crane & W. Chen	Fresh water	Shearer <i>et al.</i> (1999)
<i>O. zeae</i> Saccas	-	<i>Index of Fungi</i> 2: 84 (1951-60)

Ophioceras chiangdaoensis Thongkantha, Lumyong & K.D. Hyde, sp. nov.

Figure 4.27

Ascomata 200-310 × 170-310 μm, globosa to subglobose, paraphysata. Asci 84.8-125 × 11-17 μm (\bar{x} = 100 × 14, n = 30), octospori, cylindrici, apedicellati. Ascospores 54-75.6 × 3.9-5.4 μm (\bar{x} = 60.2 × 4.3, n = 30), multiseriatae, filiformes, fusoideae, 3-septatae, hyalinae.

Etymology: In reference to Chiang Dao National Park, where the specimens were collected.

Holotype: (here designated): CMU 26633, Thailand.

Ascomata 200-310 × 170-310 μm, globose to subglobose. **Neck** 93-273 × 52-68 μm, central, cylindrical, pale brown to black and hyaline at the apex. **Peridium** thin, comprising a few layers of dark brown to black-walled compressed cells. **Paraphyses** hyaline, 13–16.9 μm at the widest point, filamentous, smooth, septate, obtuse. **Asci** 84.8-125 × 11-17 μm (\bar{x} = 100 × 14, n = 30), 8-spored, cylindrical, apedicellate, apex rounded or truncate, with a J- subapical ring. **Ascospores** 54-75.6 × 3.9-5.4 μm (\bar{x} = 60.2 × 4.3, n = 30), multiseriate, filiform, fusoid at both ends and typically 3-septate, both ends are slightly broader immediately above and below each septum, hyaline, straight to slightly curved.

Habitat/Known distribution: Known to inhabit decaying leaves of *Dracaena loureiri*, Thailand.

Specimens examined: THAILAND: Chiang Mai, Chiang Dao National Park, in rainforest, on dead leaves of *Dracaena lourieri*, 12 July 2002, S. Thongkantha S011-1, CMU 26633 (holotype); S011-2, CMU 26634; 1 November 2005, S. Thongkantha S011-3, CMU 26887; S011-4, CMU 26888.

Notes: *Ophioceras chiangdaoensis* is characterized by short ascospores which are slightly wider and truncate at both ends. Other species of *Ophioceras* with short ascospores are *O. commune*, *O. fusiforme*, *O. leptosporum*, *O. palmae*, *O. parasiticum* and *O. tenuisporum*, but all of them have the narrower ascospores (Figure 4.27-4.28,

Table 4.3). *Ophioceras chiangdaoensis* differs from previously described species in ascospore shape. The ascospores of *O. chiangdaoensis* and *O. tenuisporum* are similar in length and are 4-celled but in *O. chiangdaoensis* ascospores are broader (66-94 × 1-1.5 μm vs. 54-75 × 3.9-5.4 μm) (Shearer *et al.*, 1999).

Table 4.3 A comparison of *Ophioceras chiangdaoensis* with some other previous described species.

<i>Ophioceras</i> species (References)	Ascomata (μm)	Asci (μm)	Ascospores (μm)	Ascospore septation
<i>O. arcuatissporum</i> (Shearer <i>et al.</i> , 1999)	313-324 × 252-340	276-307 × 15-20	170-239 × 4-7	5-12
<i>O. chiangdaoensis</i> sp. nov. (this study)	200-310 × 170-310	85-125 × 11-17	54-75 × 3.9-5.4	3
<i>O. commune</i> (Shearer <i>et al.</i> , 1999)	150-350 × 260-400	64-118 × 4-12	50-110 × 2	3-7
<i>O. dolichostomum</i> (Conway & Barr, 1977)	500 diam.	100-130 × 8-12	94-110 × 2-3	3-7
<i>O. fusiforme</i> (Shearer <i>et al.</i> , 1999)	360-500 × 330-450	70-112 × 6-12	64-104 × 1.5-3	3-5
<i>O. guttulatum</i> (Tsui <i>et al.</i> , 2001)	400-600 × 1200- 1800	130-160 × 14-17	100-128 × 4-5	3-5
<i>O. hongkongense</i> (Tsui <i>et al.</i> , 2001)	500-640 × 700-800	100-125 × 12-14	72-101 × 3.5- 4.5	3-6
<i>O. leptosporum</i> (Shearer <i>et al.</i> , 1999)	250-300 diam.	70-95 × 5-6	70-80 × 1-1.5	3-7
<i>O. palmae</i> (Tsui <i>et al.</i> , 2001)	164-320 × 244-288	76-96 × 10-14	79-90 × 3-4	5
<i>O. parasiticum</i> (Teng, 1934)	600-800 diam	100-140 × 9-11	48-70 × 2.5-3.3	3-9
<i>O. tenuisporum</i> (Shearer <i>et al.</i> , 1999)	240-625 × 260-775	82-114 × 4-6	66-94 × 1-1.5	3
<i>O. venezuelense</i> (Shearer <i>et al.</i> , 1999)	730-890 × 745-868	148-180 × 11-18	130-158 × 2-4	5

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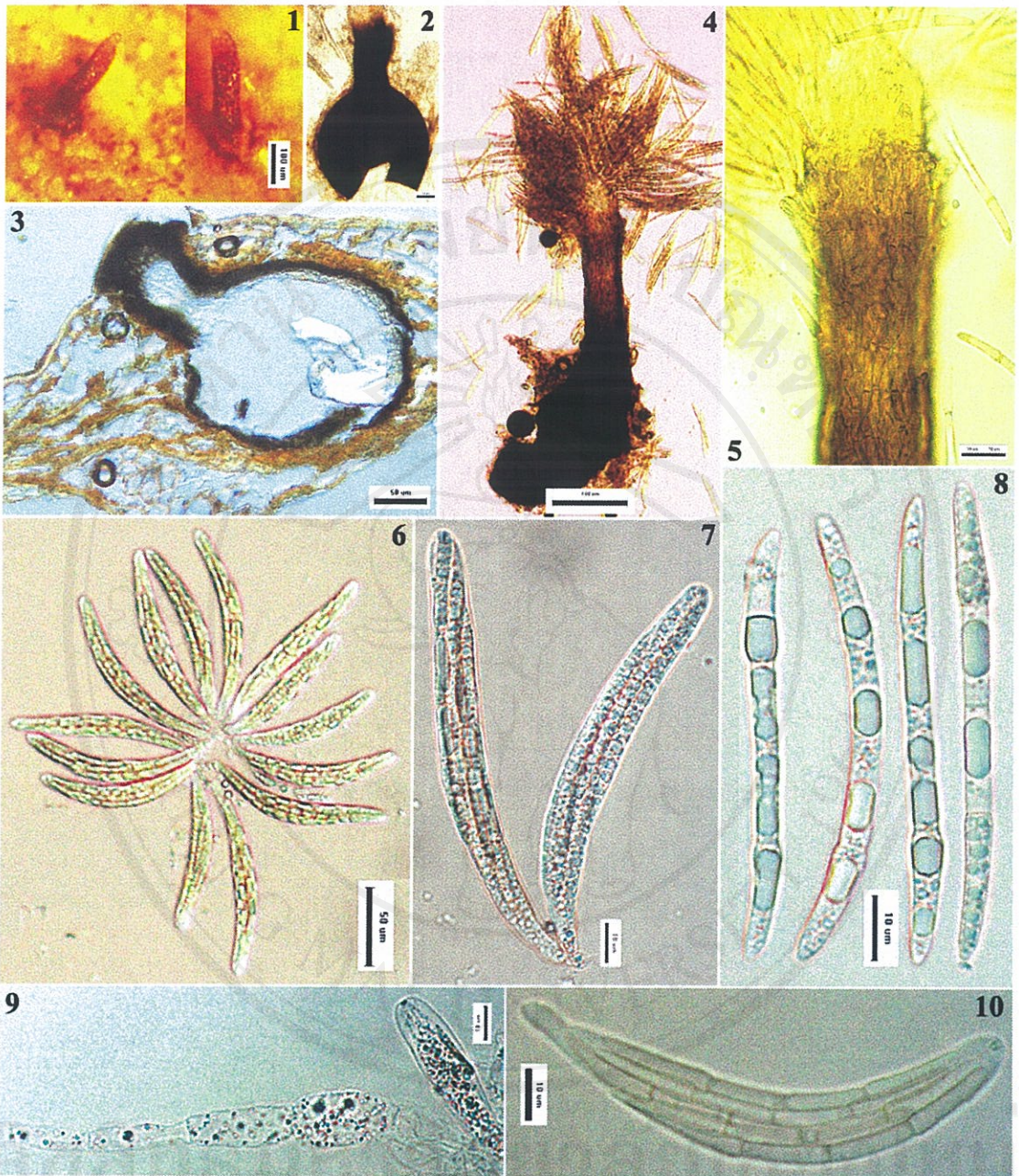


Figure 4.27 *Ophioceras chiangdaoensis* (from holotype). 1. Appearance of ascomata on the host surface. 2, 4. Ascomata. 3. Section of ascoma. 5. Beak walled. 6-7, 10. Asci. 8. Ascospores. 9. Paraphysis. Scale bars: 1, 4 = 100 µm; 2-3, 6 = 50 µm; 5 = 20 µm; 7-10 = 10 µm.

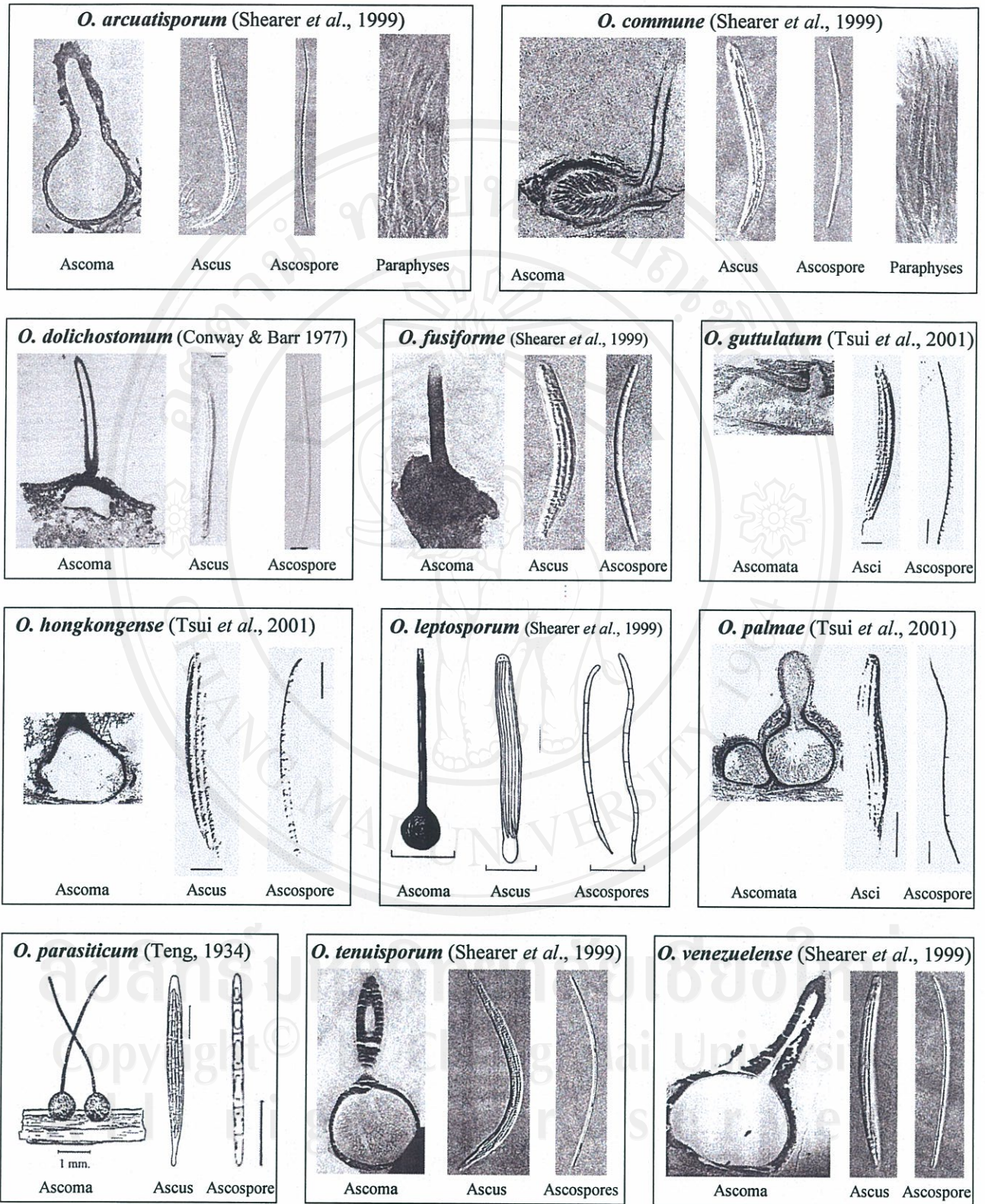


Figure 4.28 Some species of *Ophioceras* described by Conway and Barr (1977), Shearer *et al.* (1999), Teng (1934) and Tsui *et al.* (2001).

Ornatispora K.D.Hyde, Goh, J.E. Taylor & J. Fröhl.

(Unitunicate ascomycetes: Incertae Sedis)

Type species: *Ornatispora gamsii* K.D.Hyde, Goh, J.E. Taylor & J. Fröhl.

References: Hyde *et al.*, 1999b, 2000; Dulymamode *et al.*, 2001b.

Ascomata superficial, globose, collabent when dry, coriaceous, black, lacking or covered in numerous setae. **Papilla** short, long, black, shiny, periphysate. **Peridium** thin comprising several layers of cells with thin, dark brown walls, which are irregular in shape, and arranged in a textura angularis. **Paraphyses** filiform, aseptate, flexuous, deliquescent in dried material. **Asci** clavate, pedicellate, lacking an apical apparatus, deliquescent at maturity. **Ascospores** 2-3-seriate, ellipsoidal, 2-celled, euseptate, hyaline, wall verrucose and surrounded by a mucilaginous sheath.

Ornatispora was introduced to accommodate rather unusual fungi from palm (Hyde *et al.*, 1999). The most similar genera to the genus are including *Bertia*, *Chaetosphaeria* and *Niesslia*. *Ornatispora punctata* Dulymamode, P. Cannon, K.D. and Peerally has been described from dead leaves of *Pandanus rigidifolius* and *P. barklyi* (Dulymamode *et al.*, 2001b).

Ornatispora sp. nov.

Figure 4.29

Ascomata 181 × 143 μm. **Asci** 50-66 × 9-12 μm (\bar{x} = 62 × 10 μm, n = 10).

Ascospores hyaline, 1-septate, ellipsoidal and 13-16 × 2.9-3.7 μm (\bar{x} = 14 × 3.1, n = 15). **Paraphyses** 6.8-7.8 μm at the widest.

Habitat/Known distribution: Known to inhabit dead leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 20 July 2003, *S. Thongkantha S159-1*, CMU 26824; *S. Thongkantha S159-2*, CMU 26825.

Notes: The general characteristic of the present specimens agree with the description for species of *Ornatispora*, and its ascospores are smaller than any species that reported by Hyde *et al.*, (1999b, 2000) and Dulymamode *et al.*, (2001b).

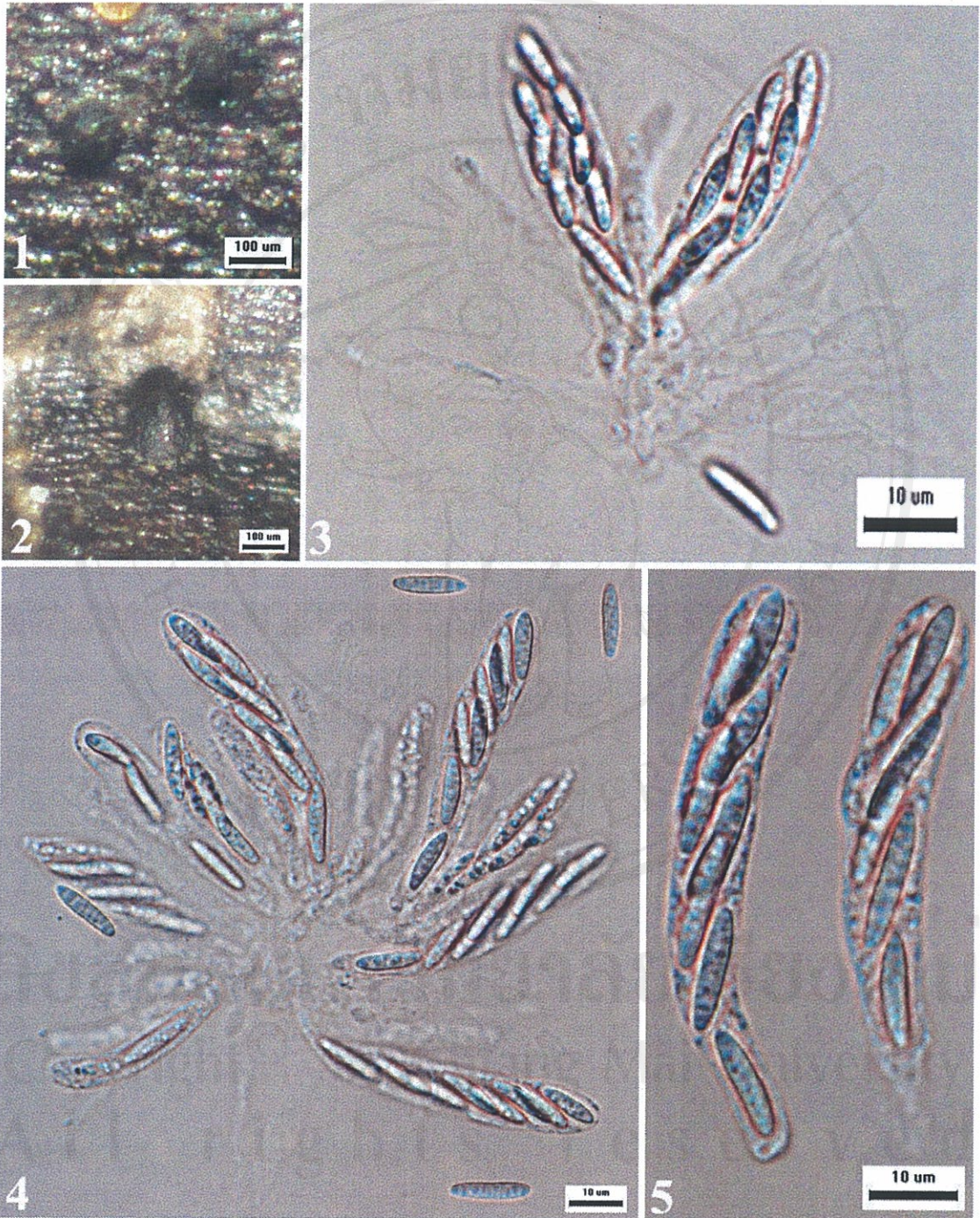


Figure 4.29 *Ornatispora* sp. 1-2. Appearance of ascomata on the host surface. 3. Asci and paraphyses. 4-5. Asci. and ascospores. Scale bars: 1-2 = 100 µm; 3-5 = 10 µm.

Oxydothis Penz. & Sacc.

(Hyponectriaceae?: Familia Incertae Sedis)

Type species: *Oxydothis grisea* Penz. & Sacc.

References: Hyde, 1993a, b, 1994; Fröhlich and Hyde, 1994, 2000; Hyde *et al.*, 2000; Whitton, 1999.

Ascomata immerse in pseudostroma, of two types, 1) ascomata develop in darkened, raised areas on the host surface with distinct eccentric ostiole; 2) ascomata develop below the raise epidermis which is usually darkened. **Asci** cylindrical, pedicellate, unitunicate with a J+ subapical apparatus (occasionally J-). **Ascospores** fusiform or filiform, 1-septate, hyaline, acute ends, and drawn out at both ends to form attenuated.

Oxydothis is a large genus especially from palm, comprising 66 species (Hyde, 1993a, b; 1994; Fröhlich and Hyde, 1994, 2000). *Oxydothis pandani* and *O. pandanicola* have been described from *Pandanus* (McKenzie and Hyde, 1996). Whitton (1999) reported *O. acutata* on decaying leaves of *Orania* sp., *P. polycephaloides* and *Pandanus* sp. from the Philippines. *Oxydothis elaeidis* is also known to inhabit decaying leaves of *Elaeis* sp., *Freycinetia banksii* and *P. tectorius* in Hong Kong, New Zealand and Zaire (Hyde, 1994; Whitton, 1999).

Oxydothis linospadicis Mason & Hughes

Figure 4.30 (1-3)

Ascomata 184.6-261.5 μm diam. **Asci** 74.5-86.7 \times 8.2-10.2 μm . **Ascospores** 38-42 \times 3.8-4.8 μm .

Habitat/Known distribution: Known to inhabit living leaf of *Linospadix microcarya* from Australia (Hyde, 1994); decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai, Chiang Dao National Park, in rainforest, on dead leaves of *Pandanus penetrans*, 24 September 2002, S. Thongkantha S024-1, CMU 26639; S024-2, CMU 26640; 21 July 2003, S. Thongkantha S024-3, CMU 26641.

Notes: *Oxydothis linospadicis* is characterized by ascospores that are $40-60 \times 6-7.5$ μm , fusiform, bicelled and taper gradually from an unstricted central septum to blunt processes, and guttulate with several guttules per cell (Fröhlich and Hyde, 1994; Hyde, 1994). The current specimens have morphological similar characters to *O. linospadicis* particularly in ascospore shape. Ascospores in the present collections are somewhat shorter and slightly narrower as compared to those of *O. linospadicis* (Fröhlich and Hyde, 1994; Hyde, 1994). Fröhlich and Hyde (1994) described *O. linospadicis* from living leave of palm, *Linospadix microcarya* on leaf spots whereas in this study found it on dead leaves of *Pandanus penetrans*.

Oxydothis oraniopsis J. Fröhl. & K.D. Hyde

Figure 4.30 (7-10)

Ascomata 145-112 μm diam, solitary or in small group. **Asci** $107.5-165.3 \times 8.4-12.9$ μm ($\bar{x} = 140.6 \times 11.3$ μm , $n=10$). **Ascospores** $39.2-58.5 \times 4-6.7$ μm ($\bar{x} = 45.5 \times 5$ μm , $n=20$).

Habitat/Known distribution: Known to inhabit on submerge petiole of *Calamus* sp. in freshwater from Australia (Hyde, 1994); on decaying leaves of *Pandanus penetrans* from Thailand.

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, in rainforest, on dead leaves of *Pandanus penetrans*, 1 September 2004, *S. Thongkantha* S161-1, CMU 26827; S161-2, CMU 26828.

Notes: *Oxydothis oraniopsis* is characterized by ascospores that are uniseriate to biseriata and twisted into a helix, hyaline, fusiform, bicelled and tapering gradually from an unstricted central septum to long processes, $57.5-77.5 \times 5.5-8$ μm (Fröhlich and Hyde, 1994; Hyde, 1994). The general characteristic of the current specimens are similar to the description and illustration *O. oraniopsis* given by Fröhlich and Hyde (1994) and Hyde (1994). Fröhlich and Hyde (1994) described *O. oraniopsis* from living leaves of palm, *Oraniopsis appendiculata* and *Laccospadix australasicus* whereas in this study found it on dead leaves of *Pandanus penetrans*.

The species most similar in ascospores shape to this species is *O. luteaspora*, but their ascospores are longer ($57.5-77.5 \times 5.5-8 \mu\text{m}$ vs. $84-100 \times 6-8.5 \mu\text{m}$) (Hyde, 1993b).

Oxydothis siamensis Thongkantha, S. Lumyong, K.D. Hyde sp. nov. Figure 4.30 (4-6)

Ascomata 164.7-211.8 μm , immersa. Asci 82-86 \times 10 μm , octospori, cylindrici, unitunicati. Ascospores (26.4)36.8-41.6 \times 4.8-6.4 μm , fusiformes, hyalinae, bicellulares, angustatae.

Etymology: In reference to Siam (Thailand), where the specimens were collected.

Holotype (here designated): CMU26795, Thailand.

Ascomata 164.7-211.8 μm diam. **Asci** 82-86 \times 10 μm , 8-spored, long-cylindrical, thin-walled, unitunicate, J^+ , with truncate apical. **Ascospores** (26.4)36.8-41.6 \times 4.8-6.4 μm , fusiform, bicelled with a central septum, hyaline, tapering from the centre to pointed spine-like process, tips with minute mucilage drops.

Habitat/Distribution: Known to inhabit decaying leaves of *Pandanus penetrans*, Thailand.

Specimens examined: THAILAND, Phayao province, Phukamyao, Huaykaew district, Kardthee village, along the brook, on decaying leaves of *Pandanus penetrans*, 27 April 2004, S. Thongkantha S141-1, CMU26795 (holotype); S141-2, CMU26796; 10 May 2004, S. Thongkantha S141-3, CMU26797; S141-4, CMU26798.

Notes: *Oxydothis siamensis* differs from previously described species in ascospore size and morphology. *Oxydothis hoehnelii* (Rehm) Sacc., *O. luteaspora* Hyde, *O. pandani* Huguenin, *O. rubella* Hyde are similar as ascospores are bicelled with a central septum, but they are longer (60-100 μm) and wider (6-8.5 μm) (Hyde, 1994). The species with small ascospores equally to this taxon are *O. asiatica* J. Fröhl. & K.D. Hyde, *O. pandanicola* (H. Syd. & P. Syd.) Petr. and *O. parvula* (H. Syd. & P. Syd.) Petr. but differ in their shape as well as the ascomata characteristics (Fröhlich and Hyde, 2000; Hyde, 1994).

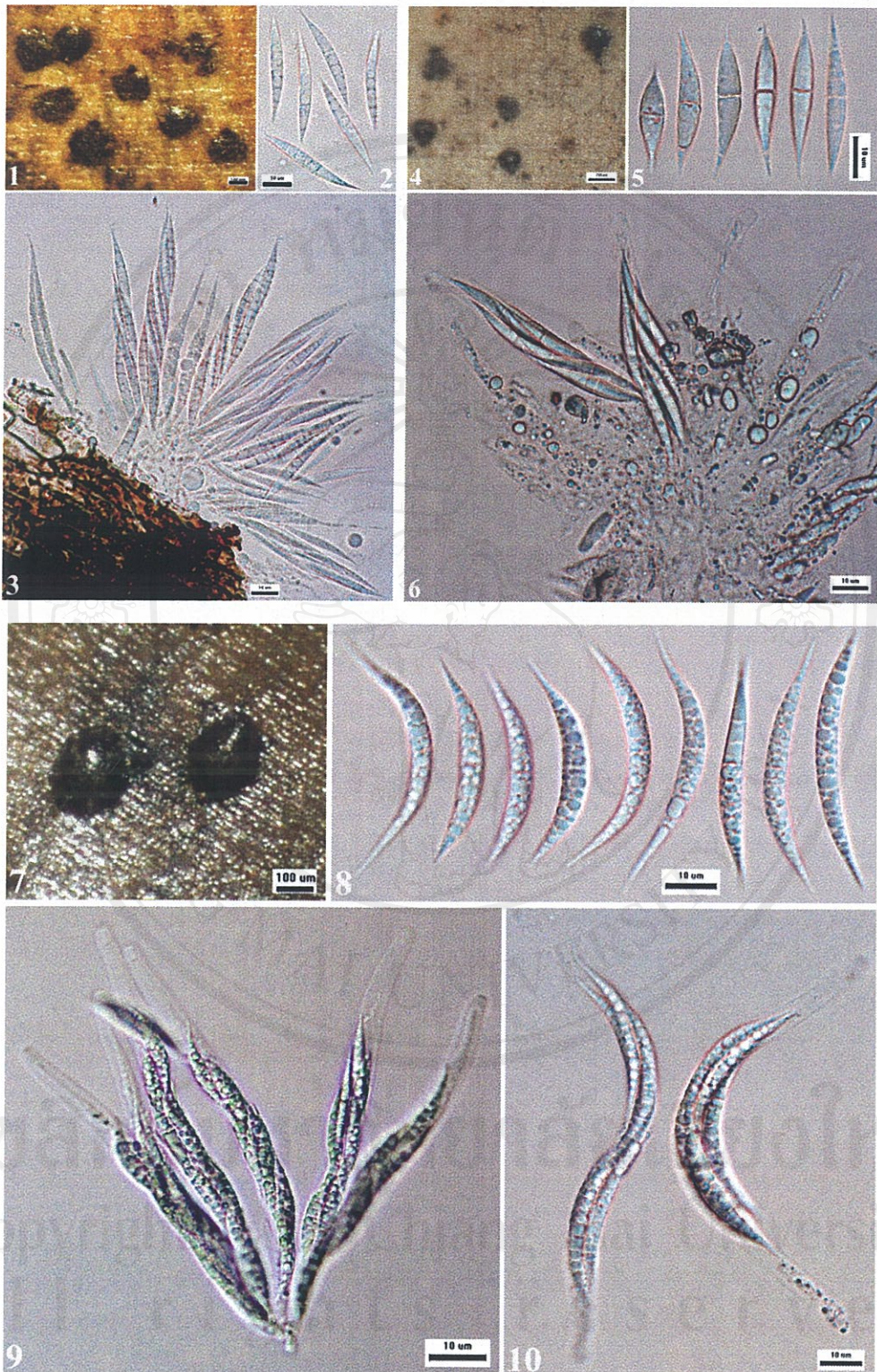


Figure 4.30 1-3. *Oxydothis linospadicis*. 1. Appearance of ascomata on the host surface. 2. Ascospores. 3. Asci., 4-6. *Oxydothis siamensis* sp. nov. 4. Appearance of ascomata on the host surface. 5. Ascospores. 6. Asci., 7-10. *O. oraniopsis*. 7. Appearance of ascomata on the host surface. 8. Ascospores. 9-10. Asci. Scale bars: 1, 7 = 100 µm; 4 = 200 µm; 2-3, 5-6, 8-10 = 10 µm.

Paraphaeosphaeria O.E. Erikss.

(Phaeosphaeriaceae: Pleosporales)

Type species: Paraphaeosphaeria michotii O.E. Eriksson.

References: Hedjaroude, 1968; Shoemaker and Babcock, 1985; Fröhlich and Hyde, 2000; Hyde *et al.*, 2000; Wong *et al.*, 2000; Câmara *et al.*, 2001; Checa *et al.*, 2002; Lee *et al.*, 2005.

Ascomata immersed, intra- or subepidermal, globose, sphaeroid or ovoid, scattered, coriaceous, black. **Ostiole** with a slightly thickened wall area, comprising numerous layers of small thin walled cells around a thin central disk that opens as a flap and reveals the ostiole. **Peridium** thin, composed of a few layers of light-brown, angular cells. **Pseudoparaphyses** numerous, hypha-like, cellular, not embedded in a gelatinous matrix. **Asci** bitunicate, with an ocular chamber, 8-spored, cylindrical, short pedicellate. **Ascospores** biseriate or overlapping biseriate, clavate to cylindrical, or oblong-cylindric, 3-10-celled, dark brown, euseptate, with first-formed septum below the middle, subtending an enlarged cell, enlarged cell shorter than wide as are most other intercalary cells, end cells longer, wall echinulate, surrounded by a mucilaginous sheath.

Eriksson (1967) established the genus *Paraphaeosphaeria* to accommodate segregates of *Leptosphaeria* with asci and ascomata as in *Phaeosphaeria*, but differing from the latter in producing brown, usually punctuate ascospores with the first-formed septum submedian, the cell immediately above that septum wider than the other cells, with *Coniothyrium* anamorph (see in Câmara *et al.*, 2001; Shoemaker and Babcock, 1985).

Nine species (*Phaeosphaeria agavensis*, *P. conglomerata*, *P. filamentosa*, *P. glauco-punctata*, *P. michotii*, *P. nolinae*, *P. obtusispora*, *P. pilleata*, *P. quadriseptata* and *P. recurvifoliae*) have been characterized and studied phylogenetic relationship (Câmara *et al.*, 2001; Lee *et al.*, 2005). All of them produce ascospores with submedian septa and rounded ends but vary considerable in the ascomatal and conidiomatal wall texture and pigmentation, presence or absence of a stroma, ascospore septation, host, colony color in culture. However, the results provided

strong support for polyphyletic. Câmara *et al.* (2001) suggested that only *P. michotii* and *P. pilleata* could be maintained in *Paraphaeosphaeria*, which have general features different to all other species and generally inhabit host plants that usually are found in moist environments such as *Juncus* or *Typha*. The ascospores are 3-celled, the ascomata are smaller than those of the other species, single, scattered, and have a thin-walled peridium. *Microsphaeropsis* anamorph produce smooth-walled conidia from inconspicuous phialides (Sutton, 1980). Further taxonomic conclusions in this genus (about 19 species reported by Wong *et al.*, 2000) warrants investigation by using both molecular and morphological characters (Câmara *et al.*, 2001; Lee *et al.*, 2005).

Species of *Paraphaeosphaeria* are found on a wide range of dicotyledonous and monocotyledonous plants. They are especially common on the Agavaceae for example *P. agavensis*, *P. conglomerate*, *P. lamentosa*, *P. nolinae*, *P. obtusispora* and *P. quadrisepata* have been described (Checa *et al.*, 2002).

Paraphaeosphaeria obtusispora (Speg.) O.E. Erikss.

Figure 4.31

Asci 77-108 × 10.8-12.3 μm. **Ascospores** brown, 2- and 5-septate, punctuate, cylindrical, broadly rounded at apex, tapering to a more narrowly rounded base and 15.2-22.7 × 4.1-5.2 μm.

Habitat/Known distribution: Known to inhabit leaves of Agavaceae, including: *Agave striata*, *Furcraea* sp., *Yucca aloifolia*, *Y. elephantipes*, *Y. gloriosa*, *Y. smalliana* and *Yucca* sp. from Argentina, Canary Islands, Portugal, southern USA (Câmara *et al.*, 2001); decaying leaf of *Dracaena lourieri* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai, Chiang Dao National Park, in rainforest, on dead leaves of *Dracaena lourieri*, 12 July 2002, S. Thongkantha S 015-1, CMU 26637, S. Thongkantha S 015-2.

Notes: *Paraphaeosphaeria obtusispora* is characterized by asci that are cylindrical to clavate and short-pedicellate and 90-110 × 11-13 μm. The ascospores are biseriate, yellowish-brown, punctuate, cylindrical with rounded at ends, broadly rounded at apex, tapering to a more narrowly rounded base, 5-septate, sometimes slightly constricted at the penultimate septum, cells immediately above this septum slightly wider and 17-22 × 5-6 μm (Câmara *et al.*, 2001; Shoemaker and Babcock, 1985). The

asci and ascospores of the present specimens are similar to those of *P. obtusispora* (Shoemaker and Babcock, 1985; Câmara *et al.*, 2001). The species has also been described and reported from species of *Agave*, *Aloë*, *Dracaena*, *Fourcroya* and *Yucca gloriosa* (Hedjaroude, 1968).

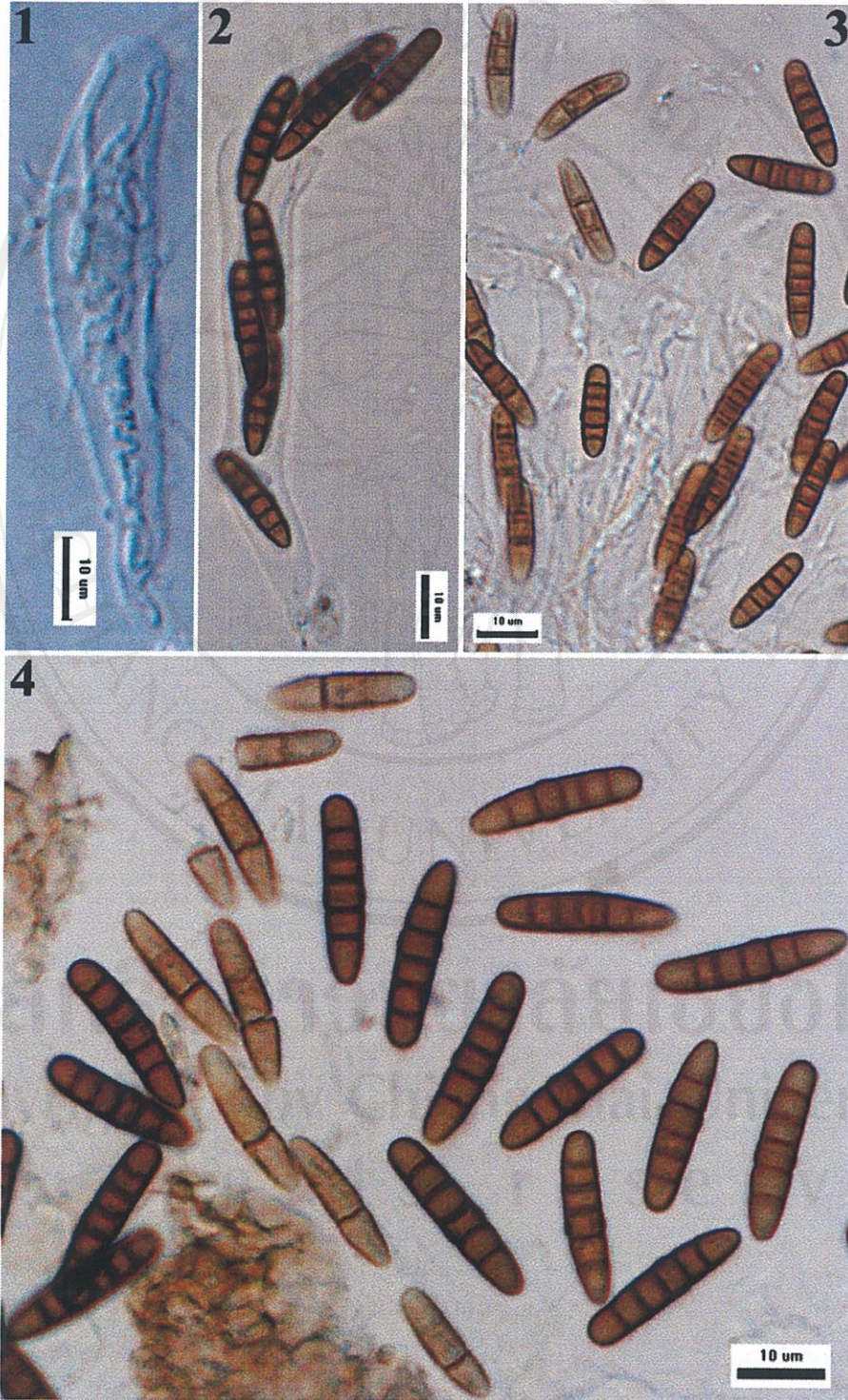


Figure 4.31 *Paraphaeosphaeria obtusispora*. 1-2. Asci. 3. Ascospores and pseudoparaphyses. 4. Ascospores. Scale bars = 10 µm.

Phaeonectriella R.A. Eaton & E.B.G. Jones

(Halosphaeriaceae: Halosphaeriales)

Type species: *Phaeonectriella lignicola* R.A. Eaton & E.B.G. Jones.

References: Eaton and Jones, 1970; Jones, 1995; Hyde *et al.*, 1999a; Pang, 2002.

Ascomata globose to subglobose, hyaline to pale brown, periphysate. **Asci** bitunicate, clavate with pedicellate, 8-spores. **Ascospores** fusiform or ellipsoidal-fusiform, hyaline to pale brown, 1-septated, with or without appendages.

Phaeonectriella lignicola is characterized by ascomata that are immersed, globose to subglobose, hyaline to pale brown, membranous, ostiolate, papillate, and periphysate. Catenophyses were not seen. The asci are clavate with pedicellate and thin-walled, apical truncate and thickened, with an apically pore and cytoplasm retracted below the ascus apex, persistent, $100-120 \times 22-35 \mu\text{m}$. The ascospores are ellipsoidal-fusiform, bicelled and longitudinally asymmetrical, slightly constricted at the septum, thin wall, hyaline or pale brown, becoming grey-brown at maturity, often with guttulations, $26-30 \times 9.5-11 \mu\text{m}$.

Phaeonectriella most closely resemble to the *Aniptodera*, the genera differing only in having pigmentation (brown) ascospores (Hyde *et al.*, 1999a). Even though, the original description of the genus Eaton and Jones (1970) and Jones (1995) used the lack of appendages to distinguish this genus from *Aniptodera*. Further investigations of both genera additional some other closely related genera especially *Halosarpheia* and *Nais* are necessary to delimit morphological characteristics (such as appendages forms and appearance) and phylogenetic relationship between them (Pang, 2002).

The type species of the genus was described from beech and Scots pine test blocks exposed in a number of water cooling towers, but the new available material from Taiwan was discussed and re-illustrated by Jones (1995). No new species of *Phaeonectriella* have been described from any members of the Pandanaceae (McKenzie and Hyde 1996, 1997; Whitton, 1999; McKenzie *et al.*, 2002).

Phaeonectriella pandani Thongkantha, S. Lumyong, McKenzie & K.D. Hyde, sp.

nov.

Figure 4.32

Ascomata 113-200 μm diam, globosa vel subglobose, immerse vel subimmersa, ostiolata, papillata, periphysata. Asci 70-76.5 \times 23.1-26.2 μm , octospori, clavati, pedicellati. Ascospores 21.4-29 \times 7.7-9 μm (\bar{x} = 25.1 \times 7.9, n=30), ellipsoidal-fusiform, pale brown, 1-septatae and longitudinally asymmetrical, slightly constricted at the septum, with appendages at each end.

Etymology: Referring to the host, *Pandanus*.

Holotype (here designated): CMU 26649, Thailand.

Ascomata 113-200 μm diam, globose to subglobose, immersed or partially immersed, pale brown, ostiolate, papillate, periphysate. **Peridium** of textura angularis. **Catenophyses** not seen. **Asci** 70-76.5 \times 23.1-26.2 μm , 8-spored, clavate, pedicellate, persistent, apical truncate and thickened, with an apically pore and cytoplasm retracted below the ascus apex. **Ascospores** 21.4-29 \times 7.7-9 μm (\bar{x} = 25.1 \times 7.9, n=30), multiseriate, ellipsoidal-fusiform, pale brown, 1-septate and longitudinally asymmetrical, slightly constricted at the septum, often with guttulations, with appendages at each end.

Habitat/Distribution: Known to inhabit decaying leaves of *Pandanus penetrans*, Thailand.

Material examined: THAILAND: Chiang Mai, Suthep-Pui National Park, in Quinin Botanic Garden rainforest, on dead leaves of *Pandanus penetrans*, 3 September 2002, S. Thongkantha S 032-1, CMU 26649 (holotype); 3 August 2003, S. Thongkantha S032-2, CMU 26650.

Notes: *Phaeonectriella pandani* is characterized by bicellular ascospores and longitudinally asymmetrical with polar appendages. Other species of *Phaeonectriella* with appendages are *P. appendiculata* and *P. lignicola* but they have the bigger

ascospores. The ascospores of *P. lignicola* and *P. pandani* are similar in shape that are constricted at the septum but *P. pandani* are smaller ($26-30 \times 9.5-11 \mu\text{m}$ vs. $21.4-29 \times 7.7-9 \mu\text{m}$). *Phaeonectriella appendiculata* has ascospores which are not constricted at the septum and broader and longer than those of *P. pandani* ($32-42 \times 10-12 \mu\text{m}$ vs. $21.4-29 \times 7.7-9 \mu\text{m}$) (Jones, 1995; Hyde *et al.*, 1999a).

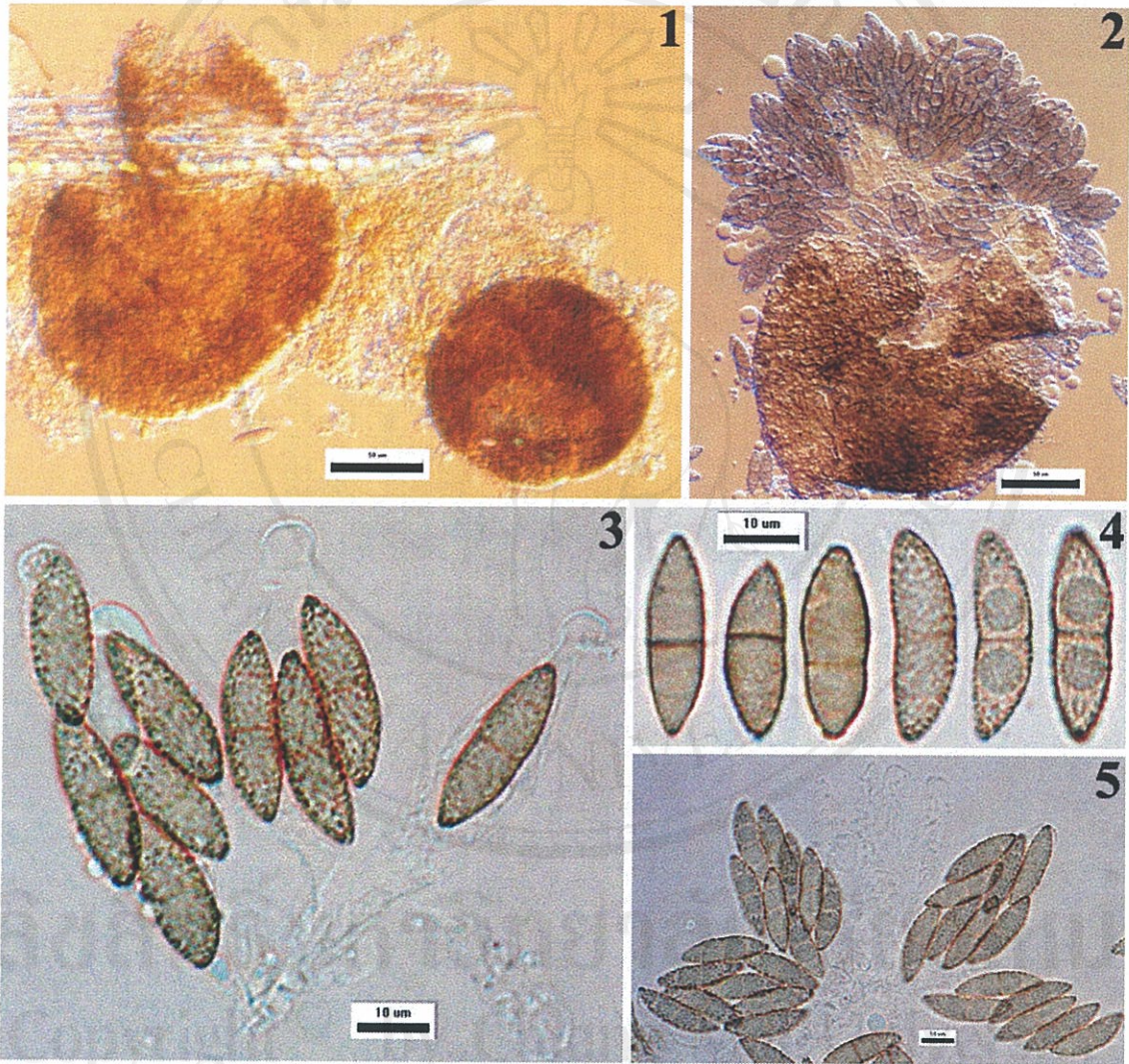


Figure 4.32 *Phaeonectriella pandani* (from holotype). 1. Appearance of ascomata on the host tissues. 2. Ascoma with asci and ascospores. 3, 5. Asci. 4. Ascospores. 9. Paraphysis. Scale bar: 1-2 = 50 μm ; 3-5 = 10 μm .

Phomatospora* Sacc.*(Genera incertae sedis: Xylariales)*****Type species:* *Phomatospora berkeleyi* Sacc.*****References:* Fallah and Shearer, 1998; Hyde *et al.*, 2000.**

Ascomata immersed, spherical, light yellowish brown peridium, becoming dark near the ostiole, often with a yellow colouration of the substrate, textura epidermoidea peridium. **Ostioles** are protruding, fine, black, with periphyses. Unitunicated **asci** cylindrical, with refractive apical apparatus, uniseriate, 8-spored. **Ascospores** hyaline, 1-celled, cylindrical, finely striate, with 2 guttules, thin-walled, sometimes with two polar slime caps about 2 wide.

Phomatospora species have hyaline unicellular spores and resemble members of the genera *Arecomyces* and *Physalospora*. *Phomatospora* differ from *Arecomyces* by have narrower cylindrical asci, with a refractive apical ring and smaller spores. *Physalospora* whose species have stroma or clypeus but ascospores are larger than 20 µm (Hyde *et al.*, 2000). Twenty species from widespread habitats were accepted (Kirk *et al.*, 2001). *Phomatospora cylindrotheca* and *P. pandani* have been described from dead leaves of *Pandanus* sp. and *P. pedunculatus* var. *stradbrokeensis* respectively (McKenzie and Hyde, 1996).

Phomatospora berkeleyi

Figure 4.33

Ascomata 150-215 µm diam. **Asci** 46-50.9 × 4.3-5.1 µm. **Ascospores** 7.8-9.3 × 2.4-2.8 µm.

Habitat/Known distribution: Known to inhabit dead leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on decaying leaves of *Pandanus penetrans*, 3 October 2002, *S. Thongkantha S027-1*, CMU 26644; *S. Thongkantha S027-2*, CMU 26645; 20 July 2003, *S. Thongkantha S158-1*, CMU 26821; *S. Thongkantha S158-2*, CMU 26822; *S. Thongkantha S158-3*, CMU 26823.

Notes: Morphologies of the ascomata, asci and ascospores of the current specimens similar to those of *Phomatospora berkeleyi* (Fallah and Shearer, 1998).

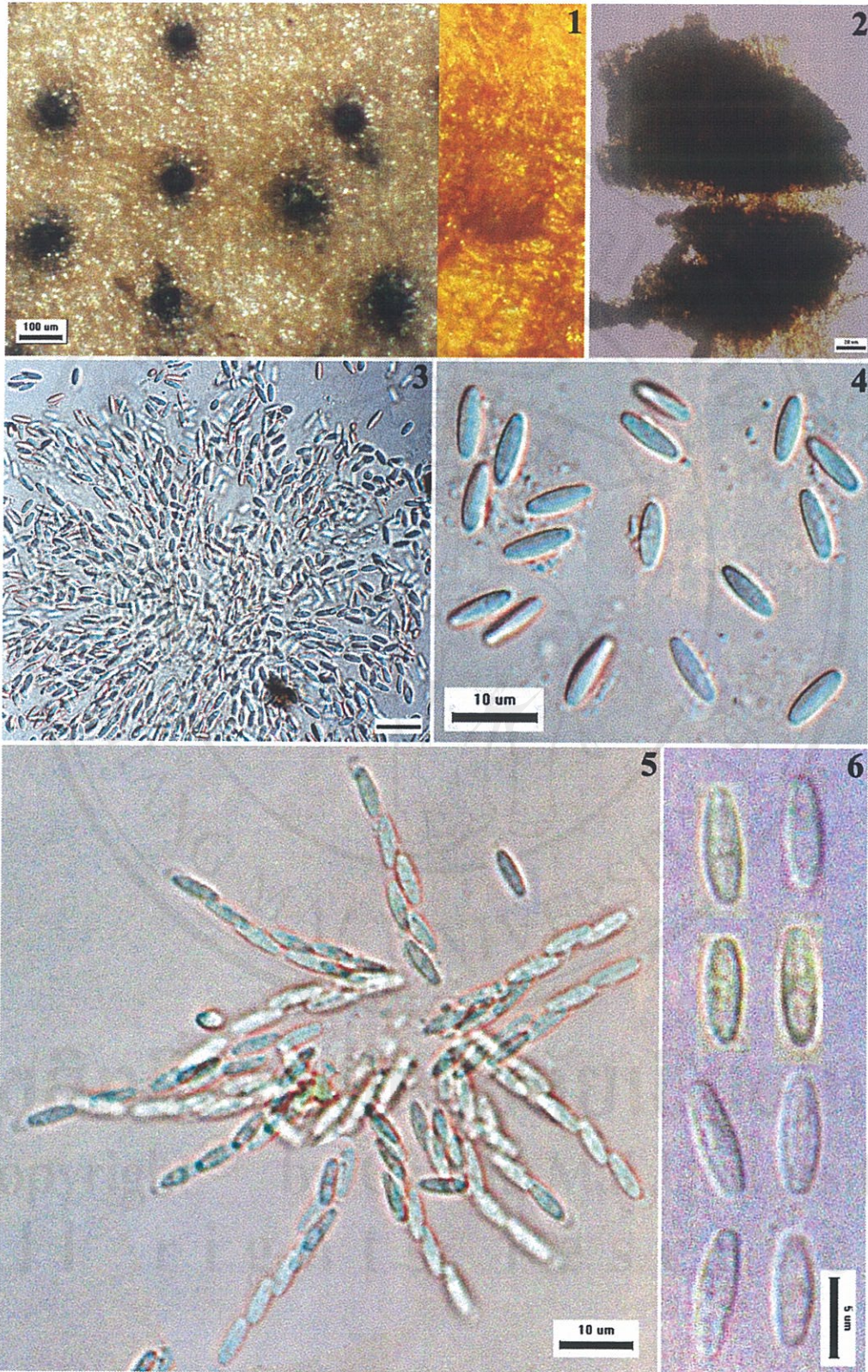


Figure 4.33 *Phomatospora berkeleyi* 1-2. Appearance of ascomata on the host surface and lower part of host tissues. 3. Ascoma. 3, 5. Asci and ascospores. 4, 6. Ascospores. Scale bars: 1 = 100 μm ; 2-3 = 20 μm ; 4-5 = 10 μm ; 6 = 5 μm .

Pseudohalonectria

(Magnaporthaceae: Incertae Sedis)

Type species: Pseudohalonectria lignicola Shearer.*References:* Shearer, 1989; Hanlin, 1998; Hyde *et al.*, 1999c; Fröhlich and Hyde, 2000; Hyde *et al.*, 2000; Ono and Kobayashi, 2001; Cai *et al.*, 2002; Promputtha *et al.*, 2004a.

Ascomata solitary or cluster, immersed to superficial, yellow to brown, occasionally black when old, globose to subglobose with cylindrical periphysate necks. **Peridium** thick, comprising 3-4 strata of pseudoparenchymatous cells, dark yellow and compressed, inner cells pale yellow. **Paraphyses** 4-8 μm wide, hypha-like, tapering distally, not embedded in gelatinous matrix. **Asci** cylindrical to clavate, apedicellate, unitunicate with a J- cylindrical apical ring. **Ascospored** filiform, multicelled and hyaline to slightly pale.

Based on morphological characters *Pseudohalonectria* is similar to *Ophioceras* (Hyde *et al.*, 1999c; Shearer, 1989; Tsui *et al.*, 2001, 2003). *Pseudohalonectria* species are often found in aquatic habitats and dead plant materials (Luo *et al.*, 2004; Tsui and Hyde, 2004). Hanlin (1998) and Hyde *et al.* (2000) has pointed out that *Pseudohalonectria* differs from *Ophioceras* in having bright yellow, membranous ascomata. However, in *Pseudohalonectria* ascospores are discharged through their beaks and accumulate in masses. In contrast, in *Ophioceras*, the whole asci are forced up through the neck to the apex. The narrow canal of the beak allows the passage of only one ascus. Moreover, the phylogenetic relationship of both genera with some other member of Magnaporthaceae have also been investigated and reported in chapter 5.

The type species of *Pseudohalonectria* and subsequently five of eleven were described and known to inhabit on submerged wood in freshwater (Cai *et al.*, 2002; 1978; Shearer, 1989). Another four species were isolated and described from various dead plant materials including *Magnolia liliifera* Baill (Promputtha *et al.*, 2004a), palm (Hyde *et al.*, 1999c), and unknown plant substrata (Ono and Kobayashi, 2001).

No species of *Pseudohalonestria* have been described or reported from any members of the Pandanaceae (McKenzie and Hyde, 1996, 1997; McKenzie *et al.*, 2002; Whitton, 1999) and the species of *Dracaena*.

Pseudohalonestria suthepensis I. Promputtha

Figure 4.34

Asci 103.4-123 × 5-6.9 μm, 8-spored, cylindrical, apedicellate, apex rounded to slightly acute, with a J- subapical ring. **Ascospores** 94-114 × 1.4-1.7 μm, hyaline, yellow to light orange in mass, multiseriate, filiform, 4-6-septated, slightly acute at the apex and rounded at base, without sheaths or appendages.

Habitat/Known distribution: Known to inhabit decaying leaves of *Manglietia garrettii* (Promputtha *et al.*, 2004) and *Dracaena loureiri* (this study) from Thailand.

Specimens examined: THAILAND: Chiang Mai, Chiang Dao National Park, in rainforest, on dead leaves of *Dracaena loureiri*, 1 November 2005, S. Thongkantha S199-1, CMU 26875; S. Thongkantha S199-2, CMU 26876.

Notes: *Pseudohalonestria suthepensis* is characterized by long ascospores with the narrow width (Promputtha *et al.*, 2004a). The general characteristic of the present specimens agree with the description for *P. suthepensis* (Table 4.4, Figure 4.34-4.35).

Table 4.4 Comparisons morphological characters of *Pseudohalonectria* species (Promputtha *et al.*, 2004).

Taxa (reference)	Ascomata (μm)	Asci (μm)	Apical ring (high \times diam μm)	Ascospores (μm)	Ascospore septation	Ascomata colour (young)
<i>P. adversaria</i> (Shearer, 1989)	79-248 \times 109-158	120-150 \times 13-20	2.5-5 \times 2.5-3	33.5-49 \times 4.5-7	5-7	Orange
<i>P. aomoriensis</i> (Ono & Kobayashi, 2001)	900-1400 \times 160-180	112-145 \times 8-11	not given	49-57 \times 3-4.5	5-7	Yellow to yellowish brown
<i>P. eubenangeesis</i> (Hyde <i>et al.</i> , 1999c)	135-175 \times 90-125	80-120 \times 8-11.5	2-2.5 \times 1.5-2	70-98 \times 2.5-3.5	3-5 (-7)	Yellow
<i>P. falcata</i> (Shearer, 1989)	81-162 \times 81-108	106-244 \times 14.4-21.6	not given	97-166 \times 4.2-7.2	6-16	Light yellow or light brown
<i>P. fuxianii</i> (Cai <i>et al.</i> , 2002)	430-570 \times 70-110	90-187.5 \times 17.5-30	2-2.5 \times 2.5-3	30-52.5 \times 7.5-12.5	3-5	Orange-brown
<i>P. lignicola</i> (Shearer, 1989)	170-621	90-132 \times 11-17.5	not given	38.4-74.8 \times 3.5-6.5	5-11	Pale yellow
<i>P. longirostrum</i> (Shearer, 1989)	1683-3712 \times 118-168	94-130 \times 8.5-12	3-5 \times 2	84-105.5 \times 3.8-4.0	4-8	Bright yellow
<i>P. lutea</i> (Shearer, 1989)	300-600 \times 160-200	122-192 \times 14.4-18	not given	99-168 \times 4.8-8.4	5	Yellowish brown
<i>P. palmicola</i> (Hyde <i>et al.</i> , 1999c)	1600 \times 132-152	120-156 \times 13-15	3.5-4 \times 2.5-4	74-83 \times 4-4.5	3-6	Dark brown
<i>P. phialidica</i> (Shearer, 1989)	614-1940 \times 89-129	82-99 \times 5-7.9	3.2-5 \times 2-3.5	64.5-79 \times 2	0-4	Yellow
<i>P. suthepensis</i> (Promputtha <i>et al.</i> , 2004a)	400-800 \times 120-180	135-170 \times 5-8.5	2-5 \times 2-3	85-137 \times 2.5	4-7	Dark brown
<i>P. suthepensis</i> (this study)	\times	103.4-123 \times 5-6.9	\times	94-114 \times 1.4-1.7	4-6	Dark brown

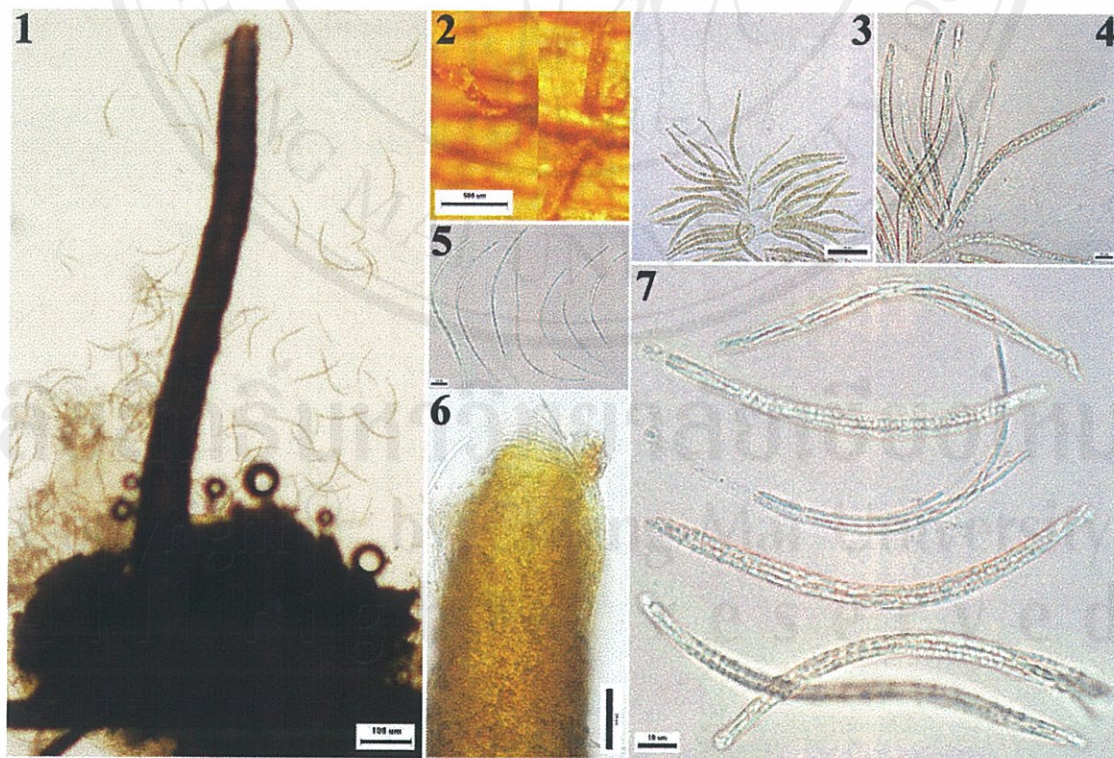


Figure 4.34 *Pseudohalonectria suthepensis* 1. Ascoma. 2. Appearance of ascomata on the host surface. 3-4. Asci and paraphyses. 5. Ascospores. 6. Neck. 7. Asci. Scale bars: 2 = 500 μm ; 1 = 100 μm ; 3, 6 = 50 μm ; 4-5, 7 = 10 μm .

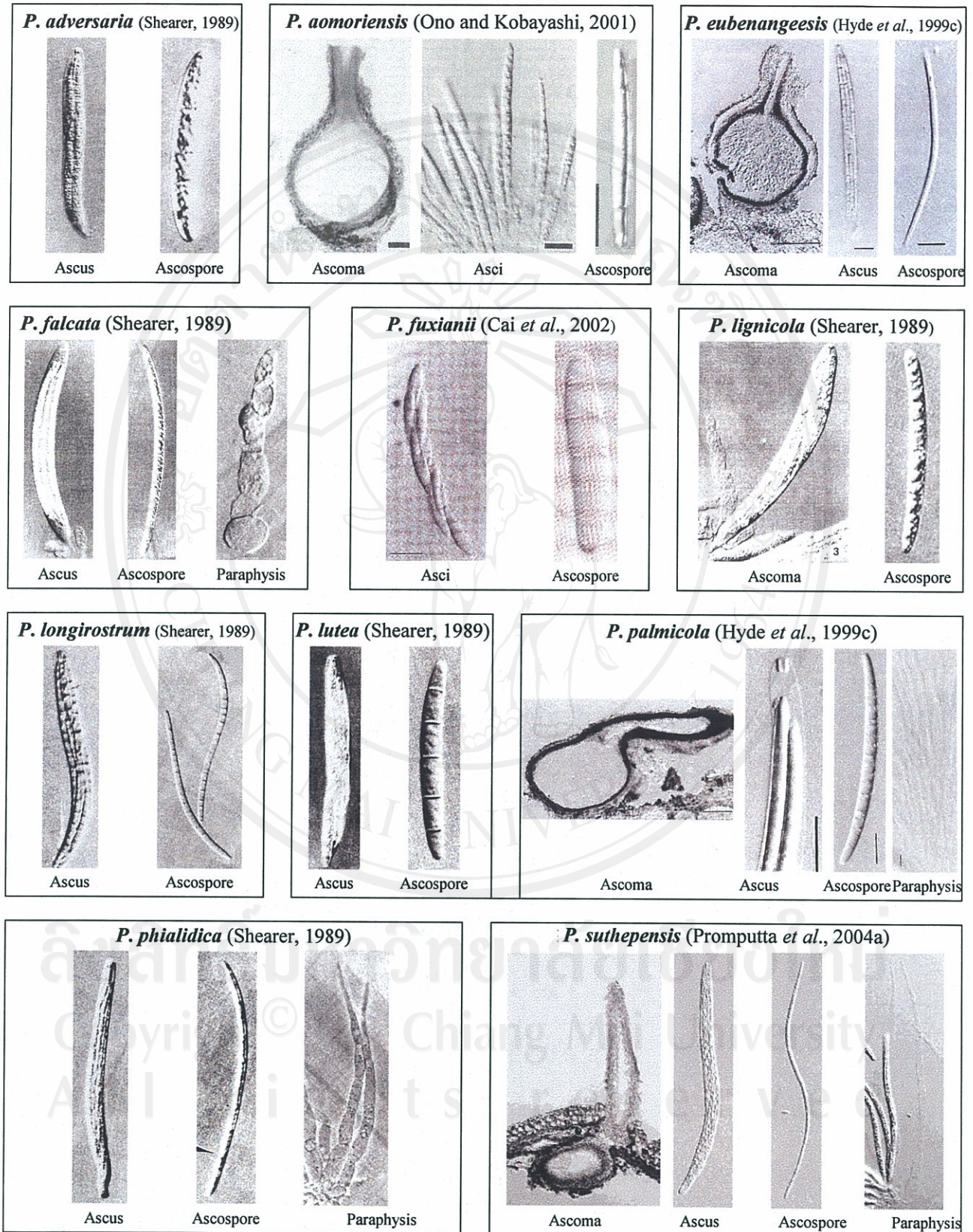


Figure 4.35 All species of *Pseudohalonectria* previously described by Cai *et al.* (2002), Hyde *et al.* (1999c), Ono and Kobayashi (2001), Promputta *et al.* (2004a), and Shearer (1989).

Sordaria Ces. & de Not.

(Sordariaceae: Sordariales)

Type species: *Sordaria fimicola* (Rob.) Ces. & de Not.

References: Matsushima, 1971; von Arx, 1981; Watanabe, 2002.

Ascomata superficial on substrate, solitary or aggregated, subspherical or flask-shaped, necked or papillate, cover with white hairs, brown, pseudoparenchymatous. **Asci** cylindrical, 4-8-spored, truncate apically, narrowed basally. **Ascospores** ellipsoidal, usually with germ pores, 1-celled, dark green or dark brown, often covered with gelatinous sheath.

No species of *Sordaria* have been described or recorded from any members of the Pandanaceae (McKenzie and Hyde 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002).

Sordaria fimicola

Figure 4.36

Ascomata 337-468.4 × 302-337.8 μm (\bar{x} = 420.9 × 317.8 μm, n=8). **Asci** 140.7-187.7 × 17.4-22.6 μm (\bar{x} = 169 × 19.1 μm, n=10). **Ascospores** ellipsoidal with germ pores, dark green or dark brown, 1-celled and 17.3-23.8 × 12-15.8 μm (\bar{x} = 21.1 × 14.4 μm, n=50)

Habitat/Known distribution: Known to inhabit in soil, worldwide (Kirk *et al.*, 2001; Matsushima, 1971; von Arx, 1981; Watanabe, 2002); dead leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dried leaves of *Pandanus penetrans*, 19 January 2003, *S. Thongkantha S140-1*, CMU 26793; *S. Thongkantha S140-2*, CMU 26794.

Notes: The general characteristic of the current specimen fit the previous description and illustrated for *S. fimicola* reported by Watanabe (2002). Slightly different in ascospores size (15-20 × 10-12(-15) μm) possibly due to those collections of Watanabe (2002) were found in melon field soil and flowering cherry seed contradict to this study which isolated from decaying leaf of *Pandanus penetrans*.

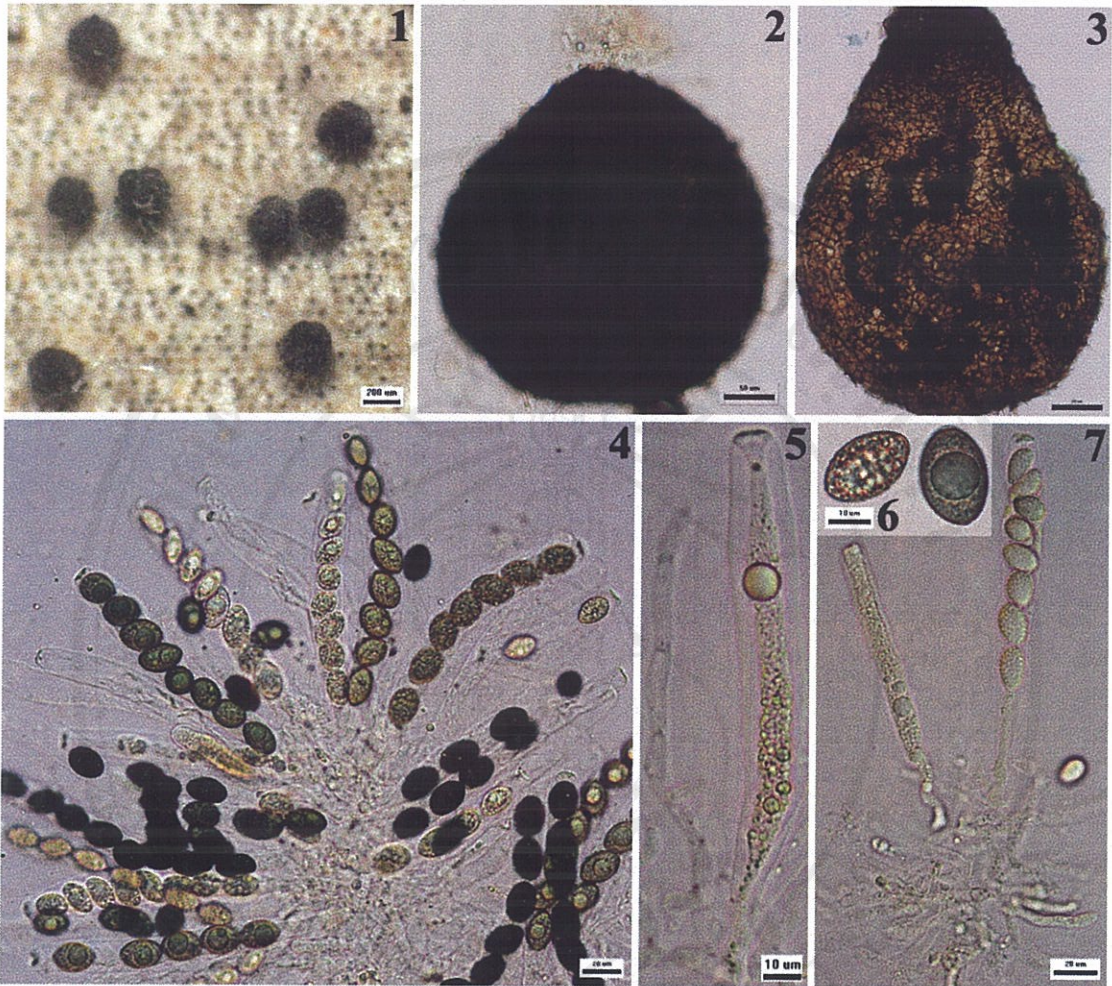


Figure 4.36 *Sordaria fimicola*. 1. Appearance of ascomata on the host surface. 2-3. Ascomata. 4. Asci. 5. Young ascus and paraphyses. 6. Ascospores. 7. Asci. Scale bars: 1 = 200 µm; 2-3 = 50 µm; 4, 7 = 20 µm; 5-6 = 10 µm.

Tubeufia Penz. & Sacc.

(Tubeufiaceae: Pleosporales)

Type species: *Tubeufia javanica* Penz. & Sacc.

References: Barr, 1980; Fröhlich and Hyde, 2000; Réblová and Barr, 2000; Kodsueb *et al.*, 2004, 2006.

Ascomata hyaline, whitish or yellowish to pinkish, but may become dark at maturity, smooth or covered with protruding cells, thick wall hyphal appendages or short dark setae. **Asci** bitunicate, oblong or clavate. **Ascospores** hyaline or lightly

pigmented, elongate fusiform or clavate, multiseptate, without sheaths and smooth walled

Tubeufia is a mainly saprobes tropical genus, usually found on old, rotten wood. Anamorphs of the genus are belonging in *Helicoma*, *Helicosporium* and *Monodictys* (Barr, 1980; Hawksworth *et al.*, 1995). Recently, a taxonomic key to 16 accepted species of *Tubeufia* has been provided and illustrated by Kodsueb *et al.* (2004). *Tubeufia* are usually confused to *Nectria*-like genera with multiseptate ascospores such as *Ophionectria*, *Paranectria*, *Scoleconectria* and *Trichonectria*. These taxa all differ from *Tubeufia* in that their asci are unitunicate and their hamathecium, where present, is composed of apical paraphyses (Rossman, 1983). Kodsueb *et al.* (2006) provided systematic revision of Tubeufiaceae base on morphological and molecular data. However, results from molecular data have not corresponded to establish morphological schemes. Characters such as colors of ascomata, shape of ascospores and anamorphic taxa did not appear to be significant in delineating several genera or species within Tubeufiaceae including *Helicomycetes macrofilamentosus*, *H. roseus*, *Thaxteriella amazonensis*, *T. helicoma*, *Tubeufia cerea*, *T. cylindrothecia* and *T. paludosa*. They also found that Tubeufiaceae was more closely related to Venturiaceae, and did not appear to be restricted to Pleosporaceae. Therefore its current taxonomic placement within the order Pleosporales was justified.

No new species of *Tubeufia* have previously been described from any members of the Pandanaceae (McKenzie and Hyde, 1996; 1997; Whitton, 1999; McKenzie *et al.*, 2002).

Tubeufia cerea (Berk. And M.A. Curtis) Höhn.

Figure 4.37

Ascomata 154-208 × 113-140 μm. Asci 81-108.3 × 10.3-14.2 μm.

Ascospores 30.7-47.2 × 3.4-4.2 μm, 6-7 septate.

Habitat/Known distribution: Known to inhabit dead plant materials from Austria, Belgium, Canada, USA and USSR (Barr, 1980); dead petiole of *Calamus comptus* from Brunei Darussalam (Fröhlich and Hyde, 2000); decaying leaves of *Pandanus penetrans* from Thailand (this study).

Specimens examined: THAILAND: Chiang Mai Province, Muang Chiang Mai, Suthep Pui National Park, on dead leaves of *Pandanus penetrans*, 20 July 2003, *S. Thongkantha S150-1*, CMU 26809; *S. Thongkantha S150-2*, CMU 26810.

Notes: The present specimen isolated from *Pandanus penetrans* leaf keys out to *Tubeufia cerea* on the basis of its ascomata walls, that are covered with protruding cells and the ascospores are similar in shape and size (Fröhlich and Hyde, 2000; Kodsueb *et al.*, 2004).

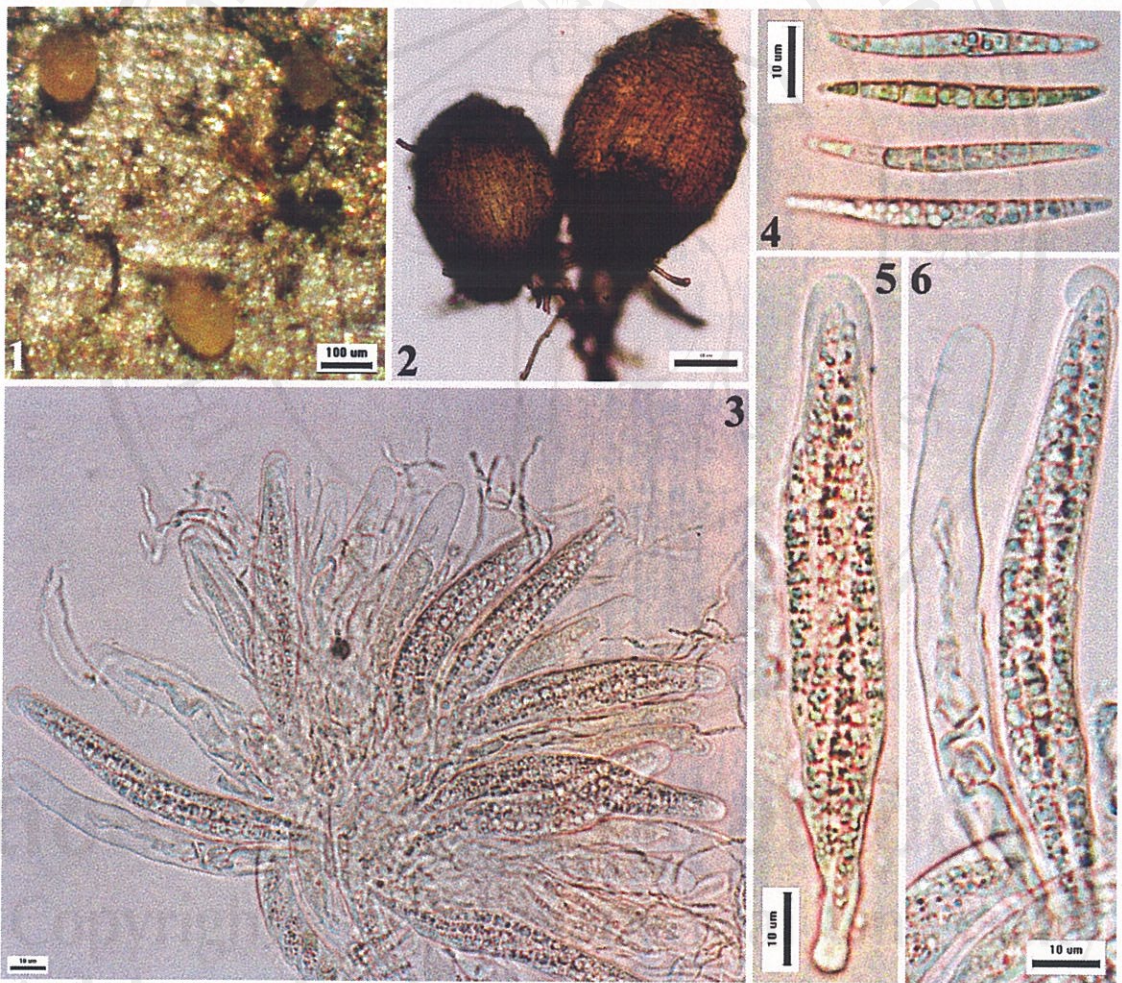


Figure 4.37 *Tubeufia cerea*. 1-2. Appearance of ascomata on the host surface. 2. Ascomata. 3. Asci and pseudoparaphyses. 4. Ascospores. 5-6. Asci. Scale bars: 1 = 100 µm; 2 = 50 µm; 3-6 = 10 µm.