

CHAPTER 2

BIODIVERSITY AND TAXONOMY

2.1. Introduction

There have been relatively few studies on the fungi associated with palms in Thailand (Aramsiriujwet, 1996; Hyde *et al.*, 2002; McKenzie *et al.*, 2002; Pinnoi *et al.*, 2004, 2006; Pinruan *et al.*, 2002, 2004, 2007, 2008; Sarapat, 2003; Hidayat *et al.*, 2006), and most of the published data were carried out in southern Thailand where species of palms at freshwater to brackish area ecosystems are widely distributed. The information of palmicolous fungi in this area was reviewed in the chapter 1. In northern Thailand, the publication on the palmicolous fungi is relatively lacking. The first report on palmicolous fungi in this area was probably reported by Techa (2001), however, the data were from unpublished thesis. Therefore, the report by Hidayat *et al.* (2006) regarding the *Oxydothis* species associated with Thai Dwarf Fishtail Palm (*Wallichia siamensis*) is arguably the first publication of fungi from northern Thailand.

Although many new species of several palmicolous genera have been reported in Thailand during the last approximately 10 years, however, information on fungi associated with necrotic leaflet of palms are few, as the previous studies mainly focused on decaying fronds (Aramsiriujwet 1996; Hidayat *et al.*, 2006; Hyde *et al.*, 2002; McKenzie *et al.*, 2002; Pinnoi *et al.*, 2004, 2006; Pinruan *et al.*, 2002, 2004; Sarapat 2003). Furthermore, study on fungi potentially causing necrotic spots on economically used palms e.g. areca palm (*Areca catechu*), sago palm (*Metroxylon sagu*) and coconut (*Cocos nucifera*), are particularly important. It is well-known that

some fungi generally cause local and general necrosis of plant tissues, and they often cause reduced growth (stunting) of plant organs or entire plants (Agrios, 2005). Leaf spot, blight, blotch, and anthracnose are common necrosis symptoms caused by fungi on plants. Necrosis on palm leaflets, such as leaf spot symptoms, can be caused by species of *Oxydothis*, *Astrosphaeriella*, *Guignardia*, *Maculatipalma* and *Mycosphaerella* (Fröhlich, 1992; Fröhlich and Hyde, 1994, 1995a, b, c, 1998, 2000; Hyde, 1995b; Hyde and Fröhlich, 1995a; Hyde, *et al.*, 1997).

The diversity of fungi associated with palms, particularly *W. siamensis*, and other terrestrial palms collected from Chiang Mai province and other locations are presented in this chapter. This includes endophytes, pathogens and saprobes. Specimens which are considered as new species or interesting taxonomically are described and illustrated. A total 181 species of fungi in 128 genera from 19 palm species have been investigated and examined (table 2.1). These include 89 Ascomycetes species in 52 genera and 29 families. Two Zygomycetes genera were recorded, both from family Mucoraceae. Two Basidiomycetes genera from two families, Agricostilbaceae and Schizophyllaceae, were also recorded. The remaining fungal genera comprised 23 species of Coelomycetes from 17 genera, and 65 Hyphomycetes species from 55 genera. Twenty-four species are new to science of which 7 species have been validly published or are in the process of publication (Hidayat *et al.*, 2006, 2007; To-anun *et al.*, 2009). Sixty-two species are new records to Thailand. Of the total species recorded, 92 species are found on *W. siamensis*. The most common families found include Botryosphaeriaceae, Mycosphaerellaceae, Xylariaceae, Pleosporaceae and Amphisphaeriaceae. *Anthostomella*, *Astrosphaeriella* and *Oxydothis* are more common on palms

Table 2.1 List of palmicolous fungi found on *Wallichia siamensis* and other palms during the present study.

Herbaria number (FIH)	Fungal species	Family	Host	References
332	<i>Acremonium alternatum</i> Link	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Magazin Ges. naturf. Freunde, Berlin</i> 3 : 15 (1809)
325	<i>Acrodictys bambusicola</i> M.B. Ellis	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Mycol. Pap.</i> 79 : 6 (1961)
185	<i>Acrogenospora sphaerocephala</i> (Berk. & Broome) M.B. Ellis	Hysteriaceae	<i>Wallichia siamensis</i> Becc.	<i>Dematiaceous Hyphomycetes</i> : 114 (1971)
329	<i>Agaricostilbum palmicola</i> J.E. Wright	Agaricostilbaceae (Basidiomycota)	<i>Borassus flabellifer</i> L.	<i>Mycologia</i> 62 (4): 680 (1970)
044	<i>Alternaria alternata</i> (Fr.) Keissl.	Pleosporaceae	<i>Borassus flabellifer</i> L.	<i>Beih. bot. Zbl., Abt. 1</i> 29 (2): 434 (1912)
335	<i>Alternaria citri</i> Ellis & N. Pierce	Pleosporaceae	<i>Borassus flabellifer</i> L.	<i>Bot. Gaz.</i> 33 : 234 (1902)
143	<i>Alternaria tenuissima</i> (Kunze) Wiltshire	Pleosporaceae	<i>Borassus flabellifer</i> L.	<i>Trans. Br. mycol. Soc.</i> 18 : 157 (1933)
115	<i>Amphisphaeria umbrina</i> (Fr.) De Not.	Amphisphaeriaceae	<i>Caryota mitis</i> Lour.	<i>Sfer. Ital.</i> : 69 (1863)
208	<i>Anthostomella frondicola</i> K.D. Hyde, J. Fröhl. & Joanne E. Taylor	Xylariaceae	<i>Daemonorops</i> sp.	<i>Sydowia</i> 50 : 71 (1998)
056, 073	<i>Anthostomella leptospora</i> (Sacc.) S.M. Francis	Xylariaceae	<i>Borassus flabellifer</i> L.	<i>Mycol. Pap.</i> 139 : 24 (1975)
125	<i>Anthostomella limitata</i> Sacc.	Xylariaceae	<i>Wallichia siamensis</i> Becc.	<i>Atti Accademia Scientifica Veneto-Trentino-Istriana</i> 4 : 101 (1875)
028	<i>Anthostomella nitidissima</i> (Durieu & Mont.) Sacc.	Xylariaceae	<i>Cocos nucifera</i> L.	<i>Syll. Fung.</i> 1 : 279 (1882)
146	<i>Anthostomella punctata</i> (Roberge) Sacc.	Xylariaceae	<i>Wallichia siamensis</i> Becc.	<i>Sylogae Fungorum</i> 1 : 278 (1882)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
324; 146	<i>Anthostomella puiggarii</i> Speg.	Xylariaceae	<i>Livistona chinensis</i> R.Br.; <i>Wallichia siamensis</i> Becc.	<i>Boln Acad. nac. Cienc. Córdoba</i> 23 : 467 (1919)
155	<i>Anthostomella zongluensis</i> K.D. Hyde	Xylariaceae	<i>Borassus flabellifer</i> L.	<i>Nova Hedwigia</i> 62 : 333 (1996)
123, 353	<i>Apiospora siamicola</i> Hidayat & To-anun, sp. nov.	Apiosporaceae	<i>Wallichia siamensis</i> Becc.	In this study
339; 356	<i>Apiosporina rhapsicola</i> Hidayat & To-anun, sp. nov.	Venturiaceae	<i>Rhapis</i> sp.; <i>Wallichia siamensis</i> Becc.	In this study
124, 354	<i>Arecomyces foliicola</i> Hidayat & To-anun, sp. nov.	Hyponectriaceae	<i>Wallichia siamensis</i> Becc.	In this study
366	<i>Arecomyces frondicola</i> K.D. Hyde	Hyponectriaceae	<i>Wallichia siamensis</i> Becc.	<i>Sydowia</i> 48 : 232 (1996)
066; 109; 426	<i>Arthrinium phaeospermum</i> (Corda) M.B. Ellis	Apiosporaceae	<i>Areca catechu</i> L.; <i>Borassodendron</i> sp.; <i>Wallichia siamensis</i> Becc.	<i>Mycol. Pap.</i> 103 : 8 (1965)
183	<i>Aspergillus niger</i> Tiegh.	Trichocomaceae	<i>Borassus flabellifer</i> L.	<i>Annl. Sci. Nat., Bot., sér. 5</i> 8 : 240 (1867)
320	<i>Astrosphaeriella caryotae</i> Hidayat & To-anun, sp. nov.	Melanommataceae	<i>Caryota mitis</i> Lour.	In this study
376	<i>Astrosphaeriella fronsicola</i> J. Fröhl. & K.D. Hyde	Melanommataceae	<i>Wallichia siamensis</i> Becc.	<i>Mycol. Res.</i> 99 (4): 453 (1995)
345	<i>Astrosphaeriella nypae</i> K.D. Hyde	Melanommataceae	<i>Latania lontaroides</i> (Gaertn.) H.E. Moore	<i>J. Linn. Soc., Bot.</i> 110 : 96 (1992)
084	<i>Astrosphaeriella palmicola</i> Hidayat & To-anun, sp. nov.	Melanommataceae	<i>Areca catechu</i> L.	In this study

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
377	<i>Beltrania rhombica</i> Penz.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Michelia</i> 2(no. 8): 474 (1882)
378	<i>Beltraniella portoricensis</i> (F. Stevens) Piroz. & S.D. Patil	Hyponectriaceae	<i>Wallichia siamensis</i> Becc.	<i>Can. J. Bot.</i> 48(3): 575 (1970)
043	<i>Bionectria ochroleuca</i> (Schwein.) Schroers & Samuels	Bionectriaceae	<i>Borassus flabellifer</i> L.	<i>Z. Mykol.</i> 63(2): 151 (1997)
037	<i>Bionectria</i> sp.1	Bionectriaceae	<i>Cocos nucifera</i> L.	
414	<i>Bionectria</i> sp.2	Bionectriaceae	<i>Chamaedorea costaricana</i> Oerst.	
379	<i>Bionectria</i> sp.3	Bionectriaceae	<i>Wallichia siamensis</i> Becc.	
064; 103	<i>Botryosphaeria cocogena</i> Subileau, Renard & Lacoste	Botryosphaeriaceae	<i>Cocos nucifera</i> L.; <i>Areca catechu</i> L.	<i>Mycotaxon</i> 51: 8 (1994)
020	<i>Botryosphaeria obtusa</i> (Schwein.) Shoemaker	Botryosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Canadian Journal of Botany</i> 42: 1298 (1964)
004	<i>Byssosphaeria schiedermayeriana</i> (Fuckel) Barr	Melanommataceae	<i>Cocos nucifera</i> L.	<i>Mycotaxon</i> 20: 34 (1984)
187	<i>Botryotrichum</i> sp.	Chaetomiaceae	<i>Wallichia siamensis</i> Becc.	
380	<i>Camposporium antennatum</i> Harkn.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Bull. Calif. Acad. Sci.</i> 1: 37 (1884)
322	<i>Catabotrys deciduum</i> (Berk. & Broome) Seaver & Waterston	Catabotrydaceae	<i>Areca catechu</i> L.	<i>Mycologia</i> 38: 184 (1946)
330	<i>Cercospora areacearum</i> Hidayat and Meeboon, sp. nov.	Mycosphaerelaceae	<i>Areca catechu</i> L.	<i>Mycol. Prog.</i> 8: 116 (2009)
381	<i>Ceuthospora palmicola</i> Joanne E. Taylor, K.D. Hyde & E.B.G. Jones	Phacidiaceae	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity Res. Ser.</i> 12: 250 (2003)
182	<i>Chaetomium</i> sp.	Chaetomiaceae	<i>Wallichia siamensis</i> Becc.	

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
029	<i>Chaetospermum chaetosporum</i> (Pat.) Smith & Ramsbottom	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Trans. Br. Mycol. Soc.</i> 4 : 328 (1914)
021	<i>Chaetosphaeria fusiformis</i> W. Gams & Hol.-Jech.	Chaetosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Mycotaxon</i> 13 : 257 (1981)
382	<i>Chalara cylindrosperma</i> (Corda) S. Hughes	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Can. J. Bot.</i> 36 : 747 (1958)
383	<i>Cladosporium cladosporioides</i> (Fresen.) G.A. de Vries	Davidiellaceae	<i>Wallichia siamensis</i> Becc.	<i>Contrib. Knowledge of the Genus Cladosporium Link ex Fries</i> : 57 (1952)
404	<i>Cladosporium oxysporum</i> Berk. & M.A. Curtis	Davidiellaceae	<i>Chamaedorea metallica</i> O.F.Cook ex H.E.Moore	<i>J. Linn. Soc., Bot.</i> 10 : 362 (1868)
164; 100	<i>Colletotrichum acutatum</i> J.H. Simmonds	Glomerellaceae	<i>Borassus flabellifer</i> L.; <i>Borassodendron</i> sp.	<i>Queensland J. agric. Anim. Sci.</i> 25 : 178A (1968)
038, 122, 139, 145; 092, 093, 096; 401	<i>Colletotrichum gloeosporioides</i> (Penz.) Penz. & Sacc.	Glomerellaceae	<i>Wallichia siamensis</i> Becc.; <i>Areca catechu</i> L.; <i>Chamaedorea metallica</i> O.F.Cook ex H.E.Moore	<i>Atti Inst. Veneto Sci. lett., ed Arti, Sér. 6</i> 2 : 670 (1884)
384	<i>Conioscypha lignicola</i> Höhn.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Annales Mycologici</i> 2 : 58 (1904)
407, 413, 417	<i>Curvularia affinis</i> Boedijn	Pleosporaceae	<i>Bismarckia nobilis</i> Hildebr. & H.Wendl.	<i>Bull. Jard. Bot. Buitenz</i> , 3 Sér. 13 : 130 (1933)
099; 160	<i>Curvularia lunata</i> (Wakker) Boedijn	Pleosporaceae	<i>Borassodendron</i> sp.; <i>Wallichia siamensis</i> Becc.	<i>Bull. Jard. Bot. Buitenz</i> , 3 Sér. 13 : 127 (1933)
161	<i>Curvularia senegalensis</i> (Speg.) Subram.	Pleosporaceae	<i>Borassus flabellifer</i> L.	<i>J. Indian Bot. Soc.</i> 35 : 467 (1956)
106, 112	<i>Cylindrosporium</i> sp.	Incertae sedis	<i>Borassodendron</i> sp.	
157	<i>Dactylaria</i> sp.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	
334	<i>Diatrype chlorosarca</i> Berk. & Broome	Diatrypaceae	<i>Wallichia siamensis</i> Becc.	<i>J. Linn. Soc., Bot.</i> 14 (2): 123 (1875)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
385	<i>Diaporthe palmarum</i> Joanne E. Taylor, K.D. Hyde & E.B.G. Jones	Diaporthaceae	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity Res. Ser.</i> 12 : 207 (2003)
386	<i>Diatrype chlorosarca</i> Berk. & Broome	Diatrypaceae	<i>Wallichia siamensis</i> Becc.	<i>J. Linn. Soc., Bot.</i> 14 : 123 (1875)
154	<i>Dictyochaeta wallichianensis</i> Hidayat & To-anun	Chaetosphaeriaceae	<i>Wallichia siamensis</i> Becc.	In this study (chapter 5)
387	<i>Dictyochaetopsis apicalis</i> (Berk. & M.A. Curtis) Aramb. & Cabello	Chaetosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Mycotaxon</i> 38 : 12 (1990)
388	<i>Dictyosporium heptasporum</i> (Garov.) Damon	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Lloydia</i> 15 : 118 (1952)
046; 088	<i>Didymella</i> sp.	Incertae sedis	<i>Borassus flabellifer</i> L.; <i>Areca catechu</i> L.	
389	<i>Didymosphaeria calamicola</i> Aptroot, J. Fröhl. & K.D. Hyde	Didymosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Nova Hedwigia</i> 69 : 453 (1999)
390	<i>Dinemasporium graminum</i> Lévl.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Annls Sci. Nat., Bot., sér. 3</i> , 5 : 274 (1846)
057	<i>Diplodia</i> sp.	Botryosphaeriaceae	<i>Borassus flabellifer</i> L.	
391	<i>Ellisembia</i> sp.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	
149	<i>Eriosporella calami</i> (Niessl) Höhn.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1</i> , 125 : 109 (1916)
420	<i>Exosporium stilbaceum</i> (Moreau) M.B. Ellis	Incertae sedis	<i>Licuala peltata</i> Roxb.	<i>Mycol. Pap.</i> 82 : 38 (1961)
147	<i>Fasciatispora petrakii</i> (Mhaskar & V.G. Rao) K.D. Hyde	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Nova Hedwigia</i> 61 : 255 (1995)
214	<i>Fasciatispora ujungkulonensis</i> Hidayat	Incertae sedis	<i>Caryota</i> sp.	<i>Mycotaxon</i> 102 : 350 (2007)
405	<i>Fusarium sansainensis</i> Hidayat & To-anun, sp. nov.	Nectriaceae	<i>Chamaedorea metallica</i> O.F.Cook ex H.E.Moore	In this study (chapter 4)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
152	<i>Gliocladium penicillioides</i> Corda	Hyphocreaceae	<i>Wallichia siamensis</i> Becc.	<i>Icon. Fung.</i> 4: 31 (1840)
050, 144; 418	<i>Glomerella cingulata</i> (Stoneman) Spald. & H. Schrenk	Glomerellaceae	<i>Wallichia siamensis</i> Becc.; <i>Livistona fulva</i> Rodd	<i>Science, N. S.</i> 17: 751 (1903)
407; 327	<i>Guignardia arengae</i> , Hidayat & To-anun, sp. nov.	Botryosphaeriaceae	<i>Arenga hookeriana</i> (Becc.) Whitmore; <i>Livistona chinensis</i> R.Br.	In this study
075, 076; 098	<i>Guignardia calami</i> (Syd.) Arx & E. Müll.	Botryosphaeriaceae	<i>Areca catechu</i> L.; <i>Borassodendron</i> n sp.	<i>Beitr. Kryptfl. Schweiz</i> 11: 55 (1954)
008, 062; 110	<i>Guignardia cocöes</i> (Petch) K.D. Hyde	Botryosphaeriaceae	<i>Cocos nucifera</i> L.; <i>Borassodendron</i> n sp.	<i>Sydowia</i> 47: 188 (1995)
016, 314	<i>Guignardia uniappendiculatum</i> Hidayat & To-anun, sp. nov.	Botryosphaeriaceae	<i>Wallichia siamensis</i> Becc.	In this study
392	<i>Gyrothrix circinata</i> (Berk. & M.A. Curtis) S. Hughes	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Can. J. Bot.</i> 36: 771 (1958)
393	<i>Helicomyces lilliputeus</i> Moore R.T.	Tubeufiaceae	<i>Wallichia siamensis</i> Becc.	<i>Mycologia</i> 49: 583 (1957)
086; 394	<i>Hermatomyces tucumanensis</i> Speg.	Incertae sedis	<i>Areca catechu</i> L.; <i>Wallichia siamensis</i> Becc.	<i>Anal. Mus. nac. Hist. nat. B. Aires</i> 13: 446 (1911)
048	<i>Lacellina graminicola</i> (Berk. & Broome) Petch	Incertae sedis	<i>Borassus flabellifer</i> L.	<i>Ann. R. bot. Gdns Peradeniya</i> 9: 171 (1924)
070	<i>Lacellinopsis sacchari</i> Subram.	Incertae sedis	<i>Borassus flabellifer</i> L.	<i>Proc. natn. Acad. Sci. India, Sect. B, Biol. Sci.</i> 37: 104 (1953)
006; 077, 095	<i>Lachnum palmae</i> (Kanouse) Spooner	Hyaloscyphaceae	<i>Wallichia siamensis</i> Becc.; <i>Areca catechu</i> L.	<i>Biblhca. Mycol.</i> 116: 484 (1987)
058	<i>Lachnum</i> sp.	Hyaloscyphaceae	<i>Cocos nucifera</i> L.	

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
063; 395	<i>Lasiodiplodia theobromae</i> (Pat.) Griffon & Maubl.	Botryosphaeriaceae	<i>Cocos nucifera</i> L.; <i>Wallichia siamensis</i> Becc.	<i>Bull. Soc. mycol. Fr.</i> 25 : 57 (1909)
291	<i>Lasiosphaeria</i> sp	Lasiosphaeriaceae	<i>Caryota mitis</i> Lour.	
091	<i>Lepteutypa sabalicola</i> (Ellis & G. Martin) M.E. Barr	Amphisphaeriaceae	<i>Areca catechu</i> L.	<i>Mycotaxon</i> 46 : 57 (1993)
181	<i>Leptodothiorella</i> sp.	Botryosphaeriaceae	<i>Wallichia siamensis</i> Becc.	
083, 087	<i>Linocarpon nonappendiculatum</i> Hidayat & To-anun, sp. nov.	Incertae sedis	<i>Areca catechu</i> L	In this study
323	<i>Lophiostoma livistoncola</i> Hidayat & To-anun, sp. nov.	Lophiostomataceae	<i>Livistona chinensis</i> R.Br.	In this study
396	<i>Lophiostoma macrostomum</i> (Tode) Ces. & De Not.	Lophiostomataceae	<i>Wallichia siamensis</i> Becc.	<i>Symbolae Mycologicae</i> : 7 (1870)
035	<i>Lophodermium arundinaceum</i> (Schrad.) Chevall.	Rhytismataceae	<i>Cocos nucifera</i> L.	<i>Fl. gén. env. Paris</i> 1 : 435 (1826)
397	<i>Massarina palmicola</i> K.D. Hyde & Aptroot	Massarinaceae	<i>Wallichia siamensis</i> Becc.	<i>Nova Hedwigia</i> 64 : 499 (1997)
415; 344	<i>Melanographium citri</i> (Gonz. Frag. & Cif.) M.B. Ellis	Incertae sedis	<i>Copernicia rigida</i> Britton & P.Wilson; <i>Latania lontaroides</i> (Gaertn.) H.E.Moore	<i>Mycol. Pap.</i> 93 : 21 (1963)
053, 068	<i>Microthyrium elatum</i> Rehm	Microthyriaceae	<i>Borassus flabellifer</i> L.	Saccardo's <i>Syll. fung.</i> XXIV: 426 (1926)
009	<i>Microthyrium fagi</i> J.P. Ellis	Microthyriaceae	<i>Cocos nucifera</i> L.	<i>Trans. Br. mycol. Soc.</i> 67 : 383 (1977) [1976]
188	<i>Mitteriella zizyphina</i> Syd.	Englerulaceae	<i>Wallichia siamensis</i> Becc.	<i>Annales Mycologici</i> 31 : 95 (1933)
398	<i>Monodictys putredinis</i> (Wallr.) S. Hughes	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Can. J. Bot.</i> 36 : 785 (1958)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
399	<i>Montagnula</i> sp.	Montagnulaceae	<i>Wallichia siamensis</i> Becc.	
357	<i>Morenoina palmicola</i> J. Fröhl., K.D. Hyde & Joanne E. Taylor	Asterinaceae	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity Research Series</i> 3 : 89 (2000)
156	<i>Mucor</i> sp.	Mucoraceae (Zygomycota)	<i>Wallichia siamensis</i> Becc.	
271	<i>Muyocopron tectum</i> (G. Winter) Arx & E. Müll.	Microthyriaceae	<i>Borassus flabellifer</i> L.	<i>Beiträge zur Kryptogamenflora der Schweiz</i> 11 : 91 (1954)
102	<i>Mycosphaerella arecearum</i> Hidayat & To-anun, sp. nov.	Mycosphaerellaceae	<i>Areca catechu</i> L.	In this study
059	<i>Mycosphaerella borassi</i> Hidayat and To-anun, sp. nov.	Mycosphaerellaceae	<i>Borassus flabellifer</i> L.	In this study
015, 030; 089	<i>Mycosphaerella palmicola</i> Chaudhury & P.N. Rao	Mycosphaerellaceae	<i>Cocos nucifera</i> L.; <i>Areca catechu</i> L.	<i>Mycopath. Mycol. appl.</i> 22 : 221 (1964)
326	<i>Mycosphaerella</i> sp.	Mycosphaerellaceae	<i>Livistona chinensis</i> R.Br.	
013	<i>Mycosphaerella wallichiae</i> Hidayat and To-anun, sp. nov.	Mycosphaerellaceae	<i>Wallichia siamensis</i> Becc.	In this study
007; 025; 108	<i>Myelosperma tumidum</i> Syd. & P. Syd.	Myelospermataceae	<i>Cocos nucifera</i> L.; <i>Wallichia siamensis</i> Becc.; <i>Borassodendron</i> sp.	<i>Annales Mycologici</i> 13 : 38 (1915)
097	<i>Myrothecium</i> sp.	Incertae sedis	<i>Borassodendron</i> sp.	
003	<i>Nectria foliicola</i> Berk. & M.A. Curtis	Nectriaceae	<i>Cocos nucifera</i> L.	<i>J. Linn. Soc., Bot.</i> 10 : 379 (1868)
111	<i>Nectria</i> sp.1	Nectriaceae	<i>Borassodendron</i> sp.	
116	<i>Nectria</i> sp.2	Nectriaceae	<i>Caryota mitis</i> Lour.	
126, 354	<i>Neorehmia arecae</i> (Syd.) Samuels & M.E. Barr	Trichosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Canadian Journal of Botany</i> 75 : 2165-2176 (1997)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
047; 400	<i>Nigrospora oryzae</i> (Berk. & Broome) Petch	Incertae sedis	<i>Borassus flabellifer</i> L.; <i>Wallichia siamensis</i> Becc.	<i>J. Indian bot. Soc.</i> 4 : 24 (1924)
412	<i>Nigrospora sphaerica</i> (Sacc.) E.W. Mason	Incertae sedis	<i>Bismarckia nobilis</i> Hildebr. & H.Wendl.	<i>Trans. Br. mycol. Soc.</i> 12 : 158 (1927)
159	<i>Nodulisporium acervatum</i> (Masse) Deighton	Xylariaceae	<i>Wallichia siamensis</i> Becc.	<i>Trans. Br. mycol. Soc.</i> 85 (3): 391 (1985)
127	<i>Oedocephalum formosum</i> Hidayat & To-anun, sp. nov.	Incertae sedis	<i>Borassus flabellifer</i> L.	In this study
338	<i>Ophioceras dolichostomum</i> (Berk. & Curtis) Sacc. M.A.	Magnaporthaceae	<i>Rhapis</i> sp.	<i>Syll. fung.</i> (Abellini) 2 : 358 (1883)
078, 094	<i>Ophioceras guttulatum</i> K.M. Tsui, H.Y.M. Leung, K.D. Hyde & Hodgkiss	Magnaporthaceae	<i>Areca catechu</i> L.	<i>Mycoscience</i> 42 (4): 321 (2001)
011; 034	<i>Ophioceras tenuisporum</i> Shearer, J.L. Crane & W. Chen	Magnaporthaceae	<i>Wallichia siamensis</i> Becc.; <i>Cocos nucifera</i> L.	<i>Mycologia</i> 91 : 149 (1999)
151	<i>Oxydothis cyrtostachicola</i> Hidayat & To-anun	Incertae sedis	<i>Cyrtostachys renda</i> Blume	<i>Fungal Diversity</i> 23 : 164 (2006)
019, 141	<i>Oxydothis daemonoropsicola</i> J. Fröhl. & K.D. Hyde	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity Research Series</i> 3 : 183(2000)
018	<i>Oxydothis inaequalis</i> Hidayat, To-anun & K.D. Hyde	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity</i> 23 : 165 (2006)
119	<i>Oxydothis linospadicis</i> J. Fröhl. & K.D. Hyde	Incertae sedis	<i>Caryota mitis</i> Lour.	<i>Mycol. Res.</i> 98 : 215 (1994)
001	<i>Oxydothis oedema</i> (Mont.) K.D. Hyde	Incertae sedis	<i>Cocos nucifera</i> L.	<i>Sydowia</i> 46 : 300 (1994)
419	<i>Oxydothis oraniopsis</i> J. Fröhl. & K.D. Hyde	Incertae sedis	<i>Chrysalidocarpus lutescens</i> H.Wendl.	<i>Mycol. Res.</i> 98 : 215 (1994)
114	<i>Oxydothis parvula</i> (Syd.) Petr.	Incertae sedis	<i>Borassodendron</i> sp.	<i>Sydowia</i> 6 : 314 (1952)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
010	<i>Oxydothis wallichianensis</i> Hidayat, To-Anun & K.D. Hyde	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity</i> 23 : 167 (2006)
184	<i>Paecilomyces variotii</i> Bainier	Trichocomaceae	<i>Wallichia siamensis</i> Becc.	<i>Bull. Soc. Mycol. Fr.</i> 23 : 27 (1907)
162	<i>Passalora clematidis</i> (R.K. Verma & Kamal) U. Braun & Crou	Mycosphaerellaceae	<i>Borassus flabellifer</i> L.	<i>CBS Diversity Ser.</i> 1 : 448 (2003)
005	<i>Pemphidium rattanicola</i> J.Fröhl. & K.D. Hyde	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Fungal Diversity Research Series</i> 3 : 225 (2000)
153	<i>Penicillium</i> sp.	Trichocomaceae	<i>Wallichia siamensis</i> Becc.	
039, 061; 331	<i>Periconia byssoides</i> Pers.	Incertae sedis	<i>Borassus flabellifer</i> L.; <i>Areca catechu</i> L.	<i>Syn. meth. fung.</i> 1 : 18 (1801)
069, 072; 417	<i>Periconia cookei</i> E.W. Mason & M.B. Ellis	Incertae sedis	<i>Borassus flabellifer</i> L.; <i>Copernicia rigida</i> Britton & P. Wilson	<i>Mycol. Pap.</i> 56 : 72 (1953)
411; 402	<i>Periconia digitata</i> (Cooke) Sacc.	Incertae sedis	<i>Bismarckia nobilis</i> Hildebr. & H. Wendl.; <i>Chamaedorea metallica</i> O.F. Cook ex H.E. Moore	<i>Syll. fung.</i> (Abellini) 4 : 274 (1886)
190	<i>Periconiella cocoës</i> M.B. Ellis	Mycosphaerellaceae	<i>Wallichia siamensis</i> Becc.	<i>Mycol. Pap.</i> 111 : 23 (1967)
027	<i>Pestalospaeria elaeidis</i> (C. Booth & J.S. Robertson) Aa	Amphisphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Proc. K. Ned. Akad. Wet., Ser. C, Biol. Med. Sci.</i> 67 : 87 (1976)
319; 342	<i>Pestalotiopsis eusora</i> (Sacc.) J. Xiang Zhang & T. Xu	Amphisphaeriaceae	<i>Caryota mitis</i> Lour.; <i>Pinanga</i> sp.	<i>Mycotaxon</i> 85 : 93 (2003)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
032	<i>Pestalotiopsis guepinii</i> (Desm.) Steyaert	Amphisphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Bulletin du Jardin Botanique de l'État à Bruxelles</i> 19 : 312 (1949)
054; 060; 410; 406; 421; 134	<i>Pestalotiopsis palmarum</i> (Cooke) Steyaert	Amphisphaeriaceae	<i>Borassus flabellifer</i> L.; <i>Cocos nucifera</i> L.; <i>Bismarckia nobilis</i> Hildebr. & H. Wendl.; <i>Chamaedorea metallica</i> O.F. Cook ex H.E. Moore; <i>Licuala peltata</i> Roxb.; <i>Livistona chinensis</i> R.Br.	<i>Bull. Jard. Bot. État Brux.</i> 19 : 322 (1949)
359	<i>Petrakia echinata</i> (Peglion) Syd. & P. Syd.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Annales Mycologici</i> 11 : 407 (1913)
328	<i>Phaeosphaeria livistoniae</i> J. Fröhl. & K.D. Hyde	Phaeosphaeriaceae	<i>Livistona chinensis</i> R.Br.	<i>Fungal Diversity Research Series</i> 3 : 273 (2000)
272	<i>Phaeophleospora striae</i> Joanne E. Taylor, K.D. Hyde & E.B.G. Jones	Mycosphaerellaceae	<i>Borassus flabellifer</i> L.	<i>Fungal Diversity Res. Ser.</i> 12 : 276 (2003)
045	<i>Phoma</i> sp.1	Incertae sedis	<i>Cocos nucifera</i> L.	
360	<i>Phoma</i> sp.2	Incertae sedis	<i>Wallichia siamensis</i> Becc.	
113, 315	<i>Phomopsis caryotae-urentis</i> Petr. & Cif.	Diaporthaceae	<i>Wallichia siamensis</i> Becc.; <i>Caryota mitis</i> Lour.	<i>Annales Mycologici</i> 28 : 413 (1930)
105; 409, 336	<i>Phomopsis elaeidis</i> Punith.	Diaporthaceae	<i>Borassodendron</i> sp.; <i>Arenga hookeriana</i> (Becc.) Whitmore; <i>Borassus flabellifer</i> L.	<i>Trans. Br. Mycol. Soc.</i> 63 : 229 (1974)
131	<i>Phomopsis pittospori</i> Archer	Diaporthaceae	<i>Livistona chinensis</i> R.Br.	<i>Trans. Br. mycol. Soc.</i> 61 : 221 (1973)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
317, 321	<i>Phyllosticta caryotae</i> C.I. Chen	Botryosphaeriaceae	<i>Caryota mitis</i> Lour.	<i>Contrib. Biol. Lab. Sci. Soc. China, Bot. Ser.</i> 8 : 157 (1932)
038; 403	<i>Pithomyces sacchari</i> (Speg.) M.B. Ellis	Pleosporaceae	<i>Borassus flabellifer</i> L.; <i>Chamaedorea metallica</i> O.F.Cook ex H.E.Moore	<i>Mycol. Pap.</i> 76 : 17 (1960)
040	<i>Pleiochaeta setosa</i> (Kirchn.) S. Hughes	Incertae sedis	<i>Cocos nucifera</i> L.	<i>Mycol. Pap.</i> 36 : 39 (1951)
265	<i>Pleospora herbarum</i> (Pers.) Rabenh.	Pleosporaceae	<i>Borassus flabellifer</i> L.	<i>Herb. myc.</i> 2 : 547 (1854)
361	<i>Pleurophragmium</i> sp.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	
002; 362	<i>Protocreopsis pertusa</i> (Pat.) Samuels & Rossman	Bionectriaceae	<i>Cocos nucifera</i> L.; <i>Wallichia siamensis</i> Becc.	<i>Stud. Mycol.</i> 42 : 66 (1999)
049	<i>Pseudogibbellula formicarum</i> (Mains) Samson & H.C. Evans	Cordycipitaceae	<i>Borassus flabellifer</i> L.	<i>Acta bot. neerl.</i> 22 : 524 (1973)
142	<i>Pseudohalonectria palmicola</i> K. D. Hyde, Joanne E. Taylor & J. Fröhl.	Magnaporthaceae	<i>Wallichia siamensis</i> Becc.	<i>Mycologia</i> 91 : 522 (1999)
041	<i>Rabenhorstia tiliae</i> (Fr.) Fr.	Incertae sedis	<i>Borassus flabellifer</i> L.	<i>Summa veg. Scand., Section Post.</i> (Stockholm): 410 (1849)
140	<i>Rachidicola obclavatum</i> Hidayat & To-anun, sp. nov.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	In this study
186	<i>Rhizopus</i> sp.	Mucoraceae (Zygomycota)	<i>Wallichia siamensis</i> Becc.	
026	<i>Rosellinia victoriae</i> Syd. & P. Syd.	Xylariaceae	<i>Wallichia siamensis</i> Becc.	<i>Annales Mycologici</i> 6 : 483 (1908)
363	<i>Rousoëlla palmicola</i> J. Fröhl., K.D. Hyde & Aptroot	Didymosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Nova Hedwigia</i> 69 : 468 (1999)
042	<i>Schizophyllum fasciatum</i> Pat.	Schizophyllaceae (Basidiomycota)	<i>Borassus flabellifer</i> L.	<i>J. Bot. Morot</i> 1 : 170 (1887)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
268	<i>Spegazzinia deightonii</i> (S. Hughes) Subram.		<i>Borassus flabellifer</i> L.	<i>J. Indian bot. Soc.</i> 35 : 78 (1956)
364	<i>Spiropes penicillium</i> (Speg.) M.B. Ellis	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Mycol. Pap.</i> 114 : 23 (1968)
365	<i>Sporidesmium</i> sp.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	
189	<i>Sporoschisma saccardoii</i> E.W. Mason & S. Hughes	Chaetosphaeriaceae	<i>Wallichia siamensis</i> Becc.	<i>Mycol. Pap.</i> 31 : 20 (1949)
368	<i>Sporormiella minimoides</i> S.I. Ahmed & Cain	Sporormiaceae	<i>Wallichia siamensis</i> Becc.	<i>Can. J. Bot.</i> 50 : 450 (1972)
197	<i>Stachybotrys kampalensis</i> Hansf.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Proc. Linn. Soc. London</i> 155 : 45 (1943)
169	<i>Stilbella</i> sp.	Incertae sedis	<i>Borassus flabellifer</i> L.	
017	<i>Submersisphaeria suthepensis</i> Hidayat & To-anun, sp. nov.	Annulatascaceae	<i>Wallichia siamensis</i> Becc.	In this study
150	<i>Terriera brevis</i> (Berk.) P.R. Johnst.	Rhytismataceae	<i>Wallichia siamensis</i> Becc.	<i>Mycol. Pap.</i> 176 : 98 (2001)
133	<i>Terriera livistonae</i> Hidayat & To-anun, sp. nov.	Rhytismataceae	<i>Livistona chinensis</i> R.Br.	In this study
085	<i>Tetraploa aristata</i> Berk. & Broome	Massarinaceae	<i>Areca catechu</i> L.	<i>Ann. Mag. nat. Hist.</i> , Ser. 2 5 : 459 (1850)
071; 367	<i>Torula herbarum</i> (Pers.) Link	Incertae sedis	<i>Borassus flabellifer</i> L.; <i>Wallichia siamensis</i> Becc.	<i>Magazin Ges. naturf. Freunde, Berlin</i> 3 : 19 (1809)
370	<i>Trichothyria alpestris</i> (Sacc.) Petr.	Microthyriaceae	<i>Wallichia siamensis</i> Becc.	<i>Sydowia</i> 4 : 168 (1950)
082	<i>Venturia frondicola</i> Hidayat & To-anun, sp. nov.	Venturiaceae	<i>Areca catechu</i> L.	In this study
343	<i>Veronea botryosa</i> Cif. & Montemart.	Incertae sedis	<i>Wallichia siamensis</i> Becc.	<i>Atti Ist. bot. Univ. Lab. crittog. Pavia, Sér. 5</i> 15 : 68 (1957)

(Table continued)

Herbaria number (FIH)	Fungal species	Family	Host	References
374	<i>Verticillium</i> sp.	Plectosphaerellaceae	<i>Wallichia siamensis</i> Becc.	
054; 372	<i>Wiesneriomyces laurinus</i> (Tassi) P.M. Kirk	Incertae sedis	<i>Borassus flabellifer</i> L.; <i>Wallichia siamensis</i> Becc.	<i>Trans. Br. mycol. Soc.</i> 82 : 748 (1984)
408; 416	<i>Zygosporium echinosporum</i> Bunting & Mason E.W.	Incertae sedis	<i>Arenga hookeriana</i> (Becc.) Whitmore; <i>Copernicia rigida</i> Britton & P. Wilson	<i>Mycol. Pap.</i> 5 : 135 (1941)
051	<i>Zygosporium gibbum</i> (Sacc., M. Rousseau & E. Bommer) S. Hughes	Incertae sedis	<i>Borassus flabellifer</i> L.	<i>Can. J. Bot.</i> 36 : 825 (1958)
333; 158	<i>Zygosporium oscheoides</i> Mont.	Incertae sedis	<i>Caryota mitis</i> Lour.; <i>Wallichia siamensis</i> Becc.	<i>Annls Sci. Nat., Bot., sér. 2</i> , 17 : 121 (1842)

2.2. Materials and Methods

A. Collecting Protocols and Site Description

Specimens of palm's necrotic leaflets and decaying fronds were collected from several natural and planted sites in Chiang Mai province and other locations, including Indonesia. Collections of *W. siamensis* fronds were carried out at Huay Kog Ma, Doi Suthep-Pui National Park, Chiang Mai, Thailand. The National Park is a typical tropical forest in northern Thailand as strongly seasonal. There are three distinct seasons, cool dry season (November-March), hot dry season (March-May), and warm wet season (May-November). The annual rainfall varies from 1100-1500

mm, with over 80% of annual rainfall within the 6 months of rainy season, whilst the months of December, January, and February are virtually without rain. The average temperature of the area ranged from 20°-23°C. In the dry season (December-February), the temperature at high elevation is low (Gardner *et al.*, 2000).

The amount of material collected at each site is standardized for each palm species depending on the bulkiness of the material. One to three of 11.5” x 16.5” resealable bags were used for each palm species. The different palm parts were collected in various states of decay. Living leaves with spots were collected if present. Collecting bags are sealed and labeled with the following information: ***Name of the palm, Collecting site, Collector/s, and Date.*** On returning to the laboratory, the material is incubated for a week and either studied immediately or air dried and stored for studying at a later date. Air drying enabled single spore isolations to be made, which would not be possible with oven dried specimens.

B. Examination of Materials

The decaying and senescent materials were examined for saprobic Ascomycetes, Coelomycetes, Hyphomycetes, and Basidiomycetes. The living leaves materials with necrosis symptoms were subjected for the observation of potential plant pathogenic fungi occur on the leaves symptom. The materials were examined using an Olympus SZ H10 dissecting microscope to determine the presence of the fungal fruiting structures. Once a group of fruiting structures is encountered, a marker is placed firmly in the material, or the area is marked with permanent pen. Each newly encountered fungus at each site is given an identity number and detail records are

made, as outlined below. Once fully examined, the piece of material with all of its markers is placed in a resealable envelope with the following information:

Herbarium number

Fungus name

Host name

Collection site

Collector/s

Date

The materials were stored in labeled boxes in a dry environment, and naphthalene balls were used to keep insect infestation at a minimum. Unused materials were destroyed. Dried herbarium specimens were deposited at Mushroom Research Center Herbarium (MRC), CMU Herbarium (CMU), Faculty of Science, Chiang Mai University, Chiang Mai, Thailand, and Laboratory of Plant Pathology, Department of Plant Pathology, Faculty of Agriculture, Chiang Mai University.

Ascomycetes and Coelomycetes

A sharp one sided razor blade or a pair of Inox 5 fine forceps were used to carefully remove the top of the fruiting body. The specimens were rehydrated if the contents are dry or crystalline by using distilled water or potassium hydroxide (KOH) 3% before extraction. The contents were then placed in a drop of distilled water on a slide and covered with an 18 x 18 mm coverslip. The specimens were observed using an Olympus BX 50 photomicroscope system with differential interference contrast microscopy. Water was used for all examinations, spore measurements, and most of the photographs/line drawings.

Specific reagents were used when necessary as follows (Hawksworth *et al.*, 1995): Melzer's reagent was used to investigate any amyloid reactions at the apical ring of ascus of Ascomycetes. Indian ink (10%) was used to highlight the presence of mucilaginous sheaths of spores. Lactophenol cotton blue was used to highlight the ascus wall layers of bitunicate Ascomycetes. Potassium hydroxide (3%) and lactic acid was used in the identification of *Nectria* and allied genera. In addition, to aid the identification of the fungi, thin sections ($\pm 10 \mu\text{m}$) of rehydrated fruiting structures were made with a Micron HM505E cryostat microtome or by using hand section. Lactophenol was added to the slides for permanent fixation. The slides were heated to remove air bubbles in the lactophenol and the edges of the coverslip sealed with two layers of clear nail varnish. The slides were then labeled with the number of specimen it occurred on.

Hyphomycetes

Hyphomycetes materials examination was prepared by hand sectioning or by using a pair of Inox 5 fine forceps. Water was used as a medium for all examination. Lactophenol was used for permanent fixation. Detailed observations of morphological characters were carried out by means of an Olympus CX31 light microscope using oil immersion (1000 Δ).

C. Single Spore Isolation

Single spore isolation of each encountered new fungus was referred to Choi *et al.* (1999) with a modification. A glass container or glass slide is sterilized with ethanol and wiped with a towel on which ethanol (70%) has been sprayed. A

sterilized pipette is then used to transfer a few drops of sterilized water into the glass container or onto the glass slide. The suspension is then prepared by mixing spores or conidia with a sterilized water on the glass container/glass slide. Sixteen squares or triangle shape are marked on the bottom of the water agar plate. The prepared homogenous spore suspension is then transferred with a sterilized pipette or loop, onto the surface of the water agar plate. A small drop of the suspension should be used at this stage to make a permanent slide and to check that the correct fungus has been selected.

The unsealed plate is incubated at 25°C for 12-24 hours. It is not sealed as this allows some of the surface water to dry out. If the plate is sealed with parafilm, water would accumulate on the surface of the agar and it would increase the chance of contamination. The spores/conidia are checked every 24 hours to establish germination. Once the spores/conidia have germinated, a sterilized glass needle is used to pick up a small piece of agar containing a spore/conidium. If the spores/conidia do not germinate after 24 hours, the plate is sealed with parafilm and periodically examined. About ten germinated spores/conidia are transferred and distributed evenly onto PDA plate and incubated at 25°C until their colony reached about 1 to 2 cm. A small piece of mycelium with agar can then be cut and transferred to another PDA plate and the culture is checked after few days, if there is no contamination, a pure culture has been obtained. Cultures can then be stored on the desired media.

There are many different groups of fungi, e.g. Ascomycetes, Coelomycetes, Basidiomycetes and Hyphomycetes and each has different types of fruiting bodies. The methods to isolate each of them are therefore different. Fungi with closed fruiting

bodies (e.g. Ascomycetes with cleistothecia, perithecia, and Coelomycetes with pycnidia) can be removed from the substrate surface using fine forceps and broken in sterilized water in order to provide spore/conidia suspension. If the fruiting body is submerged in the substrate, a razor blade is used to cut the fruiting body to expose the internal contents. The contents can then be transferred to a drop of sterilized water on a small glass container or slide in order to provide a spore/conidia suspension. Fungi with cup-shaped bodies (Ascomycetes with apothecia, Coelomycetes with acervuli) can be transferred directly, by removing the whole fruiting body. This can be placed in sterilized water and squashed with fine forceps, in order to provide a spore/conidia suspension. Basidiomycetes with gills can produce numerous spores. Spores suspension can be obtained by removing a few segments from the gills and agitating them in sterilized water. Isolation can also be carried out from sterile tissue within the cap. A few pieces of sterile tissue can be aseptically torn from the split fruiting structure and placed on water agar. Conidia of Hyphomycetes can be picked up directly from the substrate using fine forceps or a needle. It is better to pick up conidia only (not conidiophores), as this reduces the chance of contamination. The conidia are placed in sterilized water and agitated in order to provide conidia suspension.

D. Identification Procedures

Basic Identification

The following texts are consulted for basic identification:

(1) **Ascomycetes:** Müller and Arx (1962), Ainsworth *et al.* (1973), Arx and Müller (1954), Arx (1975; 1987), Wehmeyer (1975), Dennis (1981), Sivanesan (1984), Barr

(1987; 1990), Hanlin (1990, 1998a, 1998b), Fröhlich and Hyde (2000), Hyde *et al.* (2000), Taylor and Hyde (2003), and Cai *et al.* (2006).

(2) Coelomycetes: Nag Raj (1993) and Sutton (1980).

(3) Hyphomycetes: Ellis (1971, 1976), Carmichael *et al.* (1980), and Matsushima (1971, 1975, 1980, 1981, 1983, 1985, 1987, 1989, 1993, 1995, 1996).

In most cases the specimen could be identified to generic name with the above references. Further identification required examination of the relevant literatures. Sources are often suggested in the above references and the Dictionary of Fungi (Kirk *et al.*, 2008) is found particularly up to date and useful, as is the Bibliography of Systematic Mycology on CD ROM (Produced by I.M.I., C.A.B. International Wallingford, UK). The ‘searchable’ Database of Fungi on the internet is also invaluable. The following fungal databases websites are also useful in fungal identification:

(1) Index Fungorum

(<http://www.indexfungorum.org/Names/Names.asp>)

(2) USDA fungus-host database

(<http://nt.ars-grin.gov/fungalatabases/fungushost/fungushost.cfm>)

(3) Home of the Xylariaceae

(<http://mycology.sinica.edu.tw/Xylariaceae/>)

(4) Fungi associated with *Phragmites australis*

(<http://intramar.urgent.be/nemys/fungi/web/>)

Description of New Taxa

In a case of the fungus could not be identified by consulting all of the relevant literature and seeking the advice of other mycological taxonomist, it is considered novel. Thorough description are made on standardized records sheets and usually 30 ascospores/conidia, 25 asci or conidiophores/conidiogenous cells and 10 fruiting bodies, apical apparatuses, ascospores sheats or appendages and paraphyses/pseudoparaphyses are measured. Microtome/hand sections are made of one or two fruiting bodies and 10 measurements are made of the whole ascomata or conidiomata and the components including the peridium, ostiole and where necessary the clypeus and/or stroma.

Presentation of Results

All fungi recorded in this study are presented in alphabetical order of the genera and subsequently species. "Host substrate" with information from the literature listed first and the relevant references cited, after which data from this study is listed. "Material examined" with information of country/ies, collecting site/s, host/s, dates, collector/s, and Herbarium/a number/s. For interesting species or genera, and new species or genera, a full description is presented, with the etymology of the specific epithet given and the holotype indicated in the "Material examined". Several unusual or rare species, or those which are poorly documented in the literature are illustrated and/or a description given.

Taxonomy

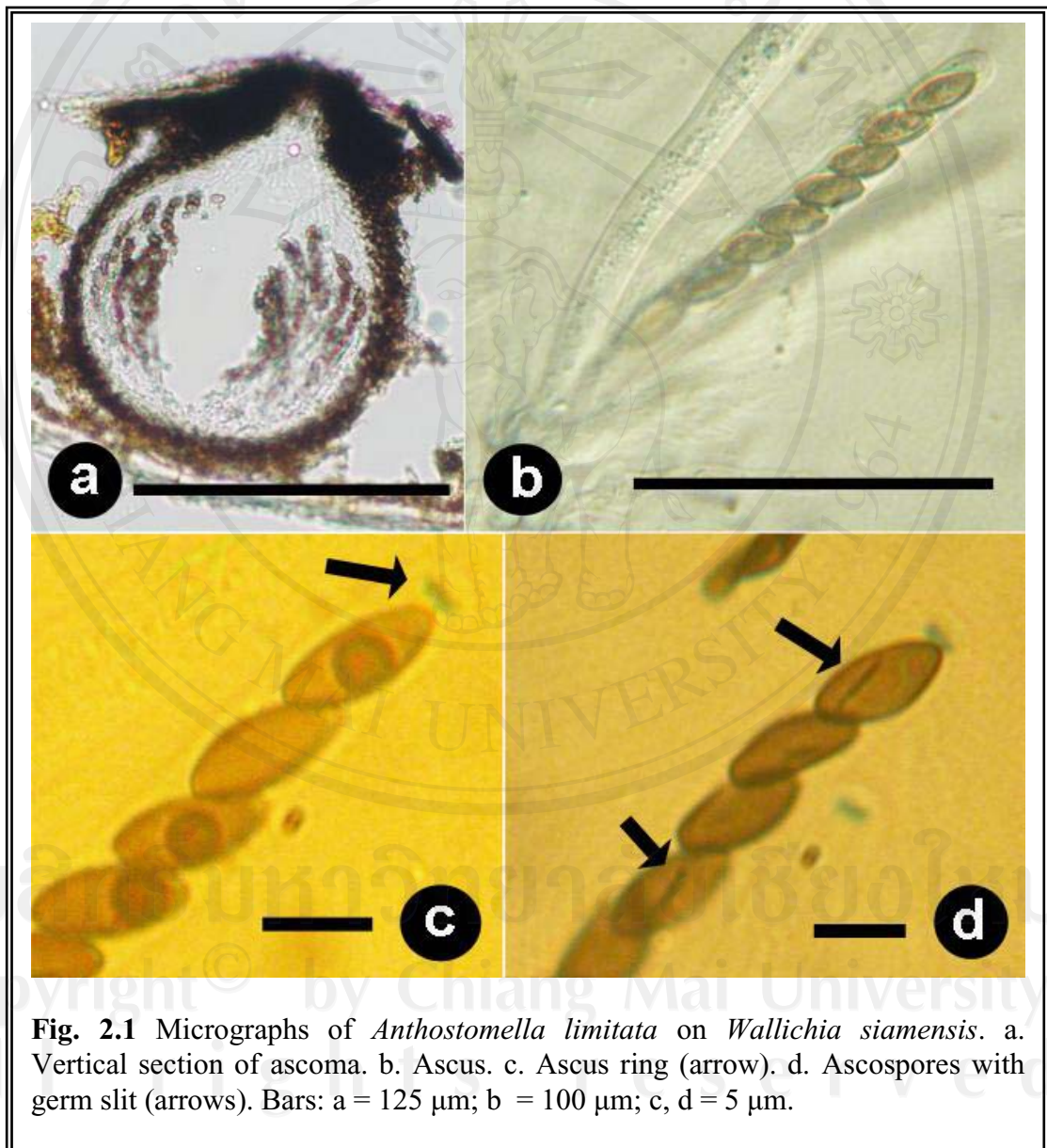
Fungi associated with *Wallichia siamensis*

- Anthostomella limitata* Sacc., *Atti Accademia Scientifica Veneto-Trentino-Istriana* **4**: 101. 1875
- ≡ *Anthostomella limitatum* (Sacc.) Cooke, *Grevillea* **17**: 90 (1889).
- = *Anthostomella argentinensis* (Speg.) Petr. and Syd., *Annales Mycologici* **23**: 213 (1925).
- = *Phaeophomatospora argentinensis* Speg., *Anales Museo Nacional Historia natural de Buenos Aires, Ser. 3*, **12**: 339 (1909).
- = *Anthostomella gracilis* Tassi, *Bulletino del Laboratorio Orto Botanico Siena* **3**: 53 (1900).
- = *Anthostomella melanoderma* Rehm, *Österreichische Botanische Zeitschrift* **54**: 82 (1904).

(Fig. 2.1)

Ascomata immersed, visible as blackened, raised, dome-shaped areas, dark-brown, coriaceous, clypeate, solitary, in section perithecium, globose to subglobose, 110.7-159.9 µm diam., 73.8-147.6 µm high. *Peridium* 12.5-20 µm wide, outside comprising 3-4 layers of brown-walled and compressed cells, inside comprising 1-2 layers of hyaline and compressed cells. *Paraphyses* septate, hyphal-like, up to 5 µm width. *Asci* cylindrical, 8-spored, unitunicate, ascus ring wedge shaped, J+ sub apical

ring, pedicellate, $85-112.5 \times 5-7.5 \mu\text{m}$. *Ascal ring* 1-1.5 μm high, 3-4 μm diam. *Ascospores* ellipsoid to ovoid to fusiform, 1-celled, $9-16 \times 4-5 \mu\text{m}$, dark brown, with a spiral germ slit (ca 5 μm long) at the middle part of cell.



Material examined: THAILAND, Chiang Mai Province, Suthep-Pui National Park, on living leaflets of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat, (FIH 125) (CMU 27949).

Host: *Callistemon*, *Carex*, *Conium*, *Daemonorops*, *Geranium*, *Galium*, *Kigelia*, *Rosa*, *Rubus*, *Sorbus*, *Typha* (Lu and Hyde, 2000).

Distribution: Argentina, Azores, Brunei, Finland, Germany, India, Italy, UK (Lu and Hyde, 2000).

Notes: This species is characteristic of *Anthostomella limitata* as it has a J+ apical apparatus and ellipsoidal ascospores with a spiral germ slit, lacking a dwarf cell and being less than 15 μm length. *Anthostomella limitata* on *W. siamensis* is only different from the type in having longer asci ($85\text{-}112.5 \times 5\text{-}7.5 \mu\text{m}$ vs. $72.5\text{-}100 \times 6.5\text{-}8 \mu\text{m}$) and longer ascospores ($9\text{-}16 \times 4\text{-}5 \mu\text{m}$ vs. $9.5\text{-}12.5 \times 4.5\text{-}5.5 \mu\text{m}$). This is the first report of *A. limitata* from Thailand and also *W. siamensis* as the host of the fungus.

Anthostomella puiggarii Speg., *Anales de la Sociedad Científica Argentina* **12**: 106 (1881); non reliquiae Mycologicae Tropicae, Imprenta y Casa editora 'Coni' (1919)
 = *Anthostomella baileyi* S. M. Francis, *Transactions of the British Mycological Society* **75**: 201 (1980).

(Fig. 2.2)

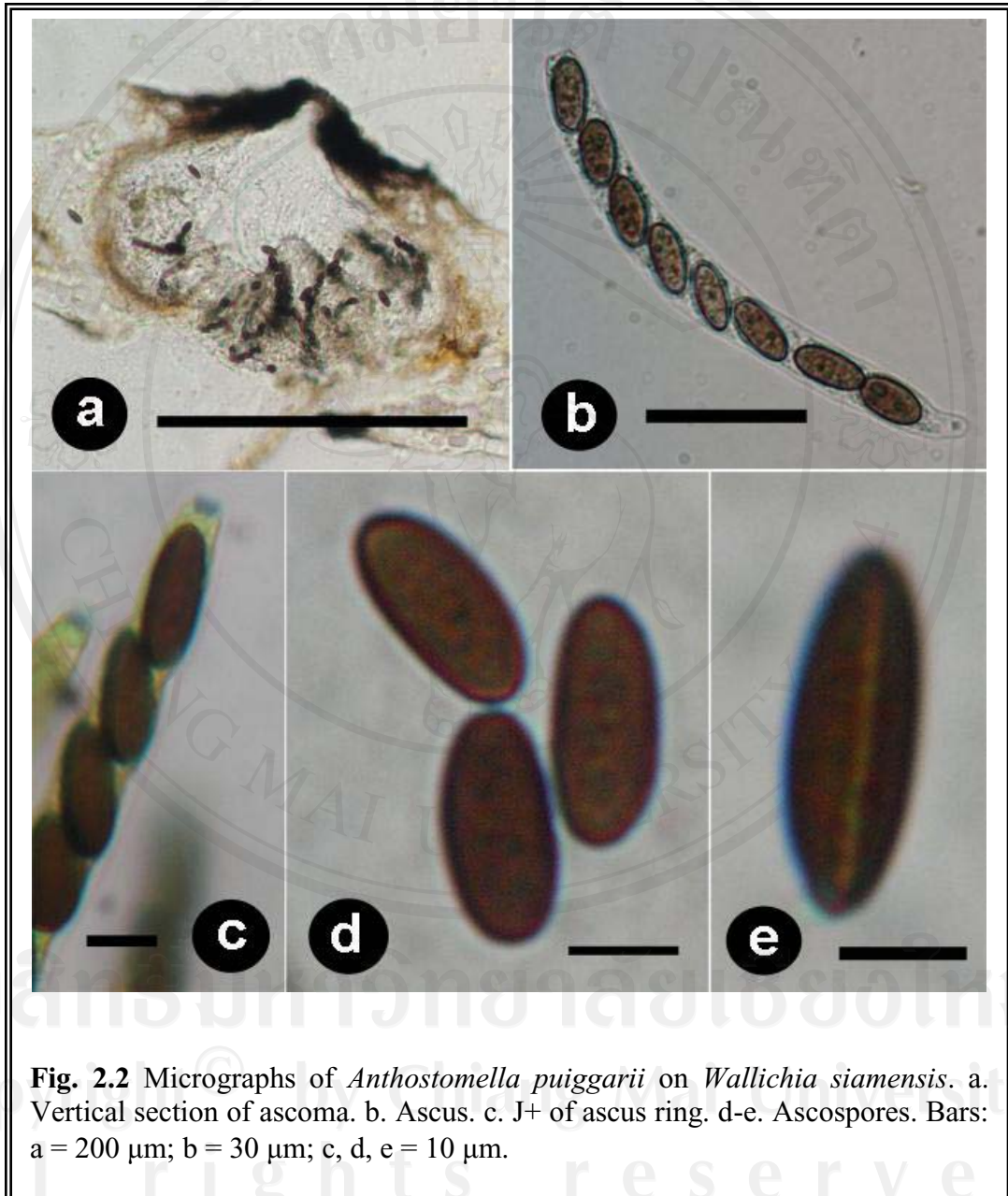
Ascomata immersed, solitary, clypeate, visible as blackened, raised, shiny, dome-shaped areas, in section 156-252.5 μm diam., 125-205 μm high, globose to subglobose, perithecium, with a central ostiole. *Peridium* 10-12.5 μm thick, outside comprising 2-3 layers of compressed brown and irregular cells, inside comprising 2-3 layers of compressed hyaline and ellipsoidal cells. *Paraphyses* 1.5-2 μm wide, numerous, filamentous, hyaline, septate, tapering to the apex, embedded in a gelatinous matrix. *Asci* 70-87.5 \times 6-7.5 μm , unitunicate, 8-spored, cylindrical, short and tapering pedicellate, apically rounded, with a J+, discoid apical ring, apical ring size 1.5-2 μm wide, 1-1.75 μm high. *Ascospores* 5-6.5 \times 7.5-12.5 μm , overlapping uniseriate, ellipsoidal, 1-celled, dark brown, thick-walled, with longitudinal germ slit through the spores, mucilaginous sheath lacking, often with oil drops structures near the ends.

Material Examined: THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, Hua Kog Ma, on primary rachis of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 146); on leaflets of *Livistona* sp. (Arecaceae), 26 October 2006, Iman Hidayat (FIH 324).

Host: *Bambusa*, *Elaeis*, *Freycinetia*, *Livistona*, *Pandanus*, *Sararanga* (Liu and Hyde, 2000).

Distribution: Australia, Brazil, New Zealand, Nigeria, Philippines (Liu and Hyde, 2000).

Notes: *Anthostomella puiggarii* is commonly associated with monocotyledonous plants. This specimen is the first record of *A. puiggarii* in Thailand, and *W. siamensis* is reported here as a new host.



Apiospora siamicola Hidayat & To-anun, **sp. nov.**

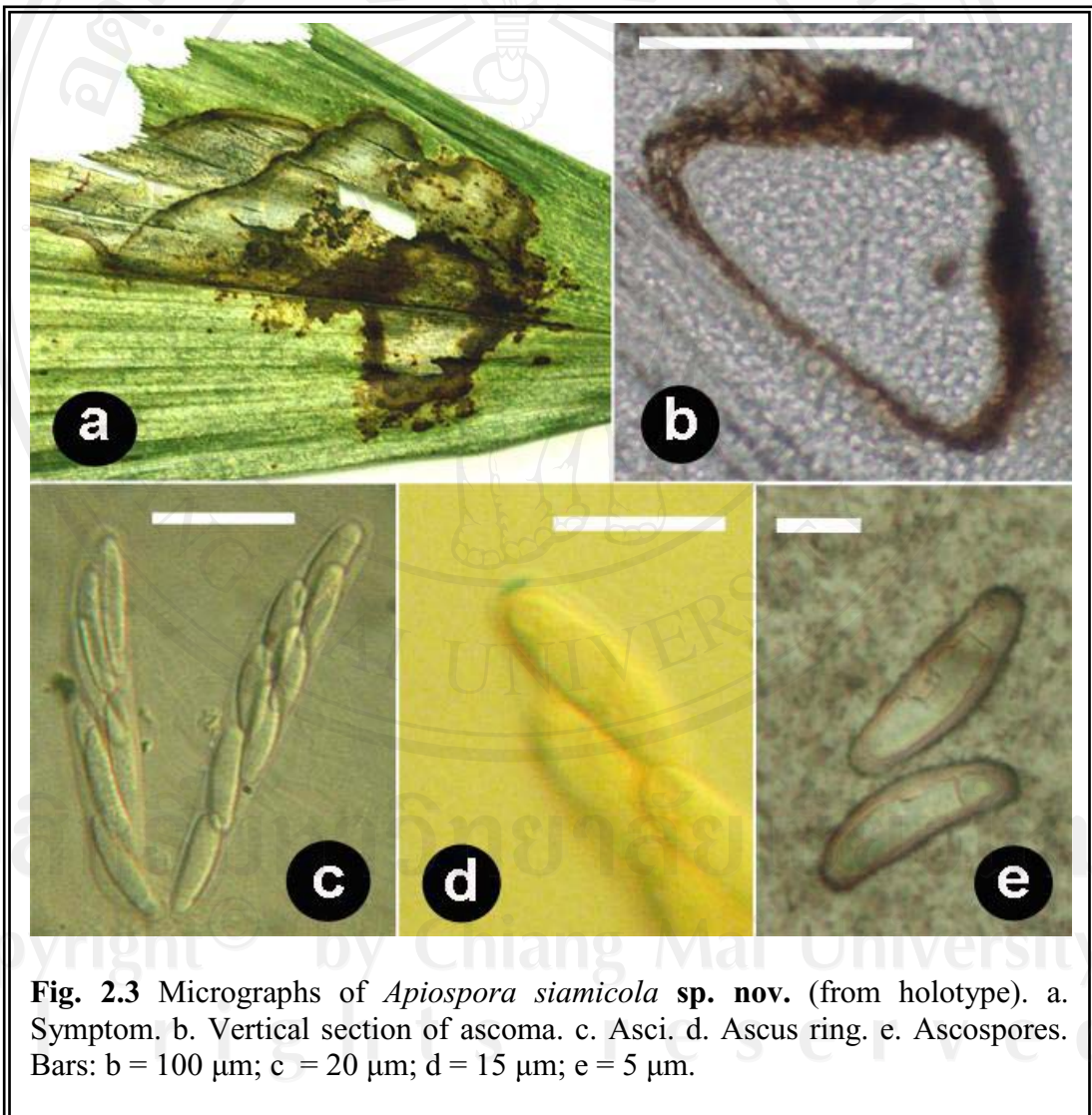
(Fig. 2.3)

Macula epiphylla, irregulare, 2-13 mm diam. × 1-3 mm alta, brunneae cum marginum fuscae. Ascomata 200-237.5 μm diam. × 112-125 μm alta, subglobosa, medium ostiolatum, solitaria, immersa. Peridium 7-13.5 μm latum. Paraphysae admodum 5 μm latae, hyalinae, septatae. Asci 62.5-77.5 × 10-17.5 μm, 8-spori, unitunicati, clavati, apedicellati, apicis rotundis, apicale apparatus J+, discoidae, 0.5-1 μm high × 2.5-3 μm diam. Ascosporae apiosporae, 1-septatae, 20-25 × 5-6.3 μm, hyalinae, tunica gelatinosa praediti, basi cellulari amphori 1/5 collossi cellulari.

Etymology: The species name refers to Thailand (Siam) where the specimen was collected.

Leaf spots epiphyllous, irregular in shape, 2-13 mm diam., 1-3 mm high, brownish throughout with black margin, often overlaps among the spots, fruiting bodies 4-35 inside the margins, scattered. **Ascomata** visible as slightly raised, brown, ellipsoidal and irregular areas, with a central thin ring-like structure surrounding ostiole, in section 200-237.5 μm diam., 112.5-125 μm high, immersed, subglobose with flattened base. **Peridium** 7-13.5 μm wide, comprising 3-4 layers of compressed, brown-walled cells. **Paraphyses** hyaline, 3.8-5 μm wide, septate, hypha-like. **Asci** 62.5-77.5 × 10-17.5 μm ($\bar{x} = 72.6 \times 14$, $n = 20$), 8-spored, unitunicate, persistent, clavate, apedicellate, apically rounded, with a J+, 0.5-1 μm high × 2.5-3 μm diam.,

discoid, refractive subapical ring. *Ascospores* 20-25 × 5-6.3 μm (\bar{x} = 21.7 × 2.2, n = 30), usually overlapping biseriate or occasionally multiseriate, ariosporous, 1-septate, hyaline, surrounded by thin persistent mucilaginous sheath, basal cell ca 1/5 the size of a larger cell.



Material examined: THAILAND, Chiang Mai Province, Suthep-Pui National Park, Huay Kog Ma, on living leaflets of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 123) (**Holotype:** MRC 00001). **Isotype:** *ibid.*, 25 October 2006, Iman Hidayat and Jamjan Meeboon (FIH 353) (CMU 27948).

Host: On living leaflets of *W. siamensis*.

Distribution: This species is only known from the type locality.

Notes: By following the key to genera of ascomycetes with apiospores (Hyde *et al.*, 1998), this species is identified as *Apiospora* Sacc. based on ascomata being immersed with a slightly raised central ostiole, apedicellate and clavate asci, and hyaline ascospores.

Apiospora montagnei Sacc. (type species) and *A. sinensis* K. D. Hyde, J. Fröhl. & E. Taylor are the only species of *Apiospora* that recorded from palms. This species differs from *A. montagnei* and *A. sinensis* in having positive amyloid reaction of apical ring and lacking of stroma. In detail, this species differs from *A. montagnei* in having ascomata appearances on the host are scattered within black margin (ascomata appearances of *A. montagnei* are gregarious in linear rows), shorter asci ($62.5-77.5 \times 10-17.5 \mu\text{m}$ vs $75-120 \times 14-18 \mu\text{m}$ of *A. montagnei*) and ascospores are surrounded by thin persistent mucilaginous sheath (in *A. montagnei*, ascospores lack of mucilaginous sheath). Furthermore, this species differs from *A. sinensis* in having shorter asci ($62.5-77.5 \times 10-17.5 \mu\text{m}$ vs $84-116 \times (13-18-25 \mu\text{m}$ of *A. sinensis*) and ascospores surrounded by thin persistent mucilaginous sheath (in *A. sinensis*, ascospores are surrounded by irregular and wide mucilaginous sheath).

The distinct character of *Apiospora siamicola* is the present of a positive amyloid reaction of the apical ring. The character is specific to *A. siamicola* as most

of the members of *Apiospora* are characterized with an amyloid negative apical ring (Hyde *et al.*, 1998). The amyloid positive apical ring can be confused with species of *Apioclypea* K. D. Hyde. However, in *Apioclypea*, the ascus is cylindrical and pedicellate, and the arrangement of ascospores in the asci is overlapping uniseriate (Hyde *et al.*, 1998).

***Arecomyces foliicola* Hidayat & To-anun, sp. nov.**

(Fig. 2.4)

Macula epiphylla, apparui brunnei et irregulari, marginae fuscae. Ascomata 112.5-162.5 μm diam. \times 100-137.5 μm alta, subglobosa, sepultum subtus pseudostromatum, parvus papillatus, medium ostiolatum. Peridium 4-12 μm latum. Paraphysae admodum 3 μm prolixae, filamentum. Asci 50-70 \times 5-6.3 μm , 2(-4)-spori, unitunicati, lati cylindrici, pedicellati, ad apicem truncata, apparatu apicale J-, discoida praedita. Ascosporae 11-17 \times 3-4.5 μm , uniseriatae, oblongus-ellipsoidus, aseptatae, hyalinae, laevae, tunica gelatinosa praedita.

Etymology: The species name refers to leaf (Latin: folium), a substrate where the fungus grew.

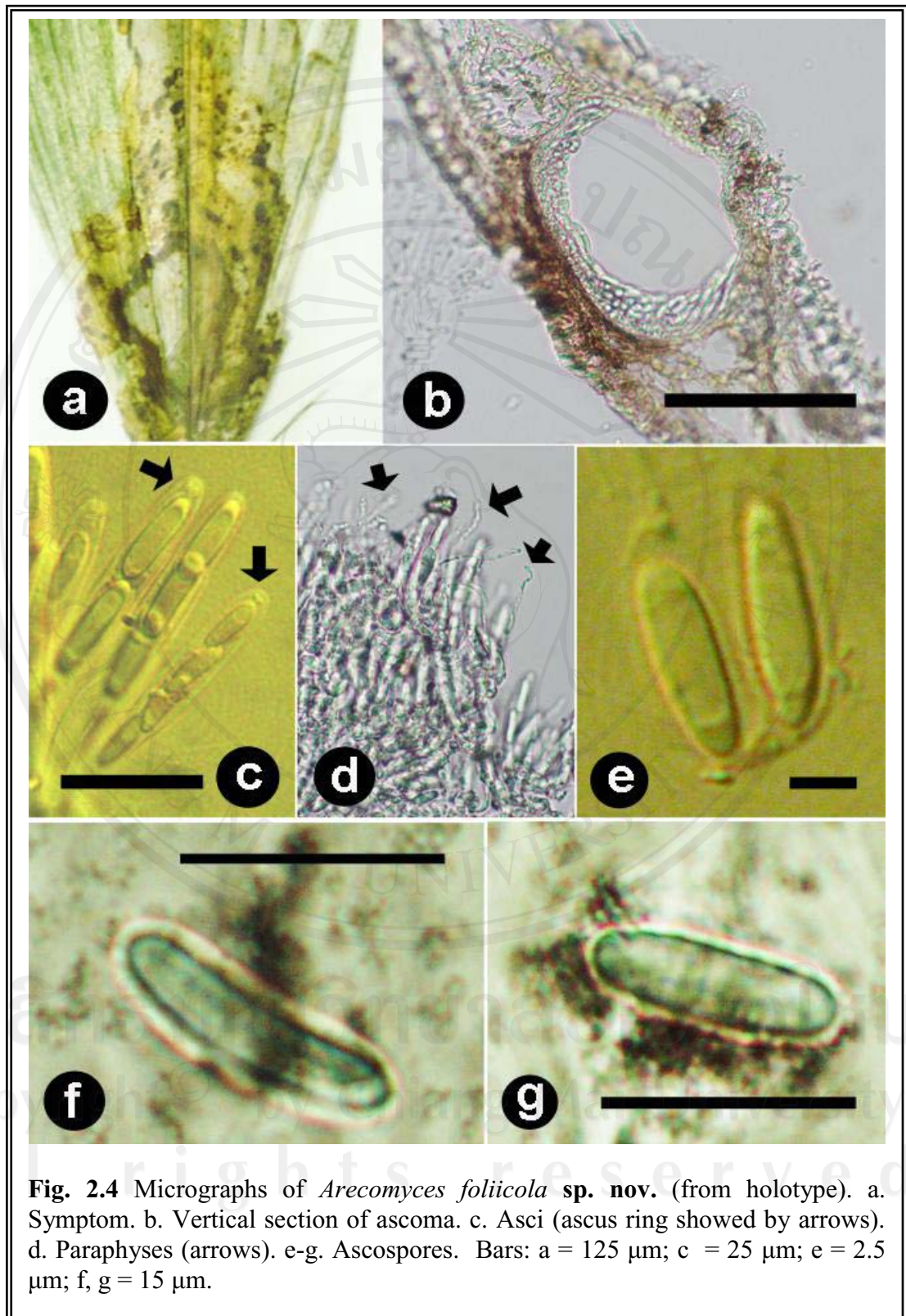
Leaf spot epiphyllous, visible as brown irregular area, darkened at the edges, fruiting bodies scattered throughout the brown area. **Ascomata** in section 112.5-162.5 μm diam., 100-137.5 μm high (\bar{x} = 125 μm diam. \times 106.3 μm high, n = 10),

subglobose to horizontally ellipsoidal, immersed under pseudostroma, short papillate, ostiole central, slightly protruding through the leaf cuticle, visible as darkened irregular discs on the host surface, intraepidermal. **Peridium** 4-12 μm wide, outer comprising 2-3 layers of compressed brown-walled cells, inner comprising 1-2 layers of compressed hyaline cells. **Paraphyses** up to 3 μm wide, septate, hyaline, hypha-like, filamentous, wider distally, not embedded in gelatinous matrix, anastomosing between asci. **Asci** 50-70 \times 5-6.3 μm (\bar{x} = 59.4 \times 5.6, n = 20), 2(-4)-spored, unitunicate, broadly cylindrical, long pedicellate, persistent, slightly truncate at the apex, broadest in the middle, with a J-, discoid, refractive sub apical ring. **Ascospores** 11-17 \times 3-4.5 μm (\bar{x} = 13.6 \times 3.8, n = 30), uniseriate sometimes overlapping, oblong-ellipsoidal with rounded apices, aseptate, hyaline, smooth, and surrounded by thin persistent sheath.

Material examined: THAILAND, Chiang Mai Province, Suthep-Pui National Park, on living leaves of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 124) (**Holotype:** MRC 00003). **Isotype:** *ibid.*, 25 October 2006, Iman Hidayat & Jamjan Meeboon (FIH 354) (CMU 27947).

Host: On living leaflets of *W. siamensis*.

Distribution: This species is only known from the type locality.



Notes: The general morphology of this species is most similar to *Arecomyces* K. D. Hyde and *Physalospora* Niessl, as ascomata are immersed, the apical ring is nonamyloid, and the ellipsoidal ascospores are hyaline (Hanlin, 1990; Hyde, 1996). However, this species differs from *Physalospora* in having ascomata immersed under pseudostroma, asci are broadly cylindrical with distinct apical ring and ascospores are less than 20 μm ($12-17 \times 3-4 \mu\text{m}$).

Arecomyces tetrasporus K. D. Hyde is the only member of *Arecomyces* having 2-4 ascospores in the ascus (Hyde, 1996). The species is characterized by ascomata immersed under clypeus; ellipsoidal and echinulose ascospores that surrounded by a wide mucilaginous sheath. However, *A. foliicola* differs to *A. tetrasporus* in having ascomata immersed under pseudostroma; smaller asci ($48-64 \times 5-6 \mu\text{m}$ vs $62-75 \times 8-12 \mu\text{m}$ of *A. tetrasporus*); and the ascospores are smooth, oblong-ellipsoidal in shape, and surrounded by thin persistent sheath. The mode of life of *A. foliicola* is also weakly parasitic due to its association with leaf spot, but *A. tetrasporus* is an obligate saprobe.

Key to *Arecomyces* species (modified from Hyde, 1996)

1a. Asci (2-)4-spored **2**

1b. Asci 8-spored **3**

2a. Ascomata clypeate, ascospores ellipsoidal, on rachis ***A. tetrasporus***

2b. Ascomata immersed under pseudostroma, ascospores oblong-ellipsoidal with rounded apices, associated with leaf spots ***A. foliicola***

- 3a. Ascospores asymmetric, $12.5-15 \times 5.7.5 \mu\text{m}$, lacking a mucilaginous sheath, developing under a blackened pseudostroma *A. sekoyae*
- 3b. Ascospores symmetric 4
- 4a. Ascospores lenticular, $15-19 \times 6.5-8 \mu\text{m}$ *A. bruneiensis*
- 4b. Ascospores oblong ellipsoidal, lenticular or ovoid, mostly less than $15 \mu\text{m}$ long 5
- 5a. Ascospores mostly $12-15 \mu\text{m}$ long 6
- 5b. Ascospores mostly less than $12 \mu\text{m}$ long 7
- 6a. Asci $94-120 \times 11-15 \mu\text{m}$, ascospores sheath regular in outline *A. frondicola*
- 6b. Asci $82-92 \times 7-8 \mu\text{m}$, ascospores sheath wavy in outline *A. epigeni*
- 7a. Ascospores oblong-ellipsoidal, $7.5-10 \times 4.5-6 \mu\text{m}$, clypeate *A. dicksonii*
- 7b. Ascospores ovoid, $8.5-12.5 \times 5-6.5 \mu\text{m}$, developing under a reddish-brown pseudostroma *A. hedgerii*

Botryosphaeria obtusa (Schwein.) Shoemaker, *Canadian Journal of Botany* **42**: 1298 (1964)

= *Sphaeria obtusa* Schwein., *Transactions of the American Philosophical Society Philadelphia N.S.* **4**: 220 (1832).

= *Physalospora obtusa* (Schwein.) Cooke, *Grevillea* **20**: 86 (1892).

(Fig. 2.5)

Stromata embedded within the cortical tissue, 510 mm wide, multilocular, scattered, solitary, botryose, dark brown to black, with ostioles darker around the neck region. **Pseudoparaphyses** 2.5-5 μm wide, hypha-like, septate, hyaline. **Asci** 140-195 \times 10-15 μm , bitunicate, cylindric-clavate, long pedicellate, 8-spored. **Ascospores** 20-25 \times 9.4-10 μm , irregularly biseriolate, fusiform, wider around the mid region, aseptate, verrucose, hyaline.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on decaying rachis of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 020).

Host: Commonly diseased as well as saprobes on *Malus* spp. and *Vitis* spp. (Arx, 1987)

Distribution: Widespread in Europe, Southern Africa, North and South America, India, Japan, New Guinea, Western Australia, Tasmania, New Zealand (Arx, 1987).

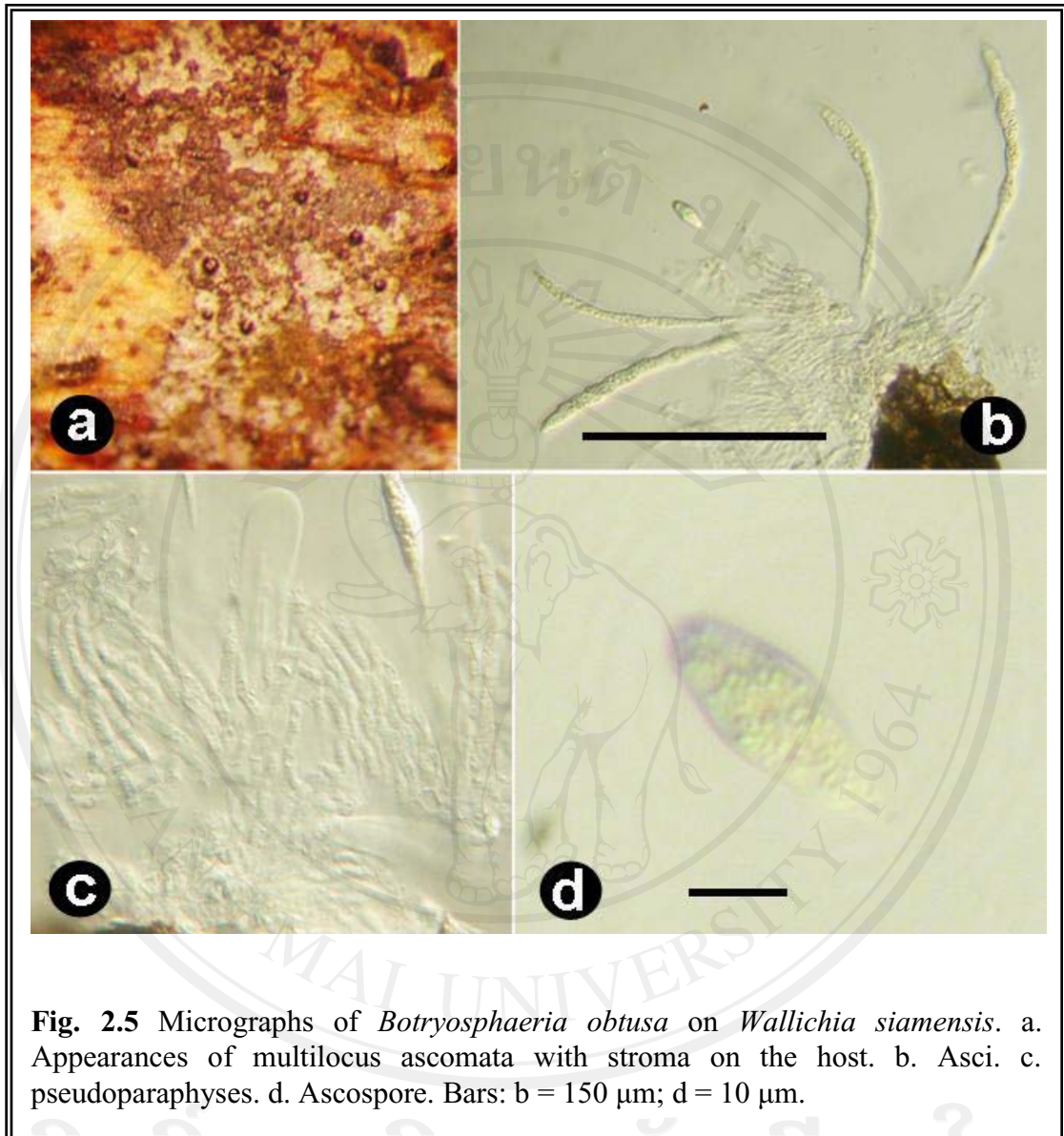


Fig. 2.5 Micrographs of *Botryosphaeria obtusa* on *Wallichia siamensis*. a. Appearances of multilocular ascomata with stroma on the host. b. Asci. c. pseudoparaphyses. d. Ascospore. Bars: b = 150 μm ; d = 10 μm .

Notes: This species is identified as *Botryosphaeria obtusa* (Schwein.) Shoemaker due to its clavate asci with long pedicellate and fusiform ascospores (Shoemaker, 1964). This specimen is the first record of *B. obtusa* from Thailand and *W. siamensis* is reported here as a new host.

Chaetospermum chaetosporum (Pat.) Smith & Ramsbottom, *Trans. Br. Mycol. Soc.*

4: 328 (1914)

= *Tubercularia chaetospora* Pat., *Bulletin de la Société Mycologique de France*

4: 40 (1888).

(Fig. 2.6)

Conidiomata 300-600 μm diam., pycnidoid, globose, innate-erumpent under white and hairy stroma, initially closed, ultimately opening by an irregular split in the apical wall, gelatinous, unilocular. **Conidiophores** loosely aggregated, sparingly branched and septate at the base, colourless, smooth, invested in gel. **Conidiogenous cells** holoblastic, discrete, cylindrical to subcylindrical or irregular, colourless, smooth, bearing a single terminal conidium or an apical cluster of up to four conidia. **Conidia** 20-35 \times 3-6.3 μm , broadly ellipsoidal to cylindrical with obtuse ends, unicellular, colourless, smooth, thin-walled, bearing appendages which are not separated from the conidium body by septa, polar or subpolar, occasionally lateral as well, unbranched, filiform, or narrow and attenuated, flexuous, often collapsing and ribbon-like with age, 2.5-12 μm long.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on secondary rachis of *Wallichia siamensis* Becc. (Areaceae), 21 July 2005, Iman Hidayat (FIH 029).

Host: *Alnus glutinosa*, *Cupressus macrocarpa*, *Dahlia* sp., *Elaeis guineensis*, *Epilobium hirsutum*, *Glyceria maxima*, *Prunus serotina*, *Theobroma cacao*, *triticum* sp., *Valeriana officinalis* (Sutton, 1980).

Distribution: India, Kenya, Tanzania, U.S.A., New Hebrides, U. K. (Sutton, 1980).

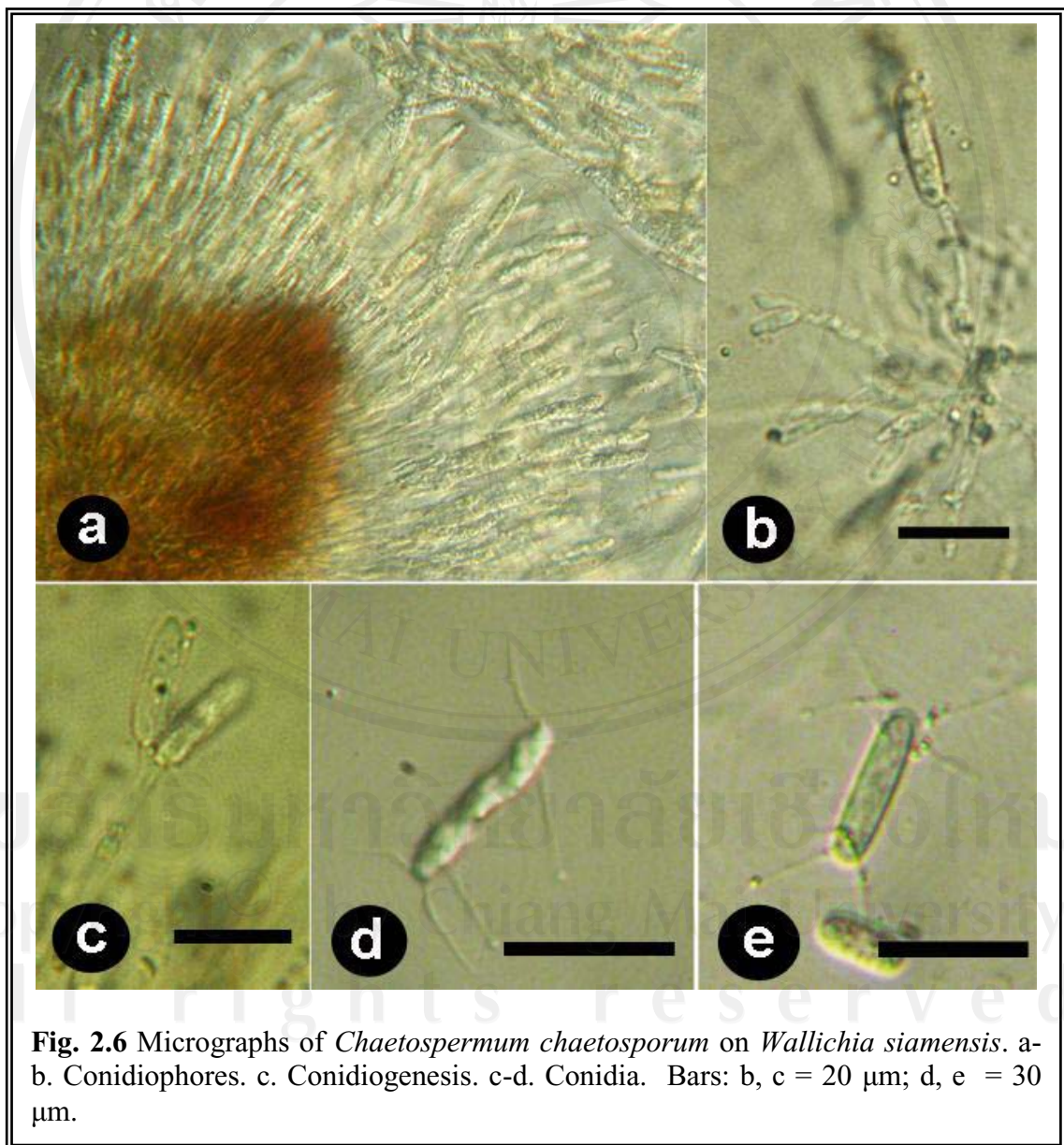


Fig. 2.6 Micrographs of *Chaetospermum chaetosporum* on *Wallichia siamensis*. a-b. Conidiophores. c. Conidiogenesis. c-d. Conidia. Bars: b, c = 20 µm; d, e = 30 µm.

Notes: Recently only three species belong to genus *Chaetospermum*, viz, *Chaetospermum carneum* Tassi, *C. chaetosporum* and *C. gelatinosum* Petch (Sutton, 1980; Kirk *et.al*, 2008). According to the key of Sutton (1980), this species is much closed to *C. chaetosporum* in having similar ascospores size and appendages (Sutton, 1980). This specimen is the first record of *C. chaetosporum* from Thailand, and *W. siamensis* is reported here as a new host.

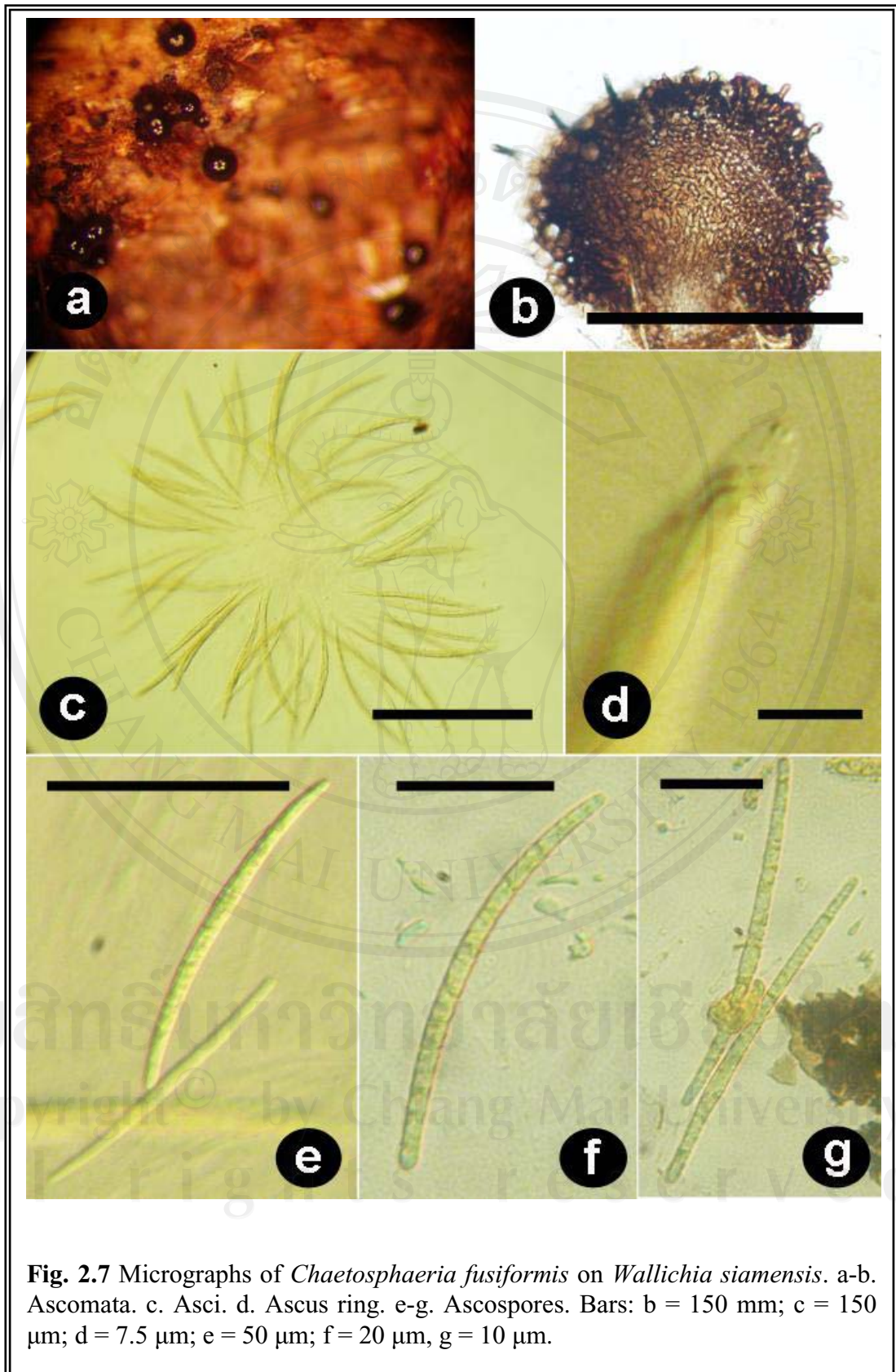
Chaetosphaeria fusiformis W. Gams & Hol.-Jech., *Mycotaxon* **13**: 257 (1981)

= *Chaetosphaeria fusispora* W. Gams & Hol.-Jech., *Stud. Mycol.* **13**: 45 (1976).

(Fig. 2.7)

Ascomata superficial, black, smooth-walled, shining, subglobose, ostiole conical, without a basal stroma, 110-160 mm diam., 125-190 mm high, consisting of numerous layers of thick-walled, pigmented cells. *Paraphyses* 1.3-2.5 μm , hyphal-like, hyaline. *Asci* 100-165 \times 7.5-12.5 μm , cylindrical-clavate, thin-walled, apedicellate, with a J-, cylindrical apical ring. *Ascospores* 47.5-82.5 \times 2.5-3.8 μm , long fusiform to filiform, hyaline, smooth, with a somewhat rounded upper end, multiseptate,

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on decaying petioles of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 021).



Host: *Abie alba* (Gams and Holubová-Jechová, 1981), Gramineae (particularly bamboos genera) (Hino, 1961).

Distribution: Czech Republic (Gams and Holubová-Jechová, 1981), Japan (Hino, 1961).

Notes: Based on the dichotomous key to species within genus *Chaetosphaeria* by Reblova *et. al.* (1999), this specimen is much closed to *C. fusiformis* in almost all morphological appearances.

Fasciatispora petrakii (Mhaskar & V. G. Rao) K. D. Hyde, *Nova Hedwigia* **61**: 255 (1995b)

= *Amphisphaerella petrakii* Mhaskar & V. G. Rao, *Current Science* **42**: 28 (1973).

(Fig. 2.8)

Ascomata immersed in pseudostroma, black, solitary, in vertical section globose to subglobose, 400-500 μm diam., 230-425 μm high. **Peridium** 2.5-7.5 μm wide, composed of elongate or angular cells. **Paraphyses** 1-2.5 μm wide, aseptate, hyaline, embedded in agelatinous matrix. **Asci** 83.5-100 \times 9.5-11 μm , unitunicate, cylindrical, 8-spored, J+ subapical ring, short pedicellate, apically rounded. **Ascal ring** 1-1.5 μm in high, 2-3 μm in diameter. **Ascospores** 11.6-16.7 \times 5.1-6.5 μm , ellipsoid, 1-celled, hyaline at the middle part and dark brown at the 1/3 ends, surrounded by mucilaginous sheath.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on laeflets of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 147).

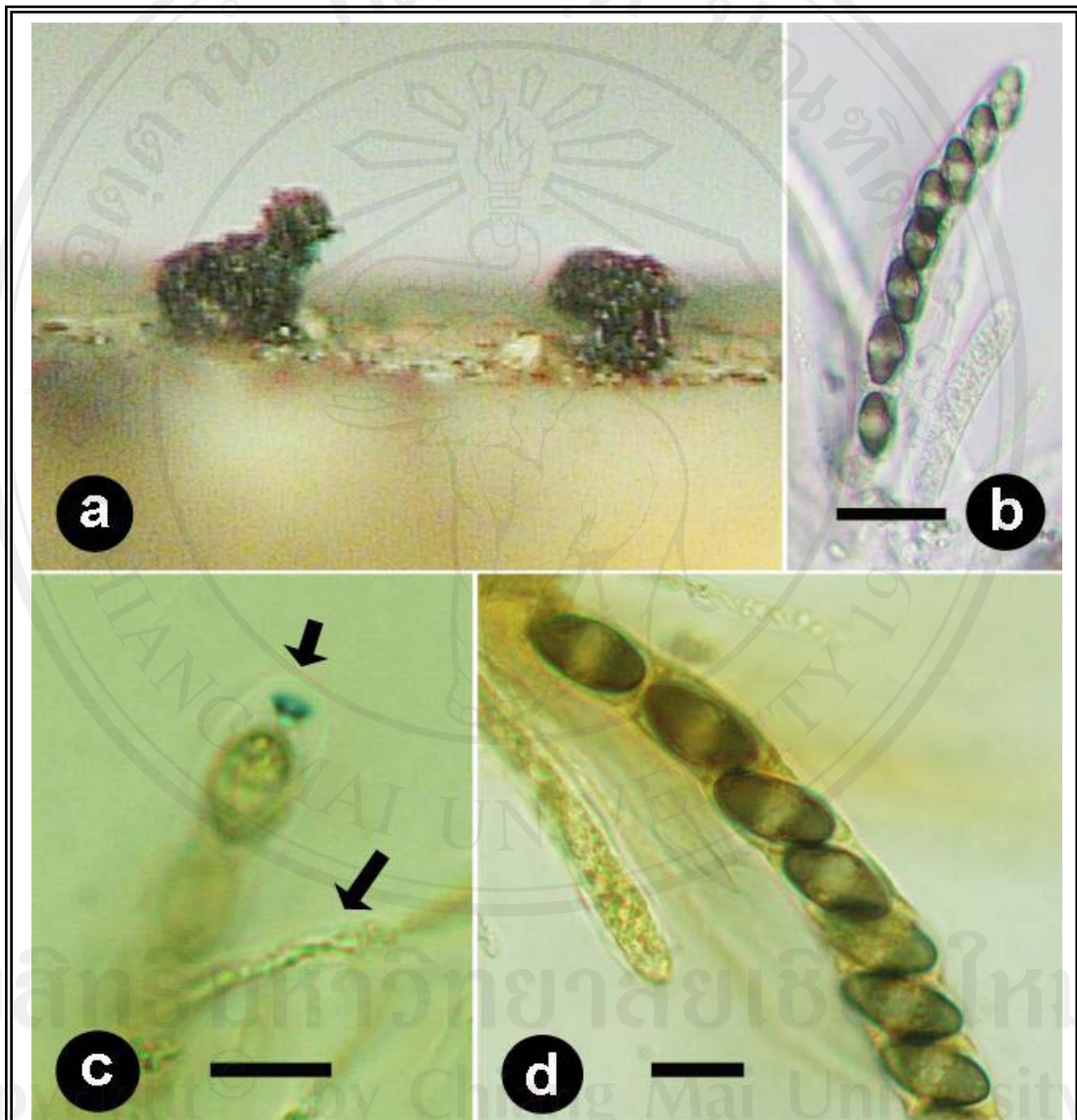


Fig. 2.8 Micrographs of *Fasciatispora petrakii* on *Wallichia siamensis*. A. Ascomata appearance on the host surface. b. Ascus. C. Ascus ring and paraphyses (arrows). d. Uniseriate ascospores. Bars: b = 15 μm ; c = 7.5 μm ; d = 5 μm .

Host: *Calamus* spp., *Cyrtostachys* spp., *Daemonorops* spp., *Elaeis* spp., *Livistona* spp., *Metroxylon* spp., *Oncosperma* spp., *Sabal* spp. (Hyde, 1995b), *Archontophoenix alexandrae*, *Trachycarpus fortunei*, *Cocos nucifera* (Taylor and Hyde, 2003).

Distribution: Brunei, India, malaysia, papua New Guinea, Philippines, U. S. A. (Hyde, 1995b), Australia, China, Hong Kong, Singapore (Taylor and Hyde, 2003).

Notes: The first report of this species from Thailand was carried out by Hidayat *et al.* (2007).

Glomerella cingulata (Stoneman) Spauld. & H. Schrenk, *Science*, N. S. **17**: 751 (1903)

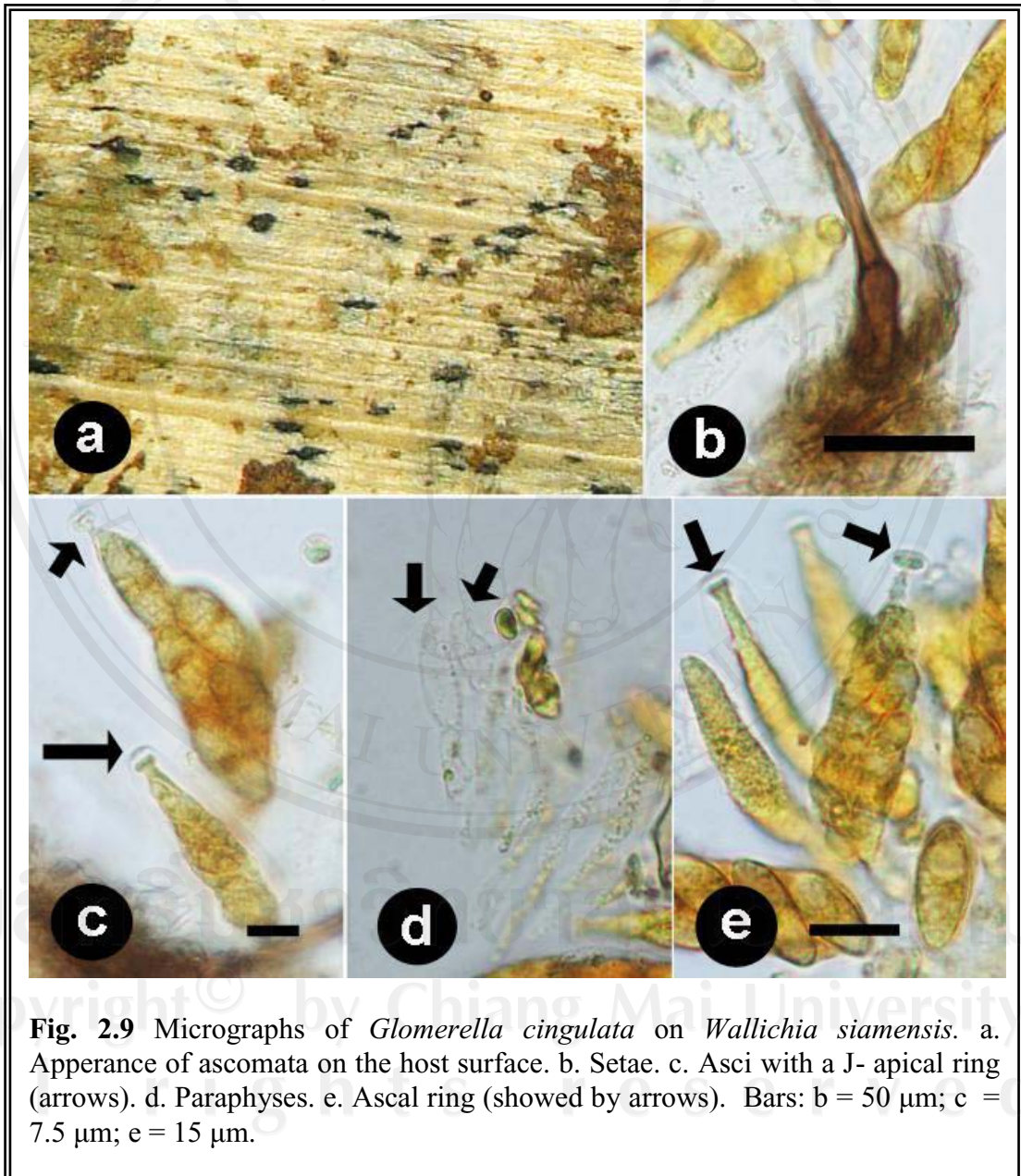
= *Gnomoniopsis cingulata* Stoneman, *Botanical Gazette* **26**:101 (1898).

(Fig. 2.9)

Ascomata 175-450 × 125 – 300 μm, immersed on the host surface, obpyriform, black, setae, solitary or in small groups. **Paraphyses** 2-5 μm wide, numerous, septate, hyphal-like, hyaline, cellular. **Asci** 65.5-72 × 5-12.5 μm, unitunicate, 4-8-spored, cylindric to pyriform, thick at the apex, short pedicellate, apically truncate, with a refractive J-, subapical ring. **Ascospores** 18-24.5 × 7-7.5 μm, biseriate to multiseriate, ellipsoid to reniform to ovoid, 1-celled, hyaline.

Material Examined: THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, Hua Kog Ma, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 16

October 2005, Iman Hidayat (FIH 137); *ibid.* (FIH 144); Queen Srikit Botanical Garden, on leaflets of *Livistona fulva* Rodd (Arecaceae), 25 November 2006, Tatiya Takaew (FIH 418).



Host: Associated with a wide range of plants (USDA fungal-host database).

Distribution: Worldwide, from temperate to tropical regions (Arx, 1987).

Notes: *Glomerella cingulata* is a common pathogen all over the world on leaves of various plants. It is the agent of bitter rot and anthracnose of *Citrus*, *Maltus* and *Pyrus*, and also occurs on berries of *Prunus*, *Coffea*, *Sambucus* and many other plants. The infection is often latent and the respective plants usually show a poor growth. Ascumata sometimes also develop in pure culture. Germinating ascospores form pigmented appressoria. The common anamorph is known as *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. (Arx, 1987).

Guignardia uniappendiculatum Hidayat & To-anun, **sp. nov.**

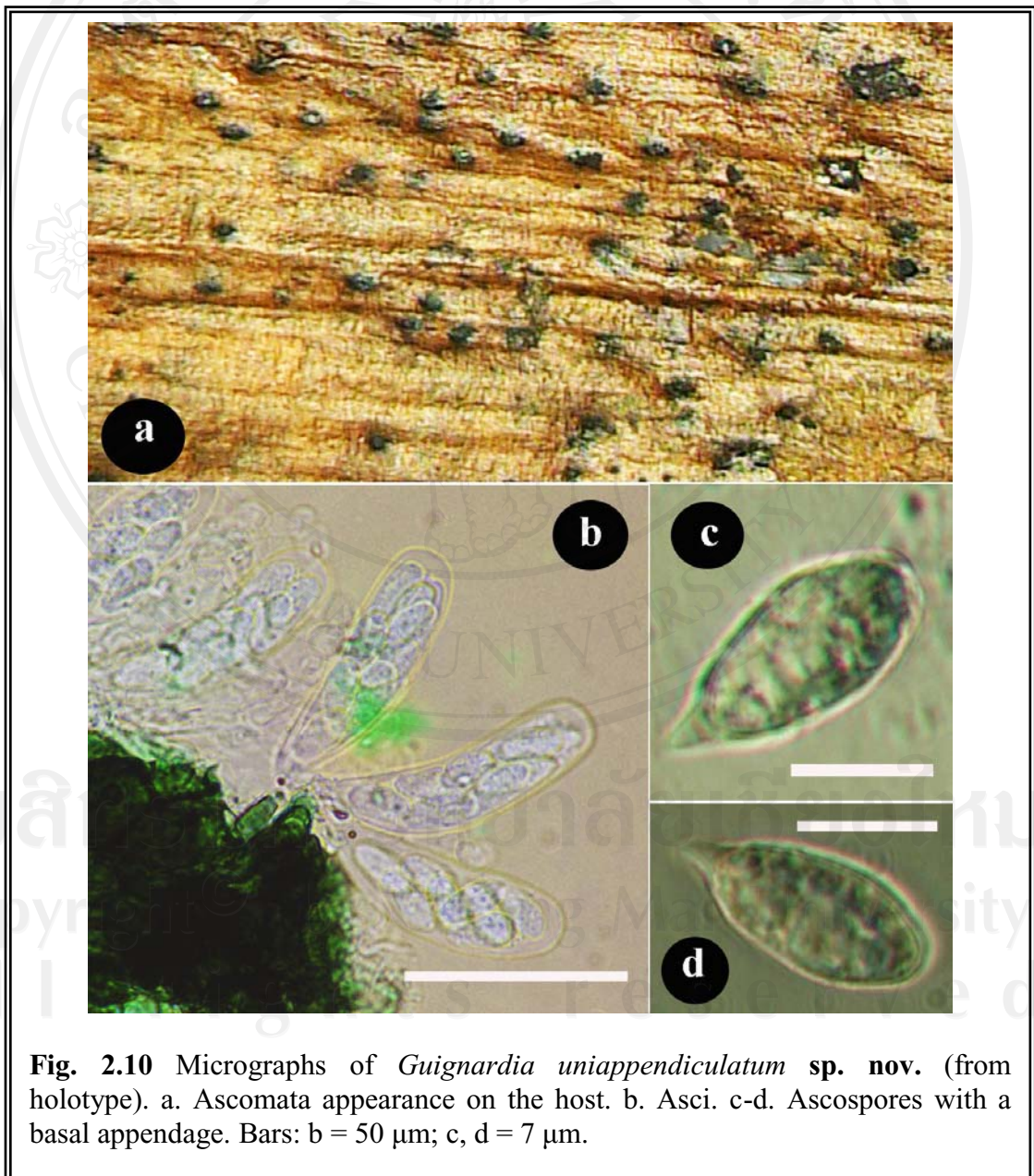
(Fig. 2.10)

Differt a Guignardia cocogena et G. candeloflamma asci decretus (47.5-65 × 15-22.5 μm), et ascospori uniappendicum.

Etymology: Named after its single appendage of the ascospores.

Stromata lacking. **Ascomata** immersed, black, developing under slightly raised regions, in vertical section 380-825 μm diam., 75-145 μm high, subglobose, with a central ostiole. **Peridium** composed of brown-walled textura globulosa, inwardly compressed. **Pseudoparaphyses** up to 4.5 μm wide, cellular, forming chains-like structure, hyaline, tapering to the apex. **Asci** 47.5-65 × 15-22.5 μm, bitunicate, 8-

spored, clavate, thick-walled, short-pedicellate, with ocular chamber near the apex, apex subtruncate. *Ascospores* 15-21.3 × 5-7.5 μm, overlapping 2-3 seriate, hyaline-greenish, ovoid, lacking germ pores, with broader part above the middle part of the spores, 1-celled, not smooth, surrounded by a thin mucilagenous sheath, with a distinct appendage at the basal end.



Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 30 April 2007, Iman Hidayat and Jamjan Meeboon (**Holotype:** FIH 016). **Paratype:** *ibid.*, 16 November 2006, Tatiya Takaew (FIH 314).

Host: Leaflets of *W. siamensis*.

Distribution: This species is only known from the type locality.

Notes: Two species of palmicolous *Guignardia* species, viz, *G. cocogena* (Cooke) Puntih. on *Cocos nucifera* and *G. candeloflamma* J. Fröhl. & K.D. Hyde on *Pinanga* sp., are the most similar species to the present novel species as having ornamented ascospores with polar appendages (Hyde, 1995a). However, *Guignardia uniappendiculatum* is distinct from the previous two species due to only having single polar appendage at the basal end of ascospores.

Mycosphaerella wallichiae Hidayat and To-anun, **sp. nov.**

(Fig. 2.11)

Differt a Mycosphaerella frenumbensis et M. serrulata asci obclavata, 40-50
× 3.8-6 µm., et ascospori ornamentum.

Etymology: Named after its genus name of host, *Wallichia*.

Leaf spots amphigenous, irregular, lesions brown. **Ascomata** pseudothecial, amphigenous, subepidermal, immersed to erumpent on the host surface, black, globose

to subglobose, 50-75 μm diam., 60-90 μm high, apical ostiole 5-10 μm diam. *Peridium* wall of 2-3 layers of medium brown textura angularis. *Paraphyses* absent. *Asci* 40-50 \times 3.8-6 μm , bitunicate, 8-spored, obclavate. *Ascospores* 10-12 \times 2-3.8 μm , biseriate overlapping, 1-septate, slightly constricted at the septum, unequally bicelled, fusoid-ellipsoidal with obtuse ends, hyaline, thin-walled, straight to slightly curved, tapering towards the lower end, surrounding by a thin mucilagenous sheath, often with mucilagenous pad at the narrow base.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (**Holotype:** FIH 013).

Host: Leaflets of *Wallichia siamensis*.

Distribution: This species is only known from the type locality.

Notes: According to the key of *Mycosphaerella* on palms by Fröhlich and Hyde (1998), this specimen is much closed to *M. frenumbensis* (Speg.) Tomilin and *M. serrulatae* (Ellis & Everh.) Diehl by having obclavate to cylindrical asci with unequal bicelled ascospores. However, this specimen is distinct to the previous two species by having ascospores surrounded by mucilagenous sheath and ornamentation at the basal end.

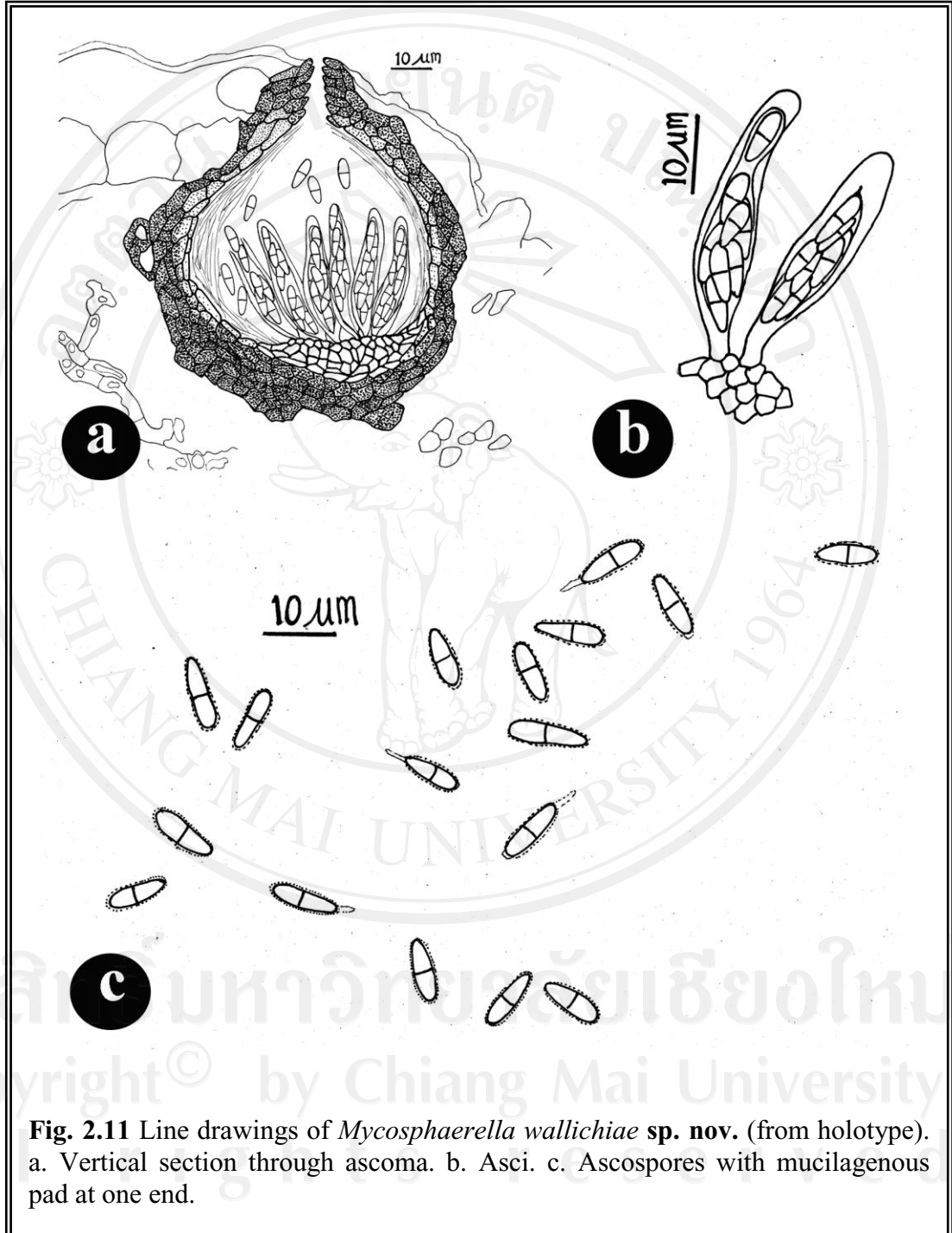


Fig. 2.11 Line drawings of *Mycosphaerella wallichiae* sp. nov. (from holotype).
 a. Vertical section through ascoma. b. Asci. c. Ascospores with mucilaginous pad at one end.

Myelosperma tumidum Syd. & P. Syd., *Annal. Mycol.* **13**: 38 (1915)

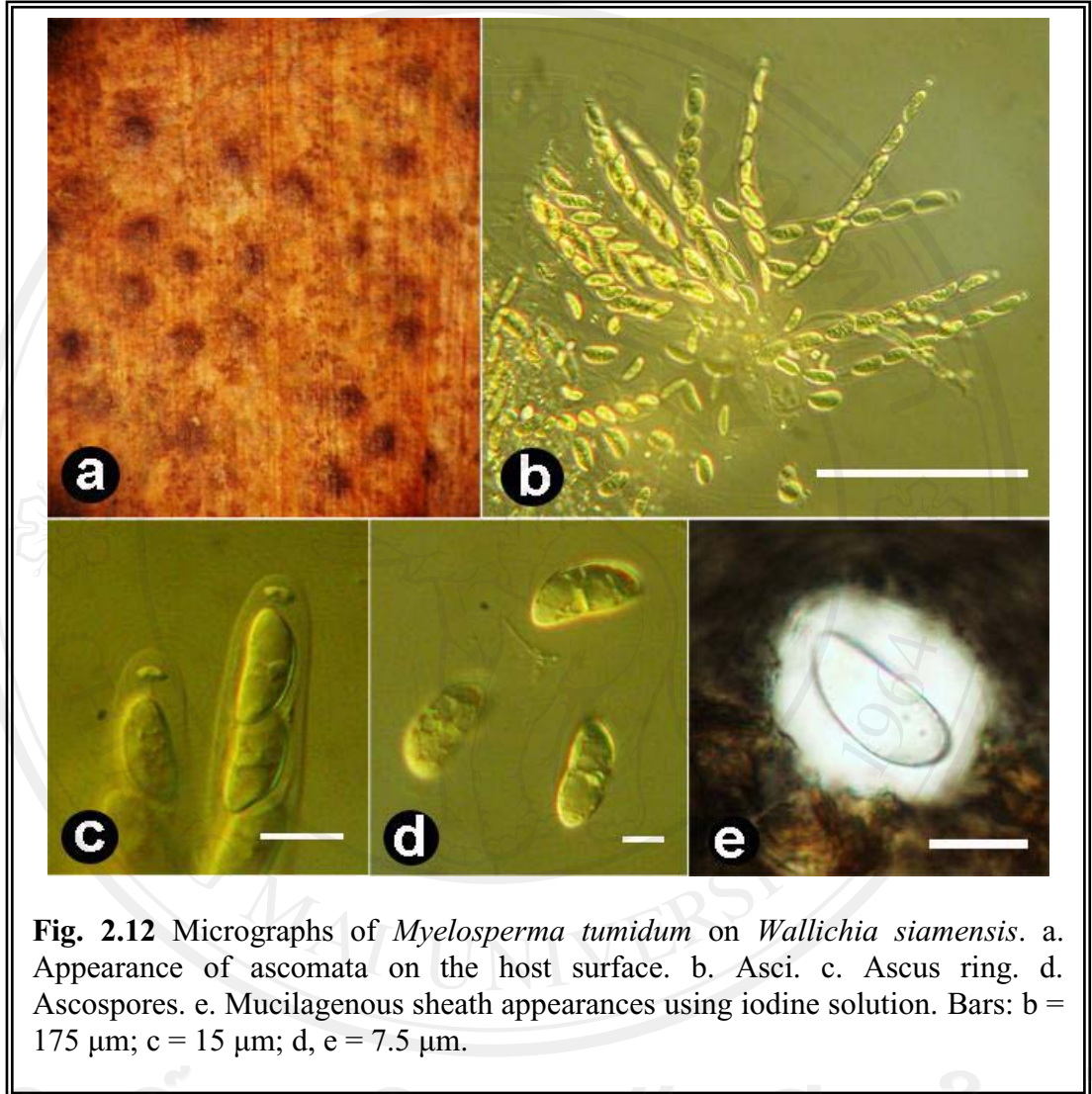
(Fig. 2-12)

Ascomata immersed, darkened brown, in groups with 3 ascomata (1 large and 2 small) with a common central pore, in vertical section 300-550 μm diam., 150-375 μm high, subglobose. *Peridium* 5-10 μm wide, comprising layers of brown-walled elongate cells, inwardly hyaline and outwardly textura intricata. *Paraphyses* 5-7.5 μm wide, hyphal-like, septate, hyaline. *Asci* 145-217.5 \times 12.5-20 μm , unitunicate, cylindrical, long pedicellate, 8-spored, with refractive, J-, discoid sub apical ring. *Ascospores* 15-27.5 \times 6.3-10 μm , uniseriate, fusiform to reniform, smooth, aseptate but old ascospores has a septa-like morphology(1-3 septate-like), hyaline, surrounded by mucilaginous sheaths.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 025); Chiang Mai University, Palm garden, on leaflets of *Borassodendron* sp. (Arecaceae), 29 October 2006, Iman Hidayat (FIH 108).

Host: *Calamus tetradactylus*, *Calamus thysanolepis*, *Calamus walkerii*, *Calamus* sp., *Cocos nucifera*, *Daemonorops margaritae*, *Licuala* sp., *Livistona chinensis*, *Livistona* sp. (Fröhlich and Hyde, 2000).

Distribution: Brunei Darussalam, Hong Kong, Indonesia, Papua New Guinea, Sri Lanka (Fröhlich and Hyde, 2000).



Notes: This specimen is the first record of *Myelosperma tumidum* from Thailand, and *W. siamensis* is reported as a new host of this fungus.

Neorehmiia arecae (Syd.) Samuels & M. E. Barr, *Canadian Journal of Botany* **75**: 2165-2176 (1997)

= *Oplothecium arecae* Syd., *Annales Mycologici* **21**: 97 (1923).

(Fig. 2.13)

Leaf spots amphigenous, rounded, brown outwardly and dark-brown at the middle, fruiting bodies hypophyllous, 6-13 mm diam., 3.5-9 mm high. **Ascomata** in section 70-91 μm diam., 49-69 μm high, globose, non-papillate, solitary or caespitose, superficial, seated on a thin, hyphal cushion. **Setae** 5-7 μm wide, 10-17 μm high, stout-cylindrical, erect, 3 to 4 branches at the apex, dark brown, arising as outgrowth of cells at the wall surface. **Peridium** 7-12 μm wide, comprising 3 to 4 light to dark brown ellipsoidal layers. **Paraphyses** numerous, narrow, delicate, interspersed among the asci. **Asci** 24-36 \times 3-4 μm , 8-spored, unitunicate, cylindrical to clavate, apedicellate, apically rounded, with a J-, apical ring. **Ascospores** 6-7 \times 5-6 μm (part spores 3-3.5 \times 2.5-3 μm), overlapping biseriata, 1-septate, ellipsoidal but then disarticulating into two equal parts subglobose with germ pore at the center, hyaline.

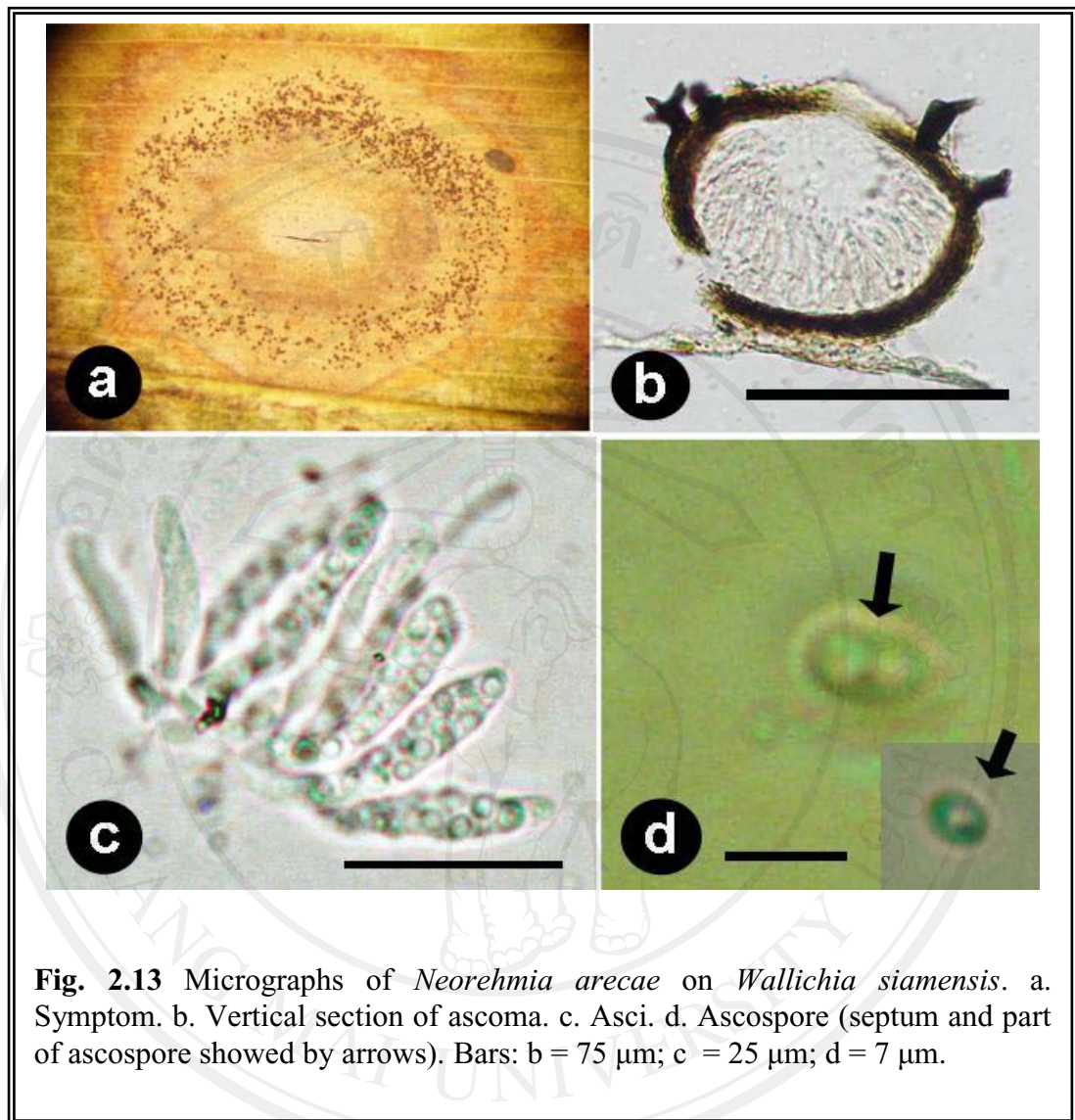
Material Examined: THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, Hua Kog Ma, on living leaflets of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 126) (MRC 00202); *ibid.*, 25 October 2006, Iman Hidayat & Jamjan Meeboon (FIH 354) (CMU 27950).

Host: *Areca catechu* (Müller and Dennis, 1965), *Wallichia siamensis* (Tonanun *et al.*, 2009).

Distribution: Philippines, Venezuela (Müller & Dennis, 1965), Thailand (Tonun *et al.*, 2009).

Notes: The species collected in this study is identified as *Neorehmia* based on setae which are branched at the tips, the partspores which are subglobose and smooth walled. Three species are known in *Neorehmia*, *N. ceratophora* Höhn (type species), *N. arecae* (syn. *Oplothecium arecae*, *T. arecae*), *N. aurea* (Höhn.) Munk (\equiv *Bresadolella aurea* Höhn.); however, Rossman *et al.* (1999) noted that *N. aurea* is a synonym of *T. decipiens*, the type species of *Trichosphaerella*. Therefore, *N. aurea* is an invalid name and only two *Neorehmia* species have been accepted in recent publication (Rossman *et al.*, 1999).

The type species of *Trichosphaerella* is *T. decipiens* E. Bommer, M. Rousseau & Sacc. and is characterized by short, dark and simple setae. Samuels and Barr (1997) transferred *Trichosphaerella arecae* to *Neorehmia arecae* (Syd.) Samuels & M. E. Barr (basonym: *Oplothecium arecae* Syd.; *Ann. Mycol.* **21**: 97. 1923) (Trichosphaeriaceae; Trichosphaeriales) based on the similar characteristic to *N. ceratophora* Höhn (type species) which is characterized by setae which are branched at the tips. The partspores of *N. ceratophora* are subglobose, smooth-walled, and numerous; narrow and delicate paraphyses are usually seen interspersed among the asci. *Neorehmia* is also connected to *Tritirachium*-like anamorph by Muller and Samuels (1982) whereas *Trichosphaerella* was linked to *Acremonium*-like anamorph.



Neorehmia ceratophora differs to this species in having delicate paraphyses interspersed among the asci and the spinulose ascospores in which this species is lacking of paraphyses and the spores are smooth. The host of *N. ceratophora* is also different being recorded from rotting conifers and hardwoods, possibly fungicolous and also found on small sticks of *Salix* and on rotting wood of *Carpinus betulus*.

Neorehmia arecae is most similar to this species, due to flattened and sphaeroid fruit-bodies with a few short setae branching at the tip and also in being

recorded from a palm (Müller and Dennis, 1965; Samuels and Barr, 1997). This species is only different to *N. arecae* only in the part of spores' size ($3.2 \times 2.7 \mu\text{m}$ vs $1.5 \times 2 \mu\text{m}$ of *N. arecae*) (Müller and Dennis, 1965). Therefore, we report this species as *Neorehmia arecae*. This is the first report of *N. arecae* from Thailand and also *W. siamensis* as the host of the fungus.

Ophioceras tenuisporum Shearer, J. L. Crane & W. Chen, *Mycologia* **9**: 149 (1999)

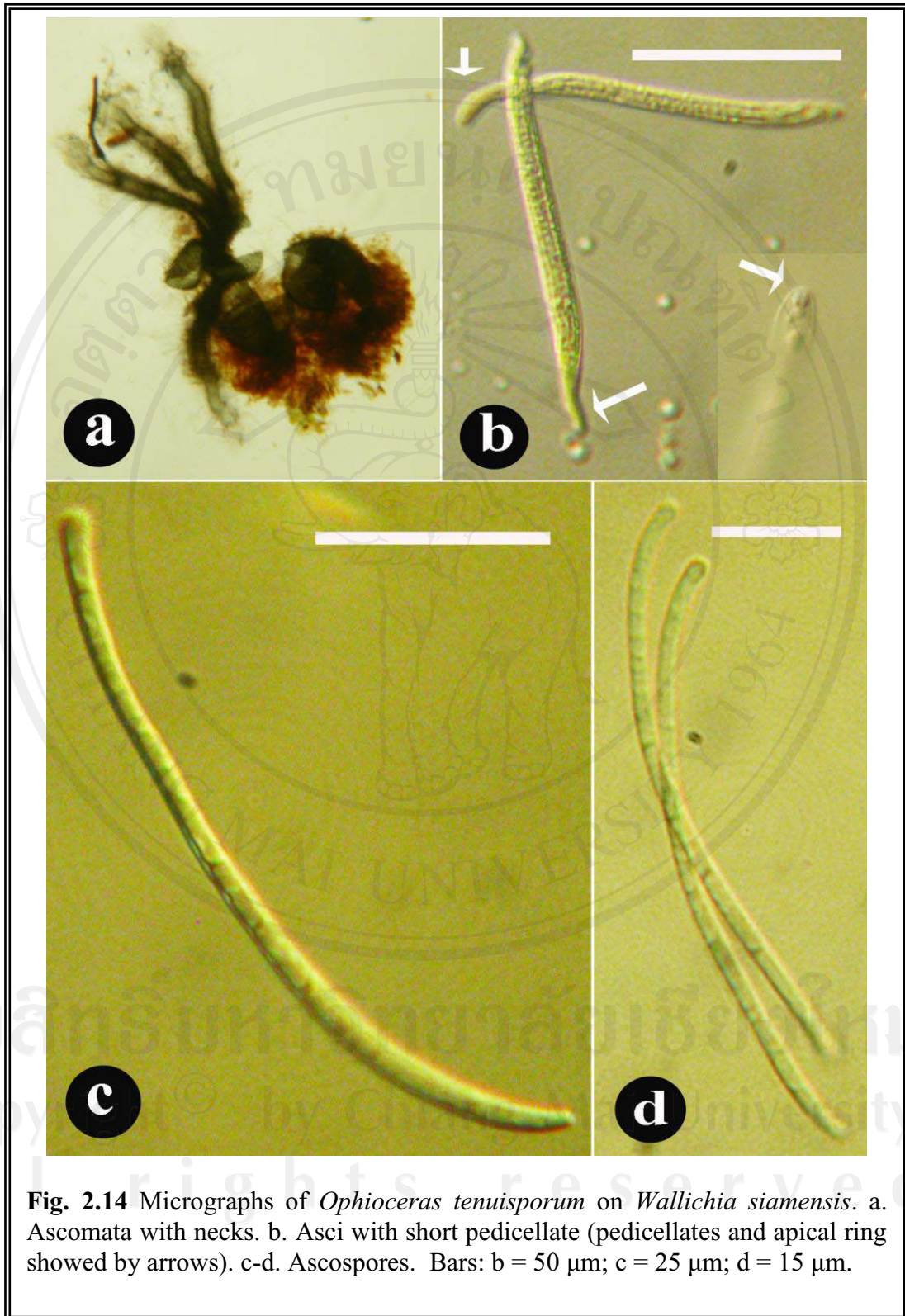
(Fig. 2.14)

Ascomata 175-300 × 200-350 μm , globose to subglobose, immersed or beneath under host surface, darkened (blackish), solitary to gregarious. Neck composed of textura intricata with hyphae arranged in rows and fanning out obliquely, 125-280 × 45-65 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, composed of large cells of textura angularis. **Paraphyses** hyaline, 0.5-0.75 μm ,

filamentous, smooth, septate. **Asci** 90-122.5 × 5-7.5 μm , unitunicate, 8-spored, cylindrical, with rounded apex, short pedicellate, refractive apical ring, J- apical ring,

Ascospores 70-95.5 × 1.25-1.5 μm , multiseriate, filiform, multiseptate, hyaline, both ends are slightly broader immediately above and below each septum.



Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on decaying leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 011); Bahn Phadeng, on *Cocos nucifera* L. (Arecaceae), 13 July 2005, Iman Hidayat (FIH 034).

Host: Saprobic on freshwater decaying woods (Shearer *et al.*, 1999), *Miscanthus* spp. (Lu *et al.*, 2000).

Distribution: Panama (Shearer *et al.*, 1999), Hong Kong (Lu *et al.*, 2000).

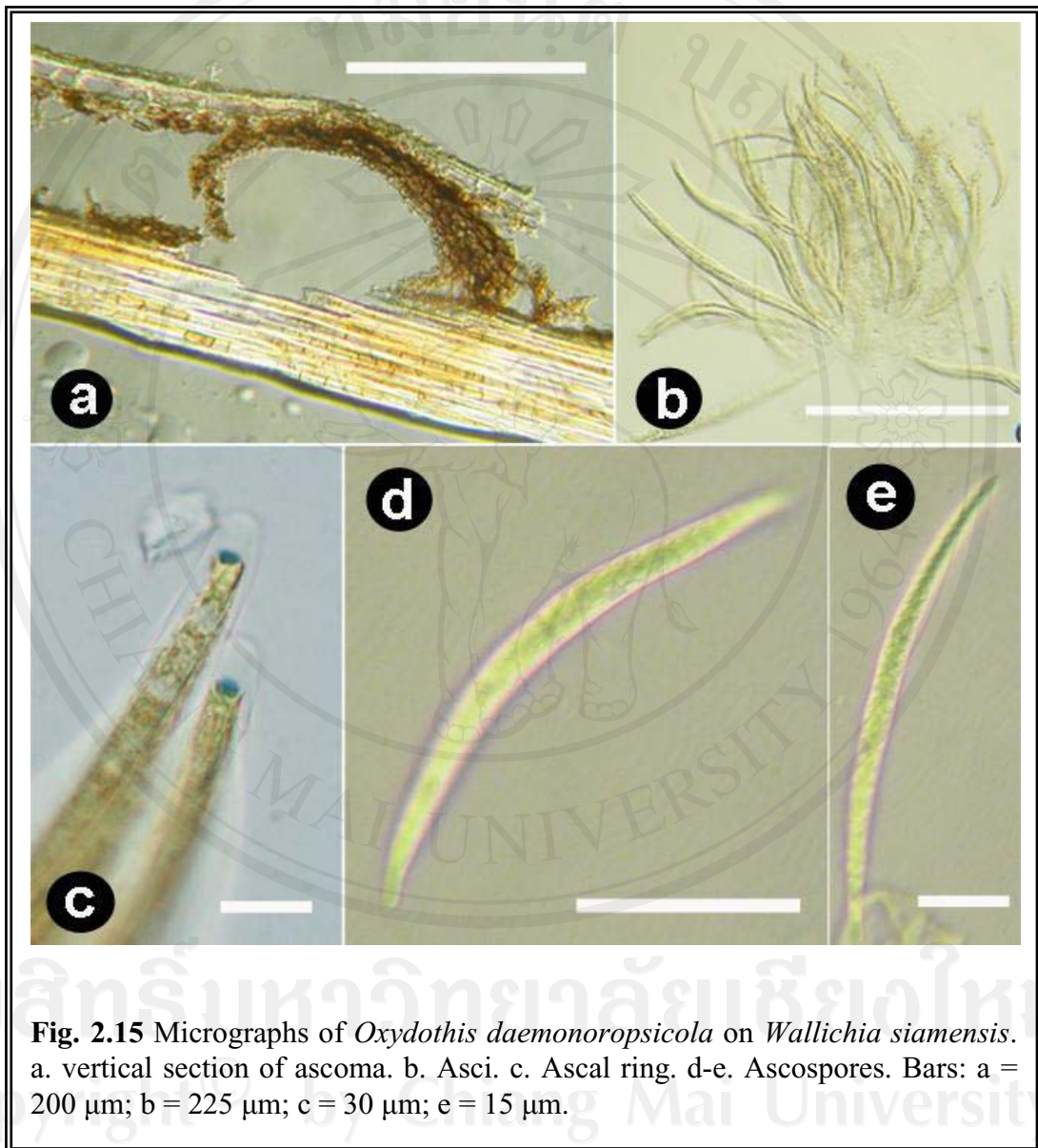
Notes: This specimen is the first report of *Ophioceras tenuisprorum* associated with *Wallichia siamensis*.

Oxydothis daemonoropsicola J. Fröhl. and K. D. Hyde, *Fungal Diversity Research Series* 3: 183 (2000)

(Fig. 2.15)

Ascomata forming under weakly raised, blister-like regions, single or clustered in groups 2-3; in section subglobose, long axis horizontal to that of the host surface with neck at one end, *ca* 135-250 μm diam., 106-127 μm high; **Peridium** 17.5-20 μm thick, composed of 3 to 5 outer layers of oblong, dark-brown cells and sometimes with an additional inner layer of oblong, hyaline cells; **Paraphyses** numerous, up to 5 μm diam.; **Asci** cylindrical, 8-spored, pedicellate, unitunicate, sub apical ring with a rectangular shape, J+ sub apical ring, 225-255 \times 12.5-13.75 μm ; **Ascal ring** 2-2.3 high, 2-3 μm diam.; **Ascospores** 95-105 \times 5-6.3 μm , 1-3-seriate,

long fusiform to filiform, hyaline, 1-septate, tapering very gradually from a unconstricted central septum to form rounded ends.



Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on decaying rachis of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 019, 141) (MRC 0005, 0006).

Host: *Daemonorops margaritae*, *Archontophoenix alexandrae*, *Wallichia siamensis* (Taylor and Hyde, 2003; Hidayat *et al.*, 2006).

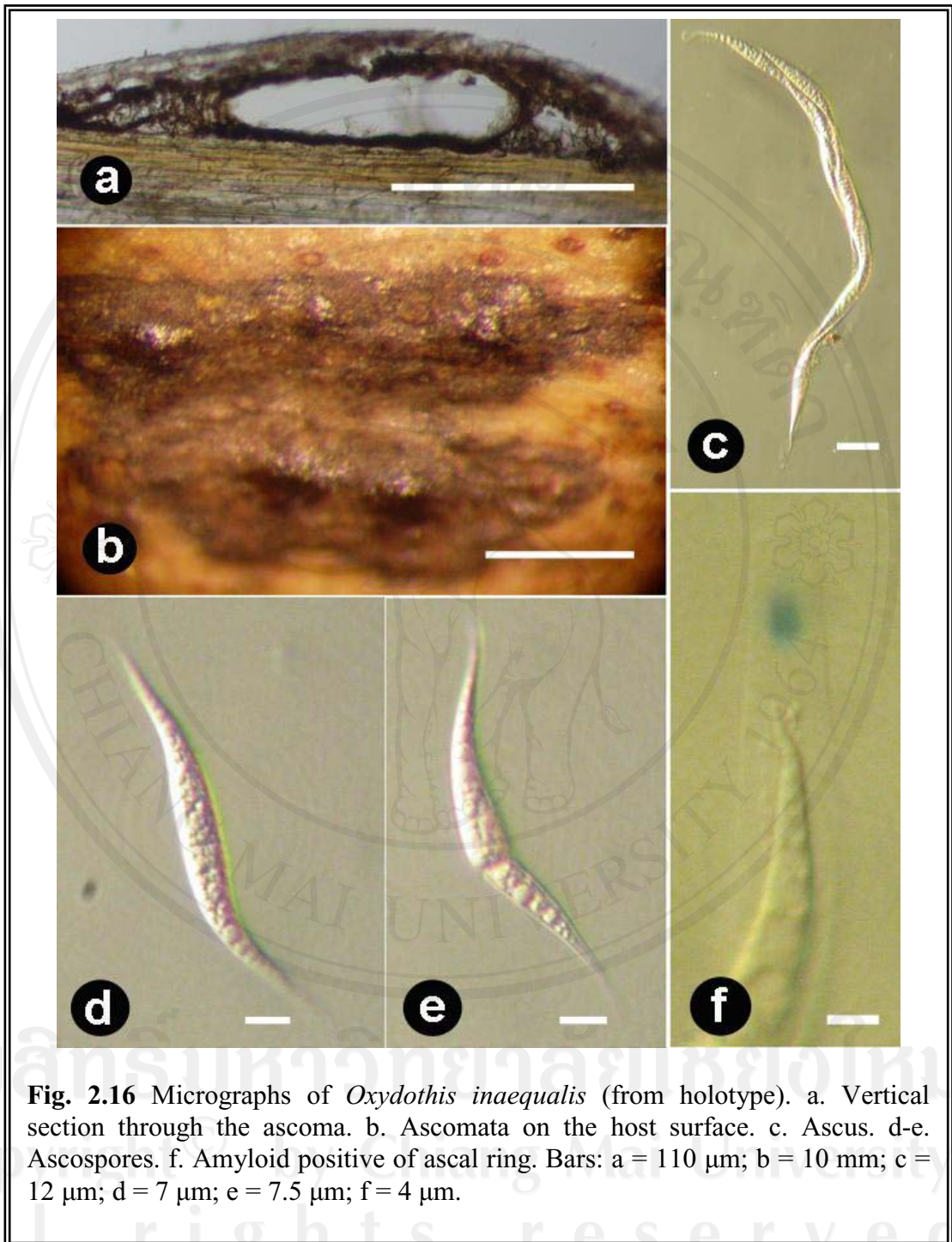
Distribution: Australia, Hong Kong, Malaysia, and Thailand (Taylor and Hyde, 2003; Hidayat *et al.*, 2006).

Notes: In Thailand, this species was reported by Hidayat *et al.* (2006).

Oxydothis inaequalis Hidayat, To-anun and K.D. Hyde, *Fungal Diversity* **23**: 165 (2006)

(Fig. 2.16)

Stromata 5–40 mm long × 5–10 mm wide, visible as blackened ellipsoidal regions on the host surface, lacking borders. **Ascomata** 110–120 µm diam. × 22–30 µm high, forming slightly raised domes, singly or clustered in groups up to 10 (mostly 2–3); in section immersed, ellipsoid, long axis horizontal to that of the host surface, papilla at one end curving upwards to the host surface. Stromatic tissue surrounds the ascomata within the host hypodermis. **Peridium** 10–12.5 µm thick, comprised of 2–3 layers; outer layers of oblong, dark-brown cells and sometimes with an additional inner layer of oblong, hyaline cells. **Paraphyses** deliquescent early, septate, ca 2.5 µm in diam. **Asci** 200–285 × 11.25–12.5 µm, 8-spored, unitunicate, cylindrical, short pedicellate, J+, 4–6(–7) µm high, 3–4 µm diam., wedge-shaped, subapical ring, apically truncate. **Ascospores** 75–100 × 5–7.5 µm, 1–2 seriate, fusiform, 1-septate, hyaline, tapering gradually to form long pointed processes. The ascospores processes are sometimes uneven which may make the septum appear slightly eccentric.



Anamorph: Unknown.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, decaying rachis of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 018) (**Holotype:** MRC 0004). **Isotype:** *ibid.*, HKU (M) 17169.

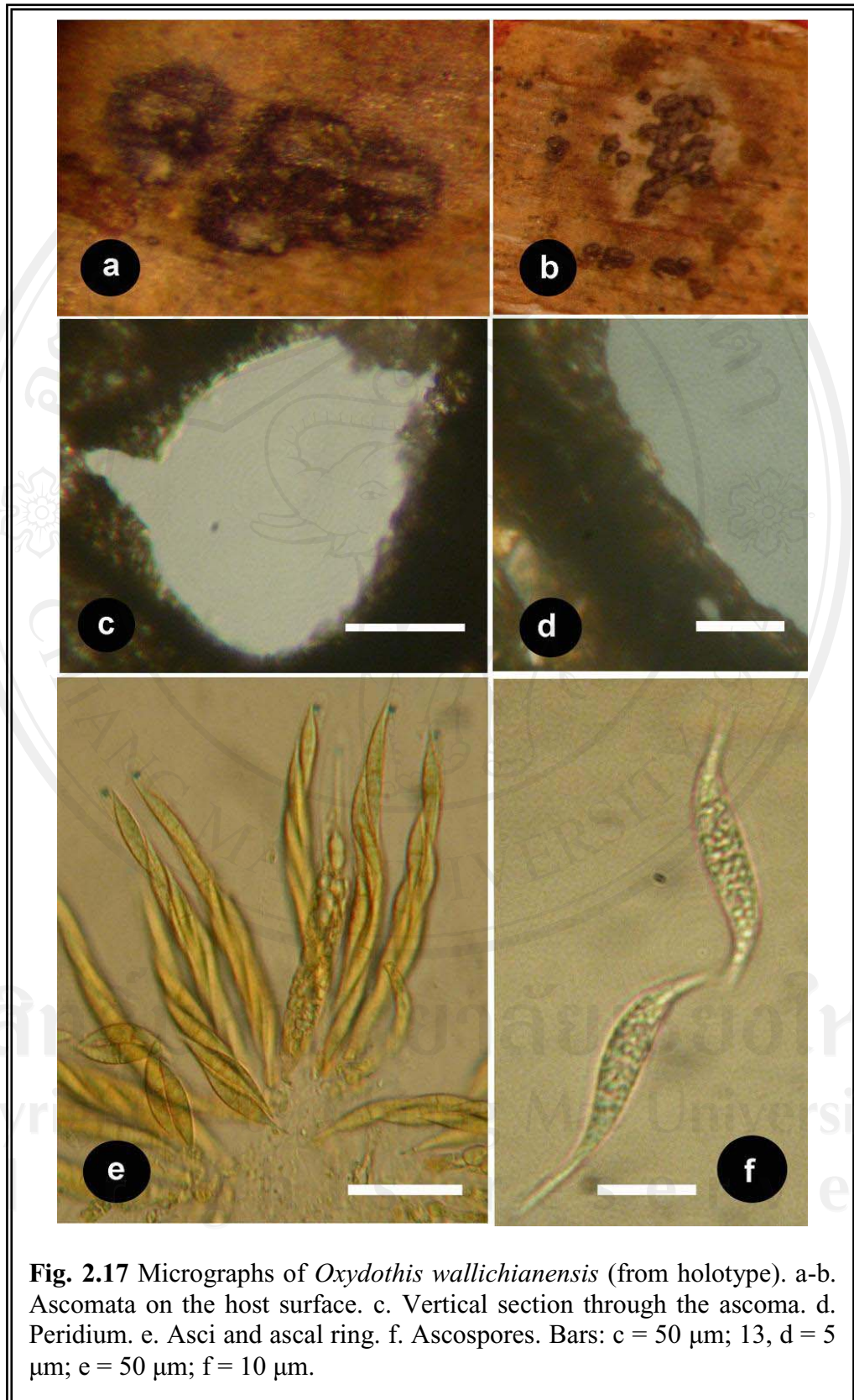
Host: Saprobic on the *W. siamensis* fronds.

Distribution: Northern Thailand.

Notes: A detail morphology and molecular elucidation of this species is presented in chapter 3.

Oxydothis wallichianensis Hidayat, To-anun and K.D. Hyde, *Fungal Diversity* **23**: 167 (2006)
(Fig. 2.17)

Stromata 2–3 mm long × 1.5–2.5 mm wide, surrounded by ellipsoidal, brown borders. **Ascomata** 70–150 µm diam. × 55–100 µm high, stromata domes on the host surface, mostly clustered in groups of up to 18; in section immersed to erumpent, subglobose, papilla at one end curving upwards to the host surface. **Peridium** 5–8.75 µm thick comprised of 2–3 layers outer layers of oblong, dark-brown cells. **Asci** 87.5–125 × 10–15 µm, 8-spored, unitunicate, cylindrical, pedicellate, with a J+, 2–2.5 µm high × 3–3.5 µm diam., wedge-shaped, subapical ring. **Ascospores** 32.5–55 × 6.3–7.5 µm, 1–2-seriate, fusiform, 1-septate, hyaline, tapering abruptly near the ends to form long spine-like processes.



Anamorph: Unknown.

Material examined: THAILAND, Chiang Mai, Doi Suthep, on decaying leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 010) (**Holotype:** MRC 0002). **Isotype:** *ibid.*, HKU (M) 17174.

Host: Leaflets of *W. siamensis*.

Distribution: Northern Thailand.

Notes: A detail morphology and molecular elucidation of this species is presented in chapter 3.

Pemphidium rattanicola J. Fröhl. and K.D. Hyde, *Fungal Diversity Research Series* 3: 225 (2000)

(Fig. 2.18)

Ascomata developing in clusters beneath the uppermost layers of the host epidermis, darkened, dome-shaped areas, immersed, with central ostiole. **Paraphyses** numerous, 2.5-7.5 μm wide, tapering towards the tip, hypha-like, filamentous, and septate. **Asci** 95-120 \times 7.5-11.3 μm , unitunicate, 8-spored, cylindrical to clavate, short pedicellate, refractive sub apical ring, J- sub apical ring. **Ascospores** 67.5-87.5 \times 1.8-3.8 μm , filiform, 1-septate, 3-4 seriate, asymmetric, tapering slightly from the broader apex to a narrower base, hyaline, smooth walled, mucilagenous drop at one of the the ascospores tip.

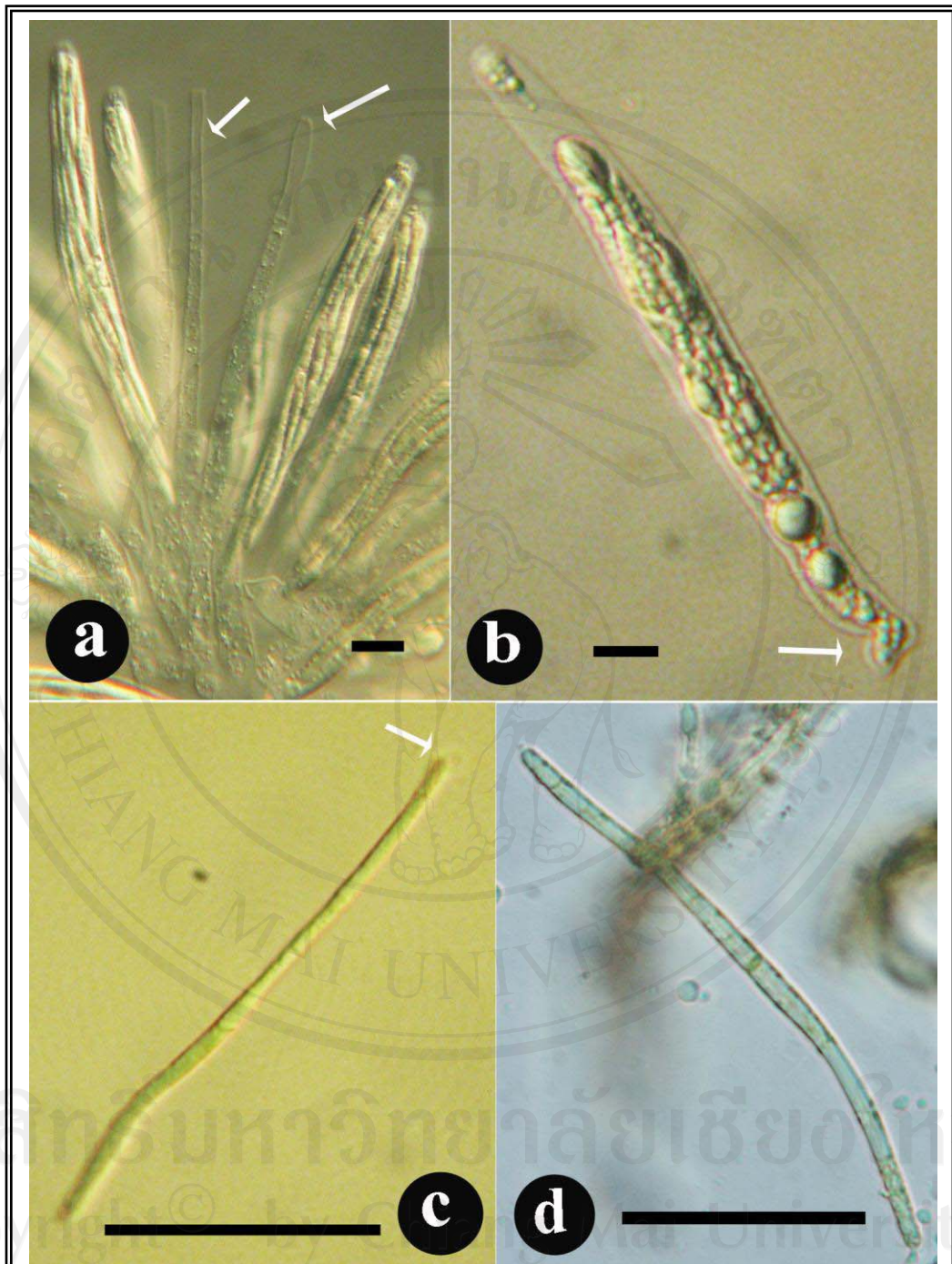


Fig. 2.18 Micrographs of *Pemphidium rattanicola* on *Wallichia siamensis*. a. Asci and paraphyses (showed by arrows). b. A single ascus with short pedicellate (showed by arrow). c-d. Ascospores with a mucilage pad at one end (showed by arrow). Bars: a, b = 10 μ m; c, d = 20 μ m.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July, 2005, Iman Hidayat (FIH 005).

Host: *Calamus caryotoides*, *C. moti* (Fröhlich and K.D. Hyde, 2000).

Distribution: Australia (Fröhlich and K.D. Hyde, 2000).

Notes: This specimen is identified as *P. rattanicola* due to its unusually wide asci and in having ascospores with a mucilage pad at only one end. This specimen is the first record of *P. rattanicola* from Thailand, and *W. siamensis* is reported here as a new host of this fungus.

Pestalospaeria elaeidis (Booth & Robertson) Aa, *Proc. K. Ned. Akad. Wet., Ser. C, Biol. Med. Sci.* **67**: 87 (1976)

= *Leptosphaeria elaeidis* C. Booth & J.S. Robertson, *Transactions of the British Mycological Society* **44**: 24 (1961).

≡ *Lepteutypa elaeidis* (C. Booth & J.S. Robertson) Arx, *The genera of fungi sporulating in pure culture*: 176 (1981).

(Fig. 2.19)

Ascomata darkened, immersed, solitary perithecial, gregarious, in section, 150-250 × 180-210 μm, subglobose, with an ostiole in the papilla. **Peridium** 15-25 μm thick, consisting of two strata; outer stratum composed of 3-5 layers of brown, thick-walled, very compressed cells; inner stratum composed of 1-2 layers of hyaline, thin-walled, very compressed cells. **Paraphyses** 2-4 μm wide, hyphal-like, septate,

narrow to the ends, not branched, hyaline. *Asci* 55-102.5 × 8.8-12.5 μm, unitunicate, 8-spored, cylindrical, pedicellate, with refractive, discoid, J+ sub apical ring, 1-2 μm high, 2-2.8 μm diam. *Ascospores* 15-16.3 × 5-6.3 μm, uniseriate overlapping, fusiform, mostly 2-septate sometimes 3-septate, brown, smooth.

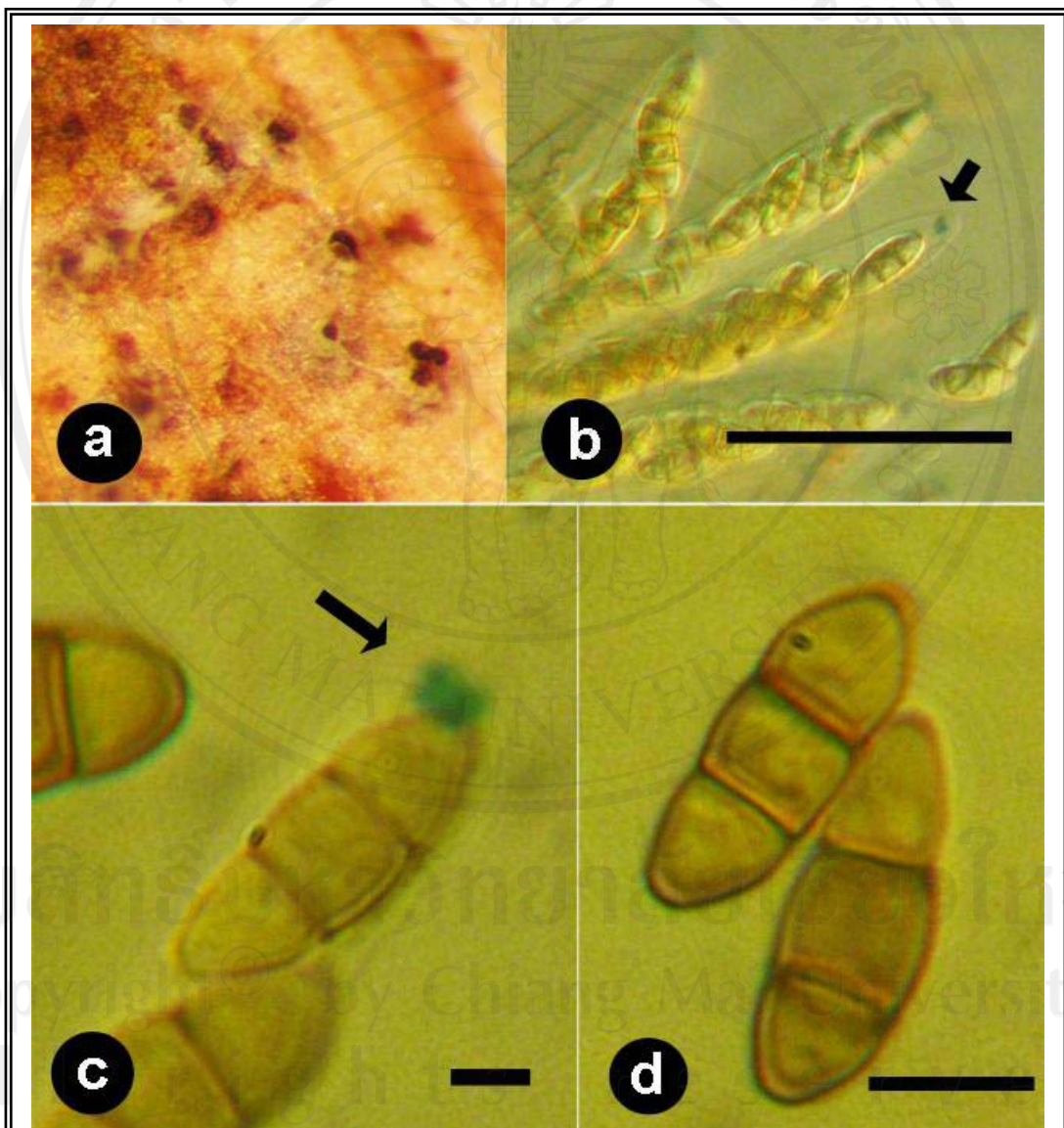


Fig. 2.19 Micrographs of *Pestalospaeria elaeidis* on *Wallichia siamensis*. a. Ascomata appearance on the host surface. b. Asci (ascus ring showed by arrow). c. Ascus ring (arrow). d. Ascospores. Bars: b = 75 μm; c = 2.5 μm; d = 10 μm.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 027).

Host: *Elaeis guineensis* (Hyde, 1996).

Distribution: Nigeria (Hyde, 1996).

Pestalotiopsis guepinii (Desm.) Steyaert [as 'guepini'], *Bulletin du Jardin Botanique de l'État à Bruxelles* **19**: 312 (1949)

= *Pestalotia guepinii* Desm., *Annales des Sciences Naturelles, Botanique* **13**: 181 (1840)

(Fig. 2.20)

Conidiomata acervular, scattered or gregarious, sub-epidermal, remaining immersed, visible at the surface by dark exuding conidial masses; in section ellipsoid, 185-400 × 175-225 μm. **Peridium** 12.5-18 μm thick, consisting of 3 to several layers of pale brown, moderately thick-walled cells of textura angularis. **Conidiophores** arising from the entire periphery of the inside of the conidiomata, reduced to conidiogenous cells or poorly developed, branched at the base, ampulliform. **Conidiogenous cells** 7.5-12.5 × 1-2 μm, annellidic, hyaline, discrete or integrated, smooth, cylindrical. **Conidia** fusiform, 20-30 × 6.5-8.5 μm, 4-septate; *apical cell* hyaline and thin-walled; *median cells* doliiform, brown, with third and fourth cells from the base darker than the second cell (at times the third cell darker than the fourth cell), moderately thick-walled; *basal cell* hyaline to subhyaline, obconical, smooth,

thin-walled. *Apical appendages* 2-3, inserted along the upper half of the apical cell, arising at different points, unbranched, flexuous, $10-20 \times 1 \mu\text{m}$, attenuated. *Basal appendage* $2-7.5 \times 1 \mu\text{m}$, single, centric, unbranched, attenuated.

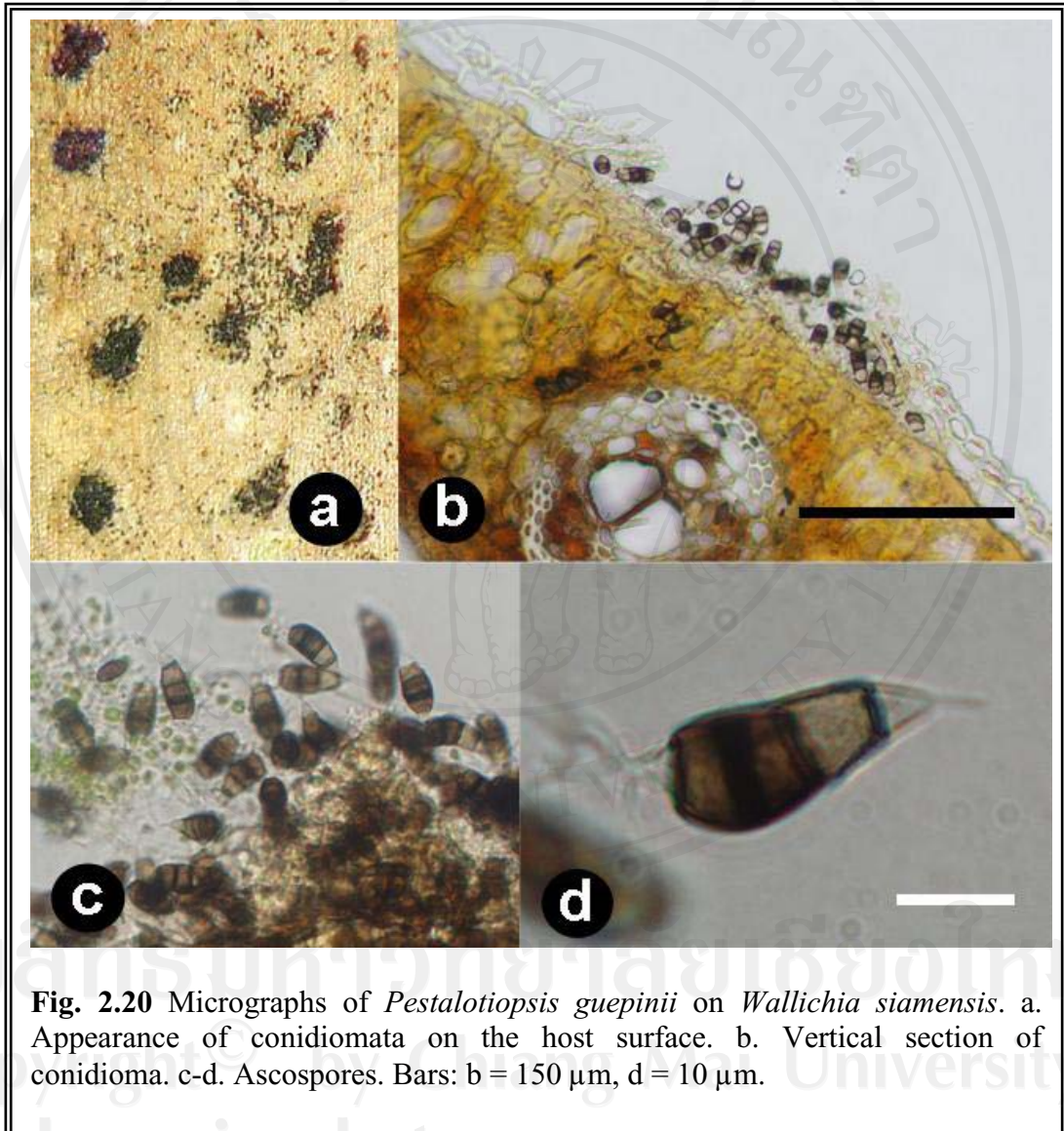


Fig. 2.20 Micrographs of *Pestalotiopsis guepinii* on *Wallichia siamensis*. a. Appearance of conidiomata on the host surface. b. Vertical section of conidioma. c-d. Ascospores. Bars: b = 150 μm , d = 10 μm .

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 032).

Host: *Camellia japonica*, *Camelia sinensis*, *Erica* sp., *Rhododendron* sp., with occasion records on unrelated hosts including *Hippocratea* sp., *Jatropha* sp., *Laurus* sp., *Pinus* sp., *Terminalia* sp. (Sutton, 1980).

Distribution: Ghana, Kenya, Togo, India, Bohemia, France, Germany, Netherlands, UK, USA. Reported in literature from Belgium, Denmark, Italy, Sweden, Switzerland, Azores, Indonesia, Japan, New Zealand, Puerto Rico, Dominican Republic (Sutton, 1980).

Notes: This species is commonly recognized as an agent of grey leaf spot, twig dieback, stem canker, petal rot diseases on the plants (Guba, 1961).

Protocreopsis pertusa (Pat.) Samuels & Rossman, *Stud. Mycol.* **42**: 66 (1999)

≡ *Nectria pertusa* Pat., in Patouillard & Lagerheim, *Bull. Soc. Mycol. France* **11**: 227 (1895).

= *Nectria scitula* Bres., *Hedwigia* **35**: 299 (1896).

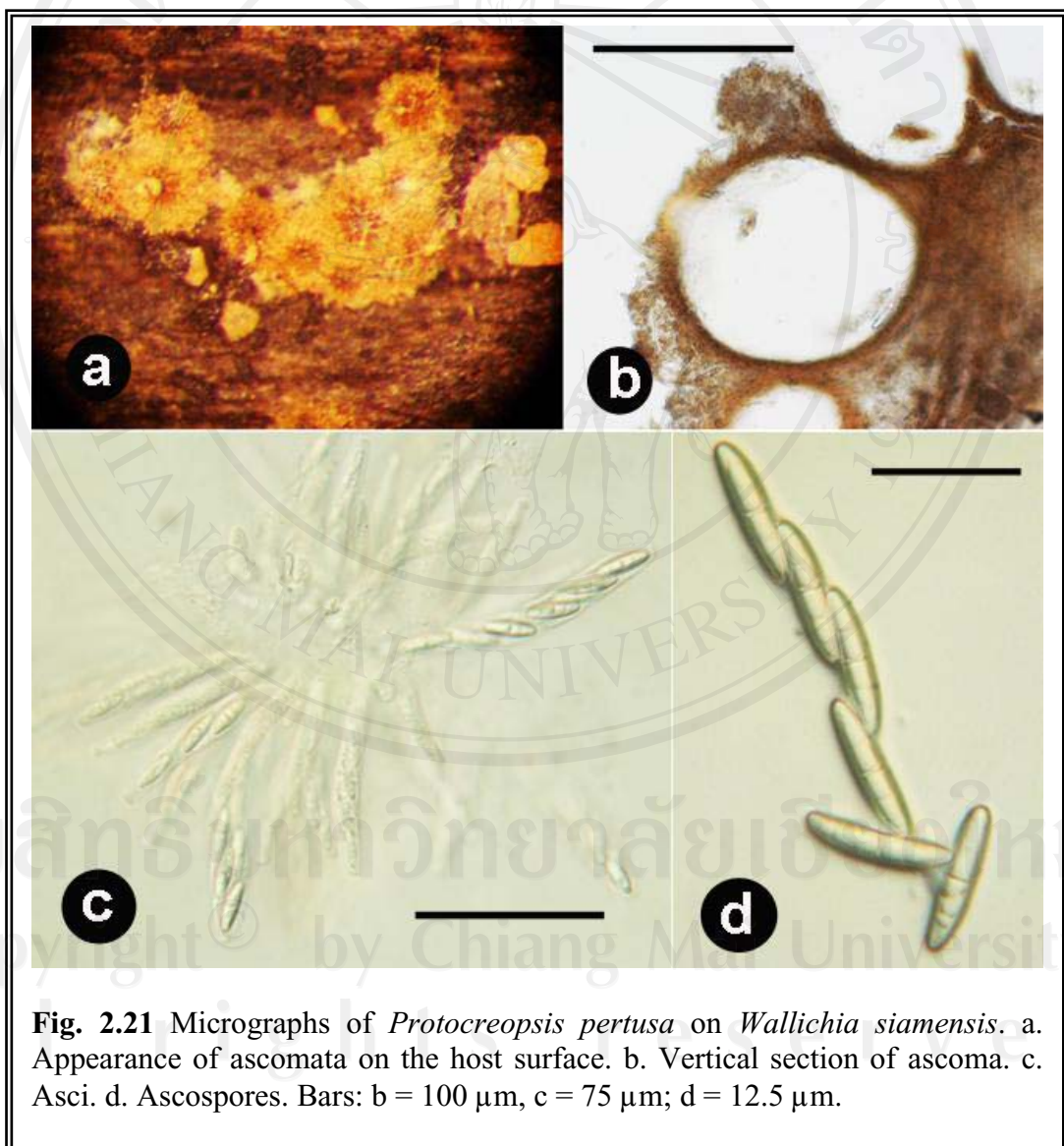
≡ *Protocreopsis scitula* (Bres.) Doi, *Bull. Natl. Sci. Mus., Tokyo, B.* **4**: 116 (1978).

= *Nectria aemulans* Rehm, *Ann. Mycol.* **7**: 539 (1909).

(Fig. 2.21)

Ascomata superficial on the substratum or immersed in a hyphal subiculum to well developed, without hairs, perithecial, KOH-, white to pale yellow, in section

globose, ostiole central, 125-183 μm diam, 175-220 μm high. *Asci* 75-90 \times 10-12.5 μm , unitunicate, 8-spored, cylindrical, truncate at the apices, with refractive, cylindrical, J- apical ring. *Ascospores* 12.5-15 \times 3.25-5 μm , fusiform and /or ellipsoid, 1-septate, striate-punctate, striations visible few (up to 3), biseriate overlapping, hyaline, greenish in mass, with mucilaginous sheath.



Specimens examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on rachis of *Wallichia siamensis* Becc. (Arecaceae), 26 November 2006, Iman Hidayat (FIH 067); Bahn Phadeng, on petioles of *Cocos nucifera* L. (Arecaceae), 13 July 2005, Iman Hidayat (FIH 002).

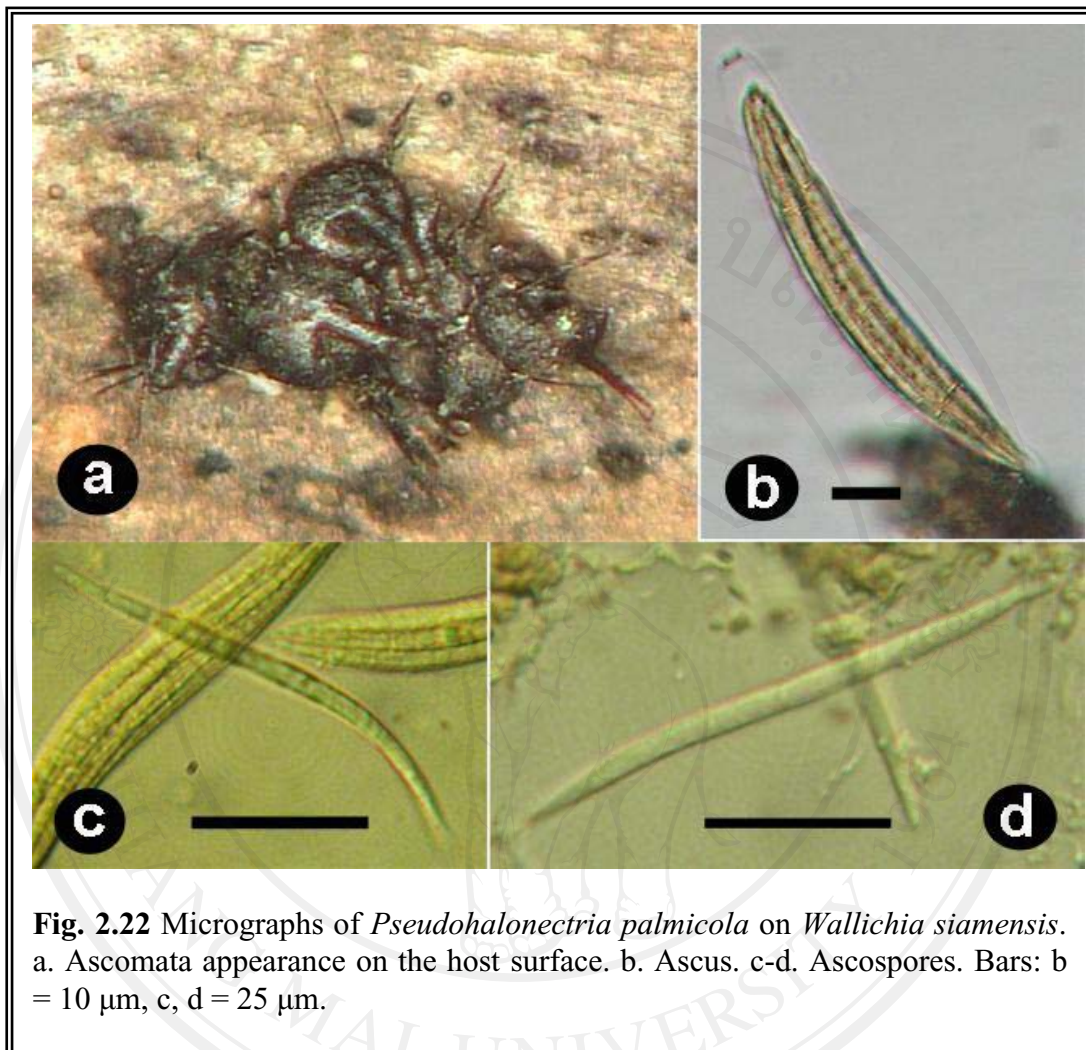
Habitat: On leaves of *Musa*, *Heliconia*, and palms, culms of bamboo, and rachides of tree ferns (Rossman *et.al*, 1999).

Distribution: Probably pantropical and subtropical.

Notes: Rossman *et.al* (1999) noted that this is a common species in the American tropics.

Pseudohalonectria palmicola K. D. Hyde, Joanne E. Taylor & J. Fröhl., *Mycologia* 91: 522 (1999)
(Fig. 2.22)

Ascomata immersed to superficial, clustered, black, coriaceous, in section 350-500 μm diam., 300-400 μm high, subglobose, with a long neck. **Peridium** 20-35 μm thick, composed of 3-4 layers of compressed, dark-brown, angular cells, inner cells hyaline. **Paraphyses** 3-7.5 μm wide, filamentous, hyaline, tapering towards the apex, embedded in a gelatinous matrix. **Asci** 75-125 \times 8.5-13.5 μm , unitunicate, 8-spored, cylindrical, with a subtruncate apex, apedicellate, with a J- apical ring. **Ascospores** 75-110 \times 2.5-3.5 μm , multiseriate, filiform with tapering towards both ends, hyaline, multiseptate, smooth.



Material Examined: THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, Hua Kog Ma, on primary rachis of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 142).

Host: *Calamus australis* (Hyde *et al.*, 1999).

Distribution: Australia (Hyde *et al.*, 1999).

Notes: This specimen is much closed to *Pseudohalonectria palmicola* in ascus size, ascus ring shape, and ascospores shape (Hyde *et al.*, 1999). This is the first report

of *Pseudohalonestria palmicola* from Thailand, and *W. siamensis* is reported here as a new host.

***Rachidicola obclavatum* Hidayat & To-anun, sp. nov.**

(Fig. 2.23)

Differt a Rachidicola palmae asci 75-125 × 12.5-22 μm, obclavati et ascospori 22.5-27 × 5-8 μm, 2-3-seriati, 6-cellulis.

Etymology: Refers to the shape of ascus, obclavate.

Ascomata immersed beneath a clypeus, visible as raised, darkened, dom-shaped, areas, in section 300-500 μm diam., 185-250 μm high, ellipsoidal, coriaceous, dark brown, solitary, with central ostiole. **Peridium** 15-30 μm thick, inwardly composed of several layers of compressed, angular cells, outwardly composed of angular, dark-brown cells. **Paraphyses** 2.3-4 μm, filamentous, embedded in a gelatinous matrix, hyaline, septate. **Asci** 75-125 × 12.5-22 μm, unitunicate, 8-spored, short-pedicellate, obclavate, apically subtruncate, with a refractive, J- apical ring. **Ascospores** 22.5-27 × 5-8 μm, 2-3-seriate, fusiform, 6-cells, slightly constricted at the septum, hyaline, slightly curved, smooth, lacking a mucilagenous sheath.

Material Examined: THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, Hua Kog Ma, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (**Holotype:** FIH 140).

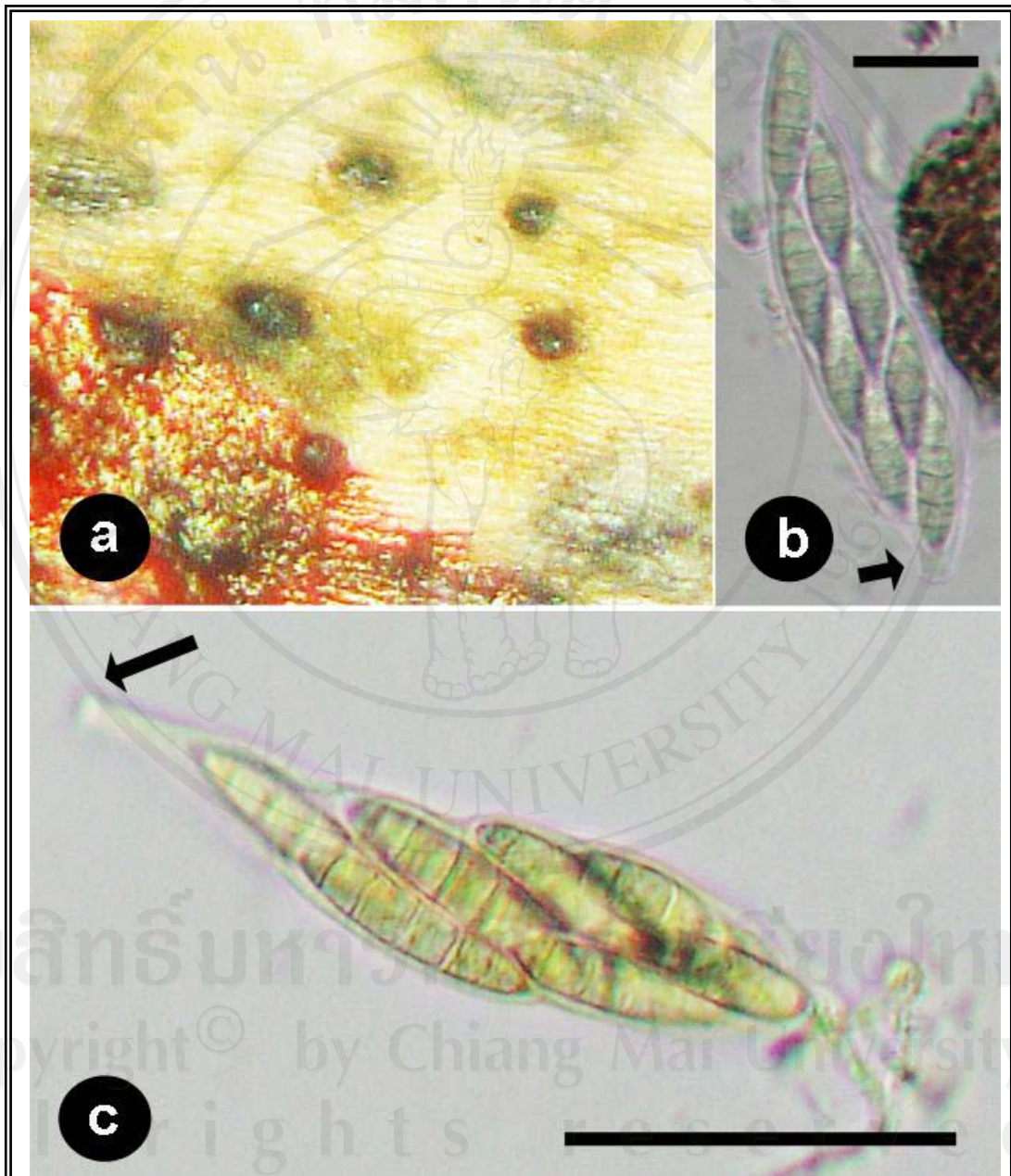


Fig. 2.23 Micrographs of *Rachidicola obclavatum* **sp. nov.** (from holotype). a. Ascomata appearance on the host surface. b. Ascus with short pedicellate (showed by arrow). c. Ascus with J- apical ring (showed by arrow). Bars: b = 25 μ m, c = 50 μ m.

Host: On leaflets of *W. siamensis*.

Distribution: Only known from the type locality.

Notes: This species is distinct from *Rachidicola palmae* K. D. Hyde & J. Fröhl. by having obclavate ascus and the septation of ascospores is more than 2-septate (5-septate) (Hyde and Fröhlich, 1995b).

Rosellinia victoriae Syd. & P. Syd., *Annales Mycologici* **6**: 483 (1908)

= *Hypoxyylon victoriae* (Syd. & P. Syd.) P. M. D. Martin, *South African Journal of Botany* **42**: 74 (1976).

= *Hypoxyylon victoriae* (Syd. & P. Syd.) P. M. D. Martin, *South African Journal of Botany* **33**: 325 (1967).

(Fig. 2.24)

Ascomata on palm rachides appear as superficial black domes with a central ostiole surrounded by persistent dark brown to black superficial hyphae (subiculum-like) within a well-developed carbonaceous stroma, 1-1.5 × 0.5-1.5 mm. **Paraphyses** 1-2.5 µm, not branched, numerous, hypha-like, septate, filiform, gradually tapering toward the apex. **Asci** 105-162.5 × 8.8-13.8 µm, unitunicate, cylindrical, long pedicellate, 8-spored, with a cylindrical, J+ sub apical ring, 3.5-4 high, 2-3 µm diam. **Ascospores** 15-21.3 × 5-8.8 µm, fusiform to reniform, dark brown, uniseriate, surrounded by mucilaginous sheath, with a longitudinal straight germ slit in the center.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on primary rachis of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (FIH 026).

Host: Decaying wood (Petrini, 2003).

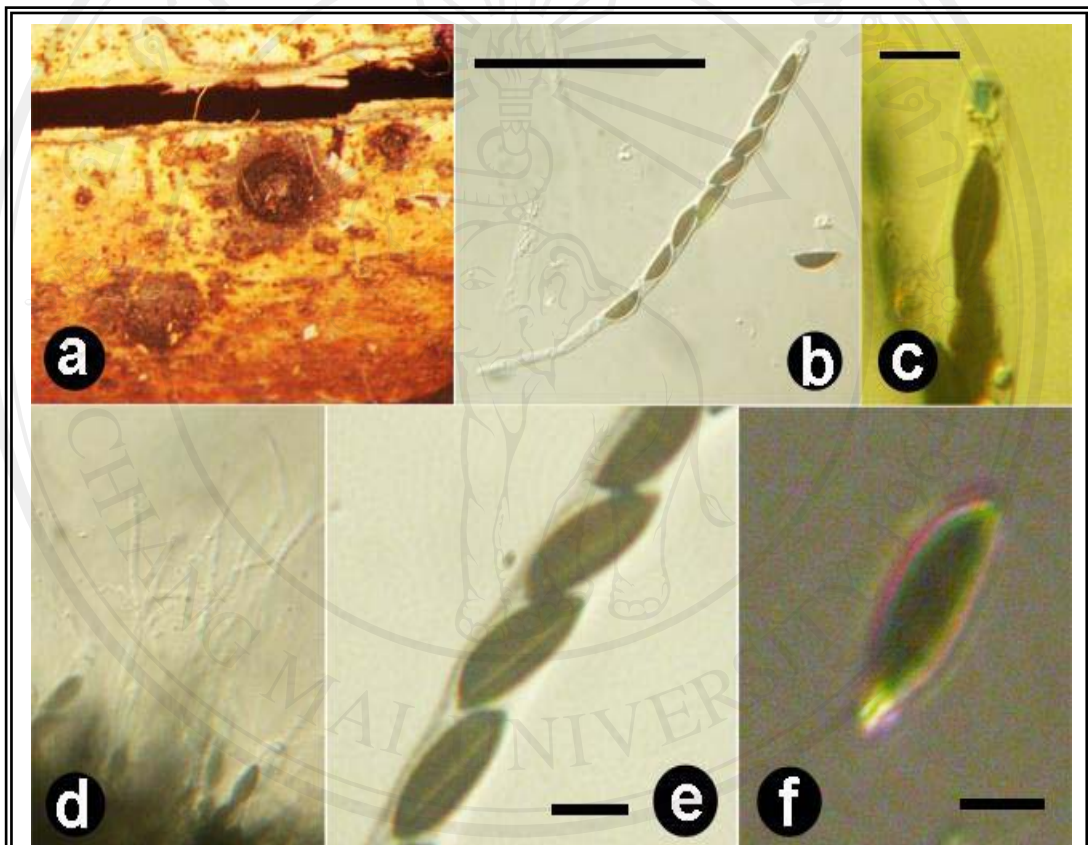


Fig. 2.24 Micrographs of *Rosellinia victoriae* on *Wallichia siamensis*. a. Ascoma. b. Ascus. c. Ascus ring. d. Paraphyses. e-f. Ascospores. Bars: b = 75 μm ; c = 10 μm ; e,f = 7.5 μm .

Distribution: Australia, New Zealand (Petrini, 2003)

Notes: This specimen is the first report of *Rosellinia victoriae* from Thailand, and *W. siamensis* is reported here as a new host.

***Submersisphaeria suthepensis* Hidayat & To-anun, sp. nov.**

(Fig. 2.25)

Asci 160-165 x 10-10.5 μm , bitunicatis, 8-sporis, cylindricis, ascosporis 22-25 x 7.5-9 μm , tetracellularibus, fusiformis, non-appendiculatum.

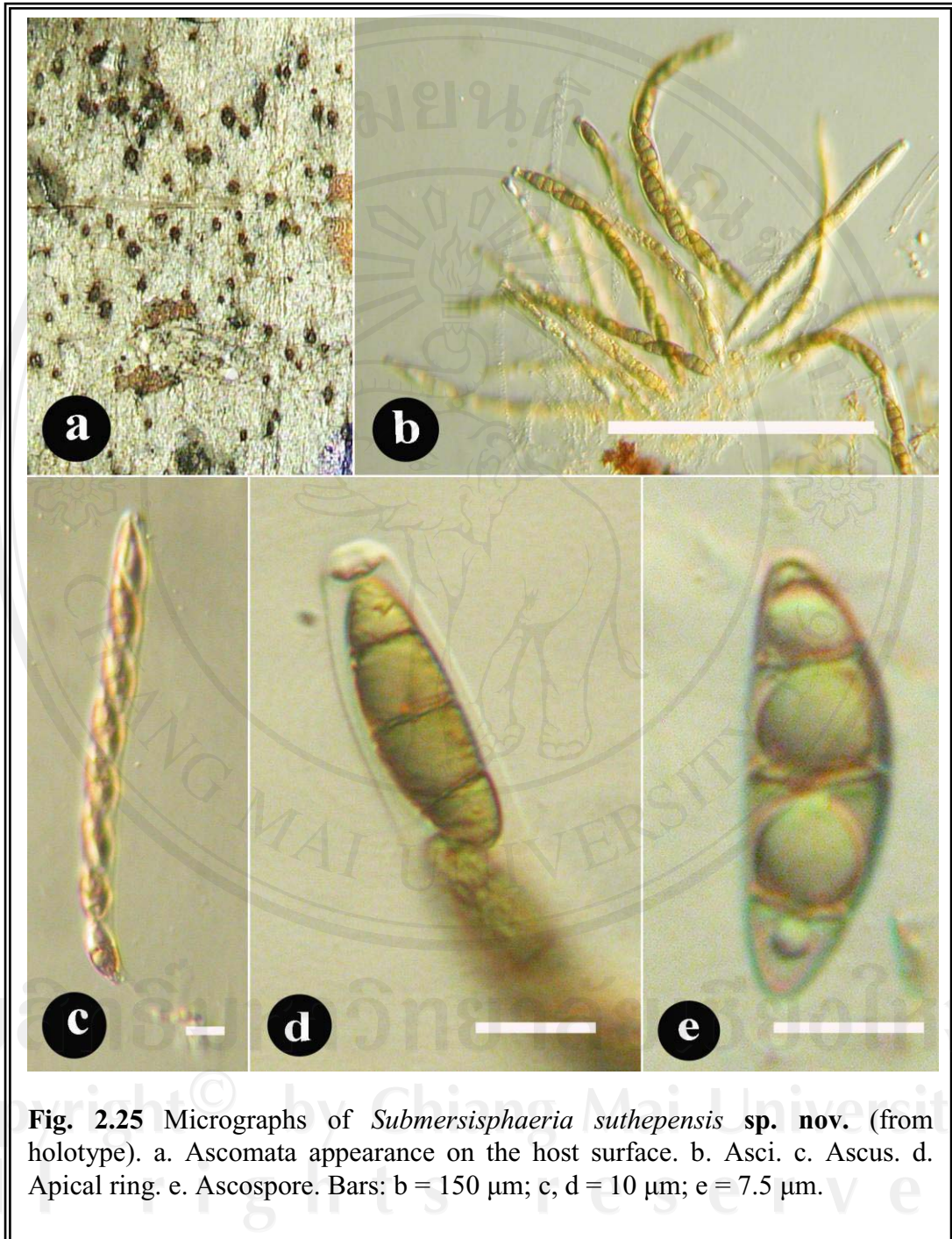
Etymology: Named after its collection site, Doi-Suthep.

Ascomata immersed, black, solitary, gregarious, in vertical section, globose, ostiolate, 120-185 μm diam., 200-250 μm high. **Peridium** up to 12 μm wide, composed of inner flattened light brown-walled cells, and outer brown-walled angular cells. **Paraphyses** 2.5-5 μm wide, hypha-like, septate, numerous, tapering towards the apex, hyaline, not embedded in a gelatinous matrix. **Asci** 160-165 \times 10-10.6 μm , unitunicate, 8-spored, long cylindrical, long pedicellate, refractive and massive apical ring, discoid, J- apical ring. **Ascospores** 22-25 \times 7.5-9 μm , fusiform, 3-septate, dark green to brown through the cell parts, thick walled, lacking of basal appendages.

Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, Huay Kog Ma, on primary rachis of *Wallichia siamensis* Becc. (Arecaceae), 21 July 2005, Iman Hidayat (**Holotype:** FIH 017).

Host: On primary rachis of *W. siamensis*.

Distribution: Only known from the type locality.



Notes: This species is much closed to *Submersisphaeria* K. D. Hyde than *Ascotaiwania* Sivan. & H. S. Chang due to the later species is characterized by having basal small hyaline/lightly cells at both ends and brown colour at the middle cells (Sivanesan and Chang, 1992). Recently, five species of *Submersisphaeria* have been reported, viz, *Submersisphaeria aquatica* K. D. Hyde, *S. bambusicola* D. Q. Zhou & K. D. Hyde, *S. palmae* Pinnoi, *S. rattanicola* J. Fröhl. & K. D. Hyde, and *S. vasicola* You Z. Wang, Aptroot & K. D. Hyde (Cai *et al.*, 2006). The present novel species is distinct to other *Submersisphaeria* species in having 4-cells ascospores, with non-appendages at both ends.

Terriera brevis (Berk.) P. R. Johnst. [as 'breve'], *Mycol. Pap.* **176**: 98 (2001)

= *Hysterium breve* Berk., *Transactions of the Linnaean Society of London* **20**: 174 (1847).

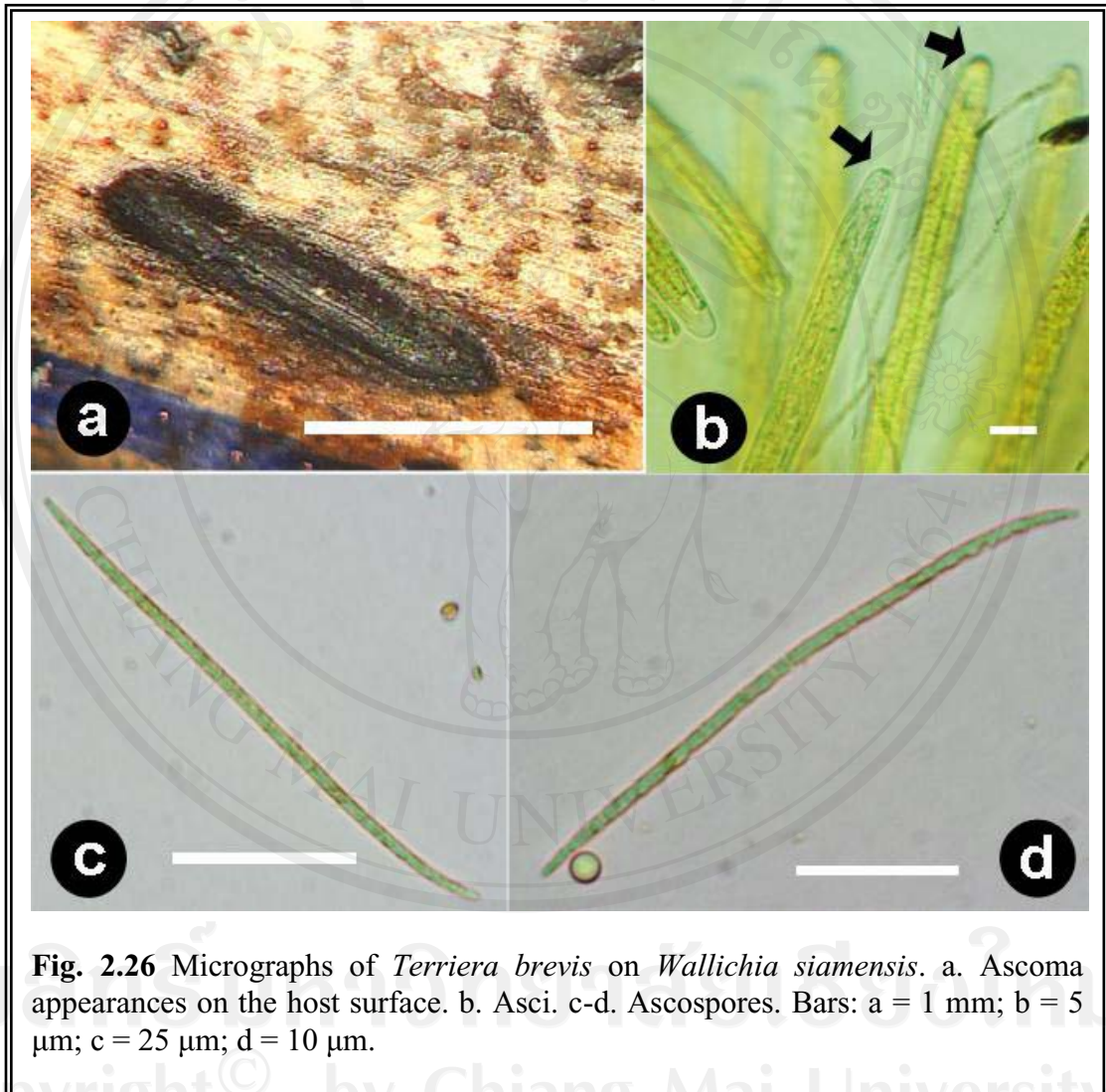
≡ *Lophodermium breve* (Berk.) De Not., *Giornale botanico Italiano* **2**: 47 (1847).

≡ *Hypoderma breve* (Berk.) Kuntze, *Revisio generum plantarum* **3**: 487 (1898).

(Fig. 2.26)

Ascomata hysterothecial (lips-like), coriaceous, black, 1-3 mm long, 0.25-0.5 mm high, solitary or clustered. **Peridium** composed of several layers of irregular shaped cells with moderately thick, dark brown walls. **Paraphyses** 1-2.5 µm wide, hypha-like, numerous, branched. **Asci** 110-144 × 6-7.5 µm, unitunicate, clavate, 8-

spored, short pedicellate, with refractive J-, sub apical ring, apically rounded and thick.
Ascospores 57.5-82.5 × 1.25-2 μm, filiform, aseptate, hyaline, lacking a mucilagenous sheath.



Material examined: THAILAND, Chiang Mai, Doi Suthep-Pui national park, on decaying rachis of *Wallichia siamensis* Becc. (Arecaceae), 16 October 2005, Iman Hidayat (FIH 150).

Host: *Carex* sp., *Uncinia* spp., *Gahnia* sp. (Johnston, 2001), *Archontophoenix alexandrae*, *Cocos nucifera*, *Trachycarpus fortunei* (Taylor and Hyde, 2003).

Distribution: New Zealand (Johnston, 2001), Australia, China, Hong Kong (Taylor and Hyde, 2003).

Notes: This specimen is the first record of *Terriera brevis* from Thailand, and *W. siamensis* is reported here as a new host.

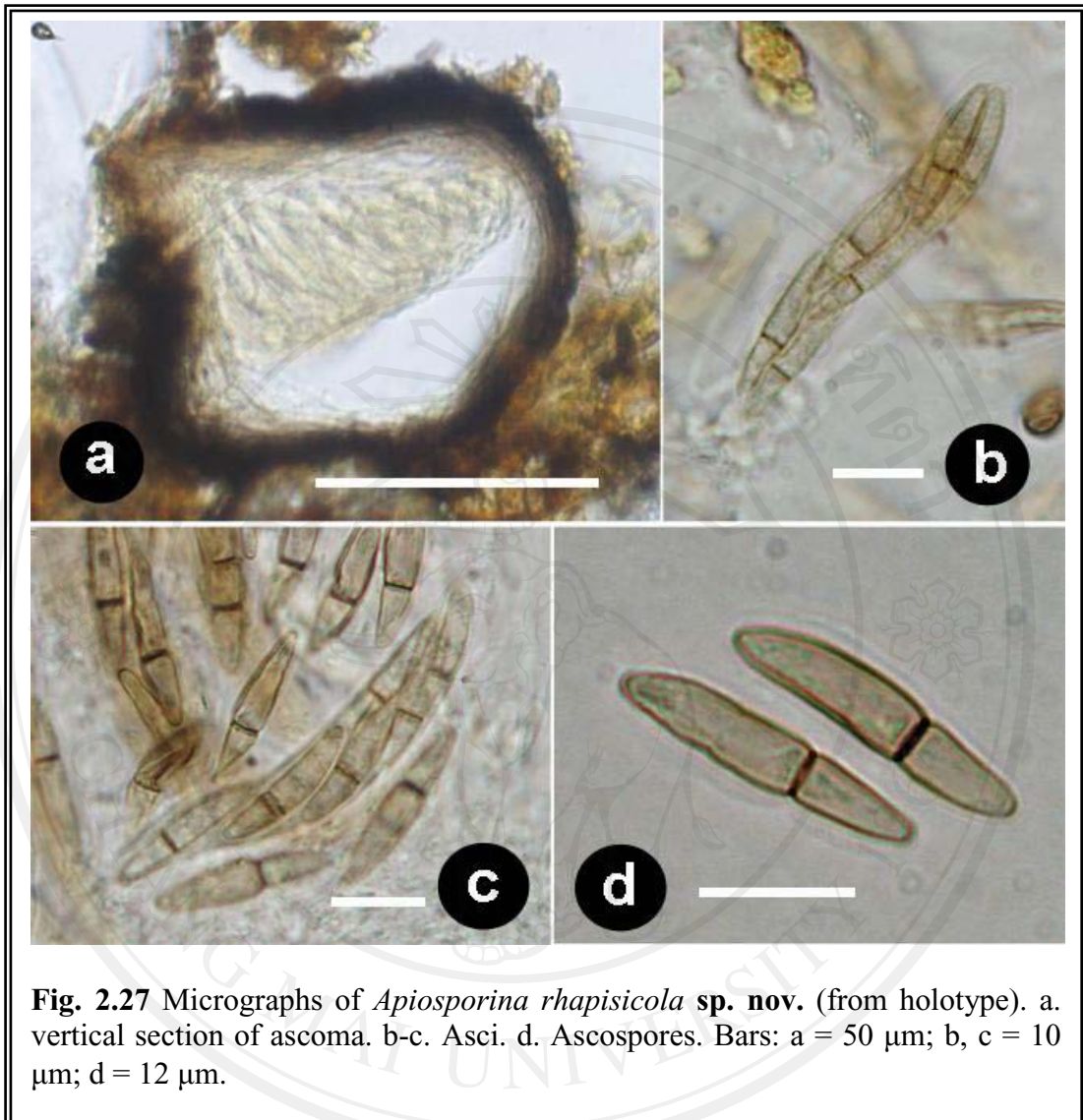
New taxa from other palms

***Apiosporina rhapsicola* Hidayat & To-anun, sp. nov.**

(Fig. 2.27)

Ascomata 90-98 μm diam, 65-71 μm alta, immersa, solitaria, subglobosa, ostiolata. *Asci* 69-87 \times 11.5-15.5 μm , bitunicata, 8-spore, cylindrico-clavata, pedunculati, praediti *Ascosporeae* 26.5-28 \times 5-6.5 μm , fusiformis, brunneus, bicellulares, apiosporae.

Etymology: In reference to the host genus, *Rhapis*.



Ascomata immersed, erumpent, solitary or clustered, in section 90-98 μm in diameter, 65-71 μm in height, subglobose, brown to dark-brown, ostiole central, papillate, lacking of setae around ostiole. *Peridium* 9.5-12 μm thick, comprising several layers, compressed, angular to ellipsoidal, dark brown cells. *Pseudoparaphyses* 1.5-2.5 μm wide, numerous, filamentous, cellular, hyaline, embedded in gelatinous matrix. *Asci* 69-87 \times 11.5-15.5 μm , bitunicate, 8-spored, cylindrical-clavate, short pedicellate, apically rounded. *Ascospores* 26.5-28 \times 5-6.5

μm , irregularly, fusiform, 1-septate, light-brown, septa constricted at the medium or sub-medium, upper cell wider and longer than lower cell.

Material examined: THAILAND, Chiang Mai, Queen Sirikit Botanic Garden, on living leaflets of *Rhapis* sp. (Arecaceae), 25 November 2006, Tatiya Takaew (**Holotype:** FIH 340). **Isotype:** Doi Suthep-Pui national park, Huay Kog Ma, on leaflets of *Wallichia siamensis* Becc. (Arecaceae), 29 April 2007, Iman Hidayat and Jamjan Meeboon (FIH 356).

Host: On living leaflets of *Rhapis* sp.

Distribution: Only known from the type locality.

Notes: This apiosporous fungus belongs to genus *Apiosporina* due to immersed and erumpent ascomata, bitunicate asci and apiosporous ascospores (Barr, 1989; Sivanesan, 1984). This genus is commonly associated with necrosis of leaves and black knot of twigs (Arx, 1987). Five species, namely, *Apiosporina collinsii* (Schwein.) Höhn., *A. coronata* (Speg.) Bat., *A. fallax* Petr., *A. harunganae* Hansf., and *A. morbosa* (Schwein.) Arx, have been recorded worldwide (Index Fungorum database). However, none of them are associated with plant family Arecaceae, therefore, this fungus is proposed as a new species.

Astrosphaeriella caryotae Hidayat & To-anun, **sp. nov.**

(Fig. 2.28)

Ascomata 103–130.5 μm diam, 44–86 μm alta, immersa, solitaria, subglobosa, ostiolata. *Asci* 51.5–73.5 \times 6–8.5 μm , bitunicata, 8-spore, clavata, pedunculati, praediti *Ascosporeae* 14.5–22 \times 3.5–5 μm , fusiformis, hyalinae, bicellulares et appendicum utrinque.

Etymology: In reference to the host genus, *Caryota*.

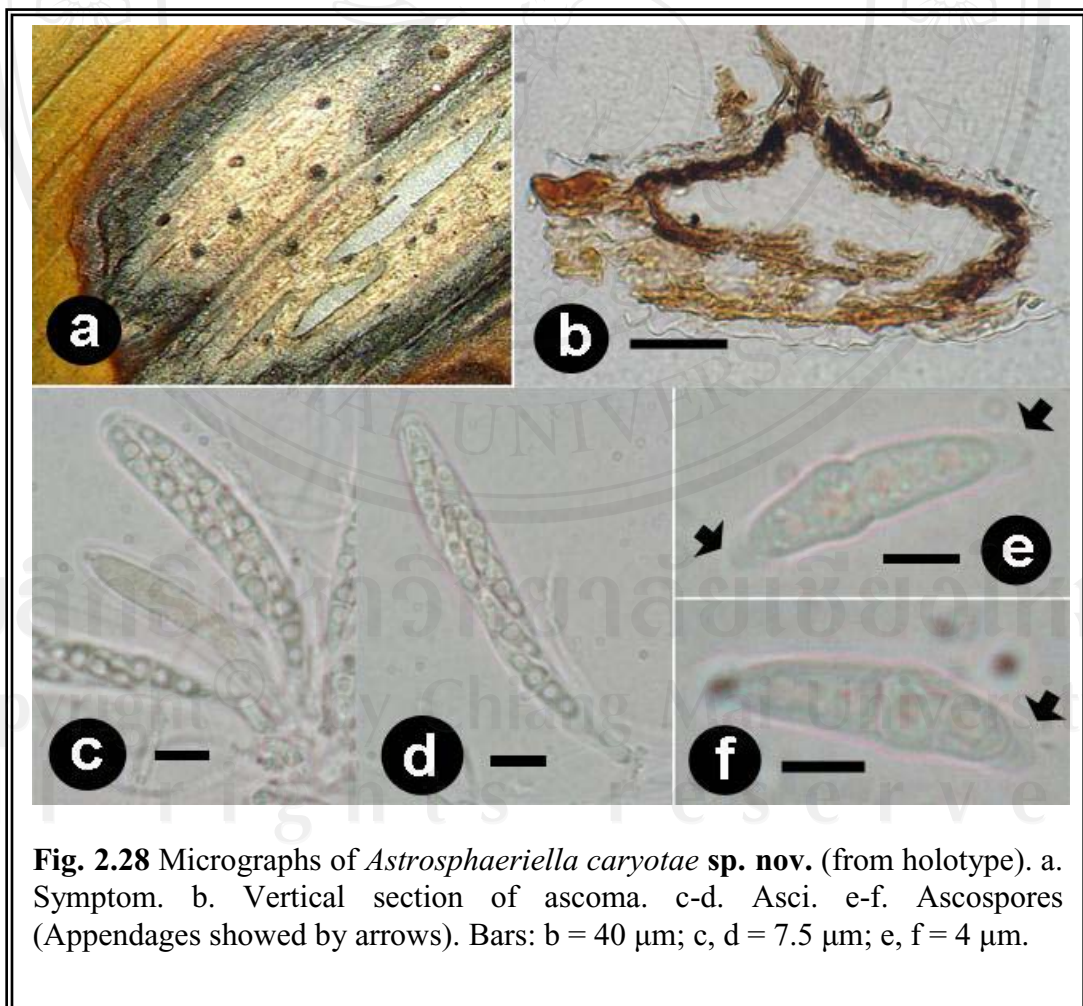


Fig. 2.28 Micrographs of *Astrosphaeriella caryotae* **sp. nov.** (from holotype). a. Symptom. b. Vertical section of ascoma. c-d. Asci. e-f. Ascospores (Appendages showed by arrows). Bars: b = 40 μm ; c, d = 7.5 μm ; e, f = 4 μm .

Ascomata immersed, solitary, scattered, visible as blackened dots, in section 103-130.5 μm in diameter, 44-86 μm high, subglobose, ostiole central. *Peridium* 4.5-7.5 μm in diameter, comprising of 3-4 layers, compressed, dark brown, textura angularis cells. *Pseudoparaphyses* 1-2 μm wide, numerous, hypha-like, cellular, anastomosing between asci. *Asci* 51.5-73.5 \times 6-8.5 μm , bitunicate, 8-spored, clavate, short pedicellate. *Ascospores* 14.5-22 \times 3.5-5 μm , overlapping biseriate, fusiform, 1-septate, euseptate, constricted at the septum, upper cell broader than the lower, hyaline, with pads-like appendages at both ends.

Material examined: THAILAND, Chiang Mai, Chiang Mai University garden, on living leaflets of *Caryota mitis* Lour. (Arecaceae), 29 October 2005, Tatiya Takaew (**Holotype:** FIH 320).

Host: On living leaflets of *Caryota mitis*.

Distribution: Only known from the type locality.

Notes: Species of *Astrosphaeriella* Syd. & P. Syd. are recognized as asaprobes inhabit various decaying plants. On family Arecaceae, *Astrosphaeriella fronsicola* J. Fröhl. & K. D. Hyde on *Oraniopsis appendiculata* (F. M. Bailey) J. Dransf., A. K. Irvine & N. W. Uhl, is the only species reported from leaf spots of palms (Fröhlich and Hyde, 1995a). The novel species is easily recognized and differentiated from *A. fronsicola* by having appendages at both ascospores ends and being recorded from *Caryota mitis*.

Astrosphaeriella palmicola Hidayat & To-anun, **sp. nov.**

(Fig. 2.29)

Ascomata 455-725 μm diam., 615-910 μm , *superficialis*, *solitaria*, *nigra*, *conicalia*, *ostiolata*; *Asci* 75-90 \times x 7.5-10 μm , *clavati*, *8-spori*, *bitunicati*, *pedicellati*; *Ascospori* 24-28 \times 2.5-4.5 μm , *biseriati*, *fusiformis*, *1-3-septata*, *hyalina*, *nonappendiculati*.

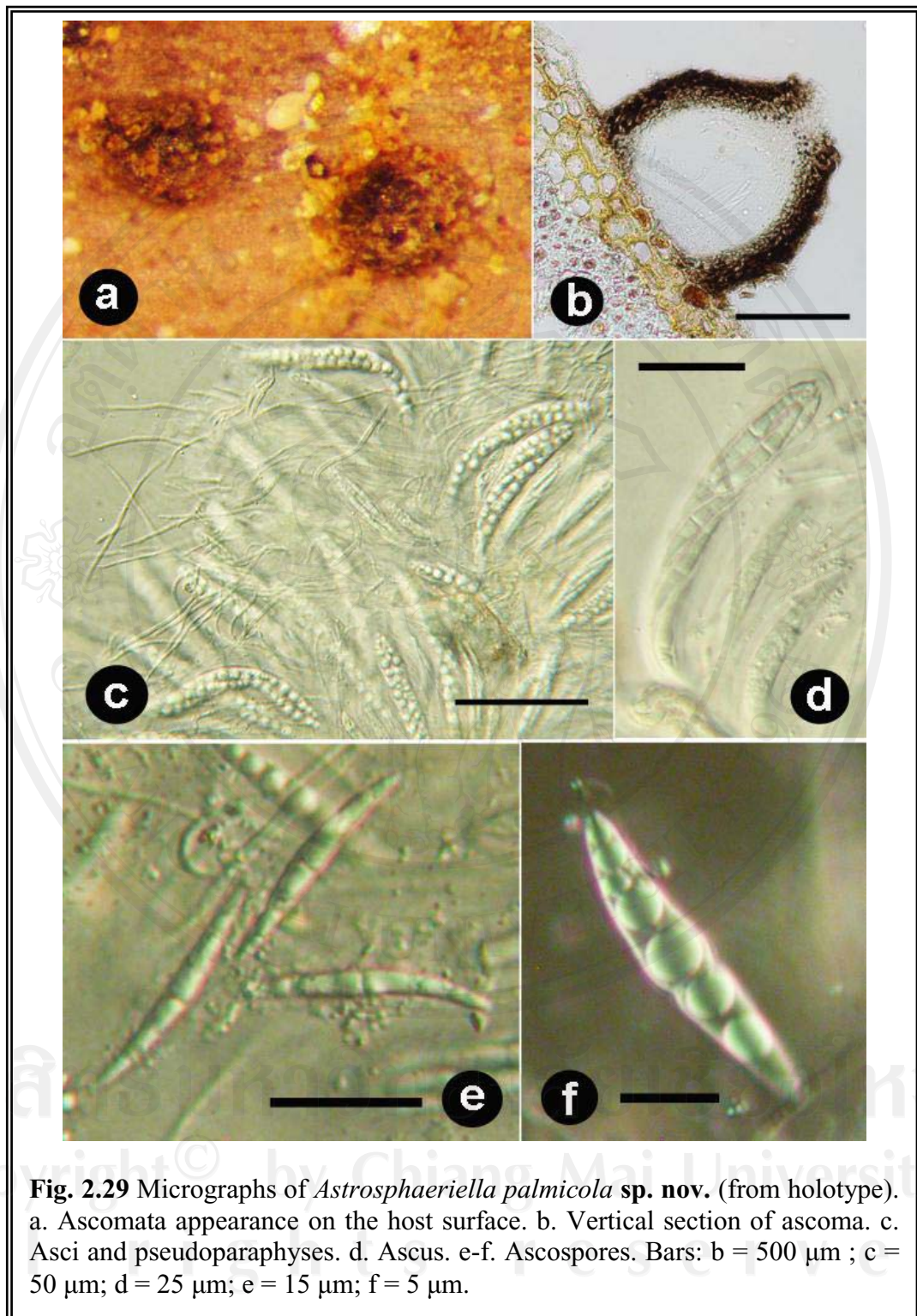
Etymology: Refers to its host common name, palm.

Ascomata superficial, solitary, black, in section 455-725 μm diam., 615-910 μm , conical, base flattened, with rounded and central ostiole. *Peridium* thick and carbonized, base poorly developed. *Pseudoparaphyses* ca 0.5 μm , numerous, filamentous, hyaline, anartomosing between asci. *Asci* 75-90 \times 7.5-10 μm , clavate, 8-spored, bitunicate, pedicellate, with rounded apex, with an ocular chamber. *Ascospores* 24-28 \times 2.5-4.5 μm , overlapping biseriate, narrowly fusiform, 1-3-septate, hyaline, lacking a mucilagenous sheath.

Material examined: THAILAND, Chiang Mai, A. Pa pae, Bahn Phadeng, Mushroom Research Centre, on leaflets of *Areca catechu* L. (Arecaceae), 5 September 2005, Iman Hidayat (**Holotype:** FIH 084).

Host: On leaflets of *Areca catechu*.

Distribution: Only known from the type locality.



Notes: According to key of *Astrosphaeriella* Syd. & P. Syd. from palms by Hyde and Fröhlich (1997), *Astrosphaeriella palmicola* sp. nov. is closed to *A. minima*

Aptroot in having ascospores lacking of mucilagenous sheath, hyaline and the size shorter than 30 μm . However, the novel species is distinct and easily distinguished from *A. minima* by having superficial and carbonaceous ascomata, thin ascospores (2.5-4.5 μm vs 7-8 μm of *A. minima*) and being recorded from palm genus *Areca* (*A. minima* is only known from Bamboo) (Hyde and Fröhlich, 1997).

Fasciatispora ujongkulonensis Hidayat, *Mycotaxon* **102**: 350 (2007)

(Fig. 2.30)

Ascomata immersa, circumglobata, clypeata, apparatus leviter elatus et ostiolatus, 115–300 μm diam., 50–120 μm alta, subglobosa, basi planissimus, perithecium, medium ostiolatum. Peridium 7.5–15 μm crassum. Paraphysae 1–2.5 μm , numerosae, filamentae, septatae et hyalinae. Asci 43–81 \times 4.5–9.5 μm , unitunicati, 8-spore, cylindrici, apicis rotundi, apicale apparatus discoidae, J+, 2–2.5 μm diam, 1–1.5 μm alta praediti. Ascosporae 6–12 \times 4.5–7.5 μm , uniseriatae, ellipsoideae, aseptatae, brunneae, fascia aequatoris pallidus vel latus, tunica gelatinosa praeditae.

Etymology: Refers to the place where the specimen was collected.

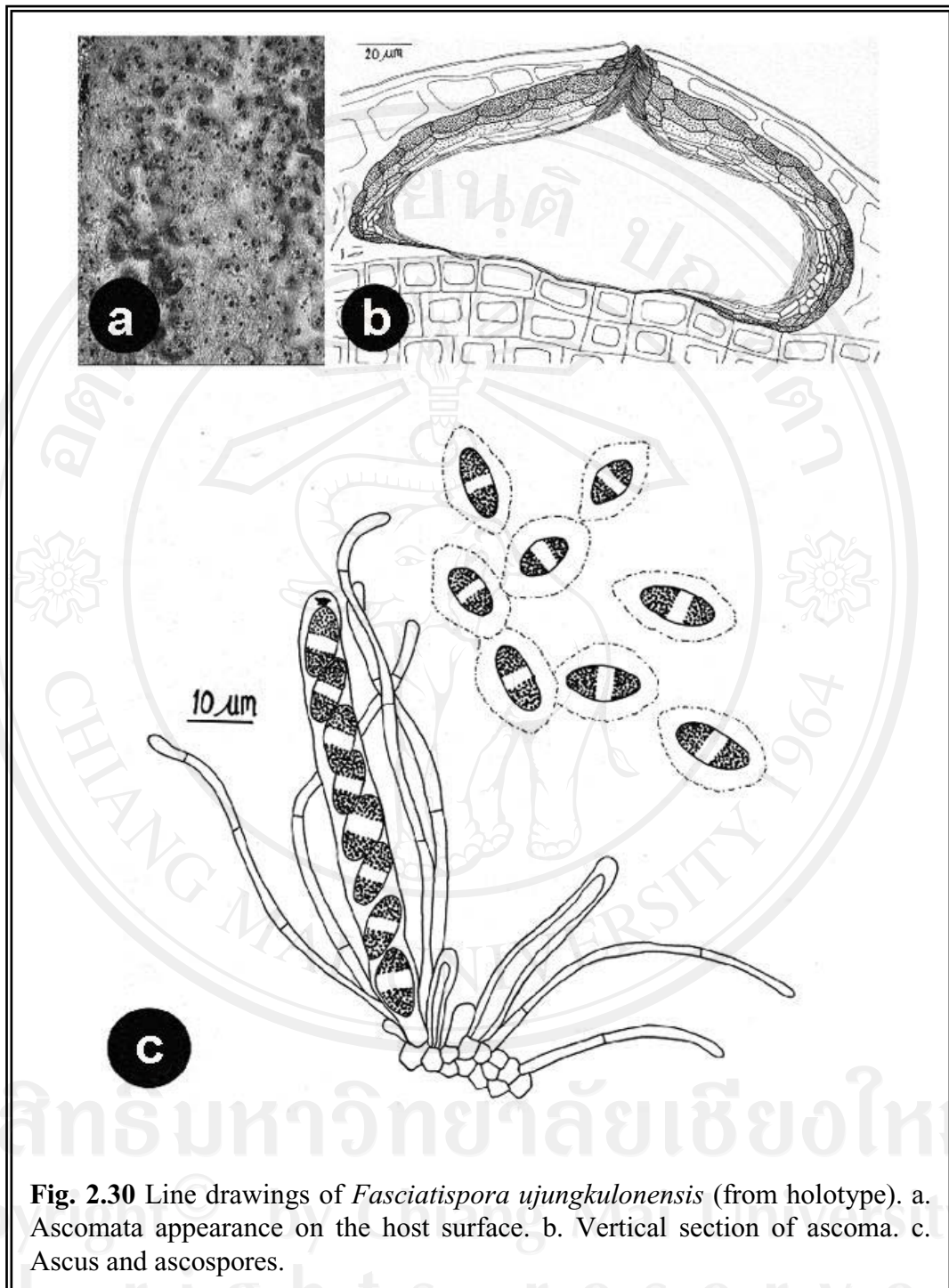


Fig. 2.30 Line drawings of *Fasciatispora ujkunlonensis* (from holotype). a. Ascomata appearance on the host surface. b. Vertical section of ascoma. c. Ascus and ascospores.

Ascomata immersed, clustered, clypeate, visible as a slightly raised, ostiolar, dome-shaped areas on the host surface, in section 115–300 µm diam., 50–120 µm high, subglobose, with a flattened base, and only covered by epidermal tissue of the

host, with a central ostiole. *Peridium* 7.5-15 μm thick, composed inwardly of 1-2 layers of compressed, hyaline cells, and externally of 2-3 layers of compressed, angular brown-walled cells. *Paraphyses* 1-2.5 μm wide, numerous, filamentous, septate, hyaline. *Asci* 43-81 \times 4.5-9.5 μm , unitunicate, 8-spored, cylindrical, short pedicellate, apically rounded, with J+, and non-refractive discoid subapical ring, 2-2.5 μm diam \times 1-1.5 μm high. *Ascospores* 6-12 \times 4.5-7.5 μm , overlapping uniseriate, ellipsoidal, aseptate, brown with a wide equatorial pallid band, and surrounded by a wide mucilaginous sheath, ca 2.5-10 μm from the ascospore proper.

Specimen examined: INDONESIA, West Java, Tanjung Lame, Ujung Kulon National Park, on decaying fronds of *Caryota* sp. (Arecaceae), 29 March 2006, Dewi and Iman Hidayat (**Holotype:** FIH 195) (MRC Herbarium 00630).

Host: On decaying fronds of *Caryota* sp.

Distribution: Indonesia.

Notes: *Fasciatispora ujungkulonensis* is similar to *F. petrakii* in being a terrestrial saprobe on palms and in having ascospores shorter than 14 μm (Hyde, 1995b). Ascospores of *F. ujungkulonensis*, however, are distinct from those of *F. petrakii* in being ellipsoidal with blunt ends (6-12 \times 4.5-7.5 μm); those of *F. petrakii* (10-14 \times 5-5.8 μm) are ovoid to almost rhomboid with acute ends (Hyde, 1995b). Furthermore, a mucilaginous sheath which surrounds the ascospores of *F. ujungkulonensis* is relatively wide (ca 2.5-10 μm from the ascospore proper), compared with that of *F. petrakii* which is fairly thin. Asci of *F. ujungkulonensis* are also shorter and narrower than those of *F. petrakii* (43-81 \times 5-9.5 μm vs 84-94 \times 8-10 μm of *F. petrakii*) (Hyde, 1995b). *Fasciatispora ujungkulonensis* is also distinct

from *F. bicincta* (Syd. & P. Syd.) K. D. Hyde in having a discoid ascus ring; that of *F. bicincta* is wedge-shaped. Besides *F. bicincta* has larger ascospores ($14\text{--}20 \times 8\text{--}12 \mu\text{m}$) and larger asci ($75\text{--}100 \times 12\text{--}20 \mu\text{m}$). A synopsis of characters of *F. ujungkulonensis*, *F. petrakii* and *F. bicincta* is given in Table 1. Numerous attempts were made to grow single spore isolates of *F. ujungkulonensis* in culture, but each time they proved unsuccessful.

Key to *Fasciatispora* species (modified from Hyde, 1995b):

- 1a. Ascus ring J- *F. melanosticta*
- 1b. Ascus ring J+ 2
- 2a. Marine saprotrophs on palms or other timber 3
- 2b. Terrestrial saprotrophs on palms 4
- 3a. Ascospores with polar cap-like appendages *F. nypae*
- 3b. Ascospores surrounded by a mucilagenous sheath *F. lignicola*
- 4a. Ascospores mostly shorter than $14 \mu\text{m}$ 5
- 4b. Ascospores mostly longer than $14 \mu\text{m}$ 6
- 5a. Ascospores ellipsoidal, asci $43\text{--}81 \times 4.5\text{--}9.5 \mu\text{m}$ *F. ujungkulonensis*
- 5b. Ascospores ovoid to rhomboid, asci $84\text{--}94 \times 8\text{--}12 \mu\text{m}$ *F. petrakii*

6a. Ascospores pale brown, ellipsoidal to ovoid, with a swollen equatorial pallid band *F.*

bicincta

6b. Ascospores brown to dark brown, ellipsoidal, without a swollen equatorial pallid band 7

7a. Ascospores dark brown, asci $90\text{--}118 \times 15\text{--}19 \mu\text{m}$ *F. pandanicola*

7b. Ascospores brown, asci $120\text{--}170 \times 12\text{--}16 \mu\text{m}$ *F. sabalicola*

Guignardia arengae, Hidayat & To-anun, **sp. nov.**

(Fig. 2.31)

Differt a Guignardia candeloflamma asci *decretus*, $47.5\text{--}65 \times 15\text{--}22.5 \mu\text{m}$, *ascosporae uniappendicum*, et *G. cocogena* asci *clavatus* et *multiseriati*.

Etymology: Named after its host generic name, *Arenga*.

Stromata lacking. *Ascomata* immersed, black, developing under slightly raised regions, in verticl section $120\text{--}165 \mu\text{m}$ diam., $120\text{--}145 \mu\text{m}$ high, subglobose, with a central ostiole. *Peridium* $20\text{--}30 \mu\text{m}$ thick, composed of brown-walled textura globulosa, inwardly compressed. *Pseudoparaphyses* $2\text{--}4 \mu\text{m}$ wide, cellular, forming chains-like structure, hyaline. *Asci* $35\text{--}55 \times 10\text{--}17.5 \mu\text{m}$, bitunicate, 8-spored, broadly clavate, thick-walled, short-pedicellate, with ocular chamber near the apex, apex

subtruncate. *Ascospores* 12-17.5 × 5-7.5 μm, overlapping 3-multi-seriate, hyaline-greenish, ovoid, lacking germ pores, with broader part above the middle part of the spores, 1-celled, not smooth, with distinct appendages at the basal ends.

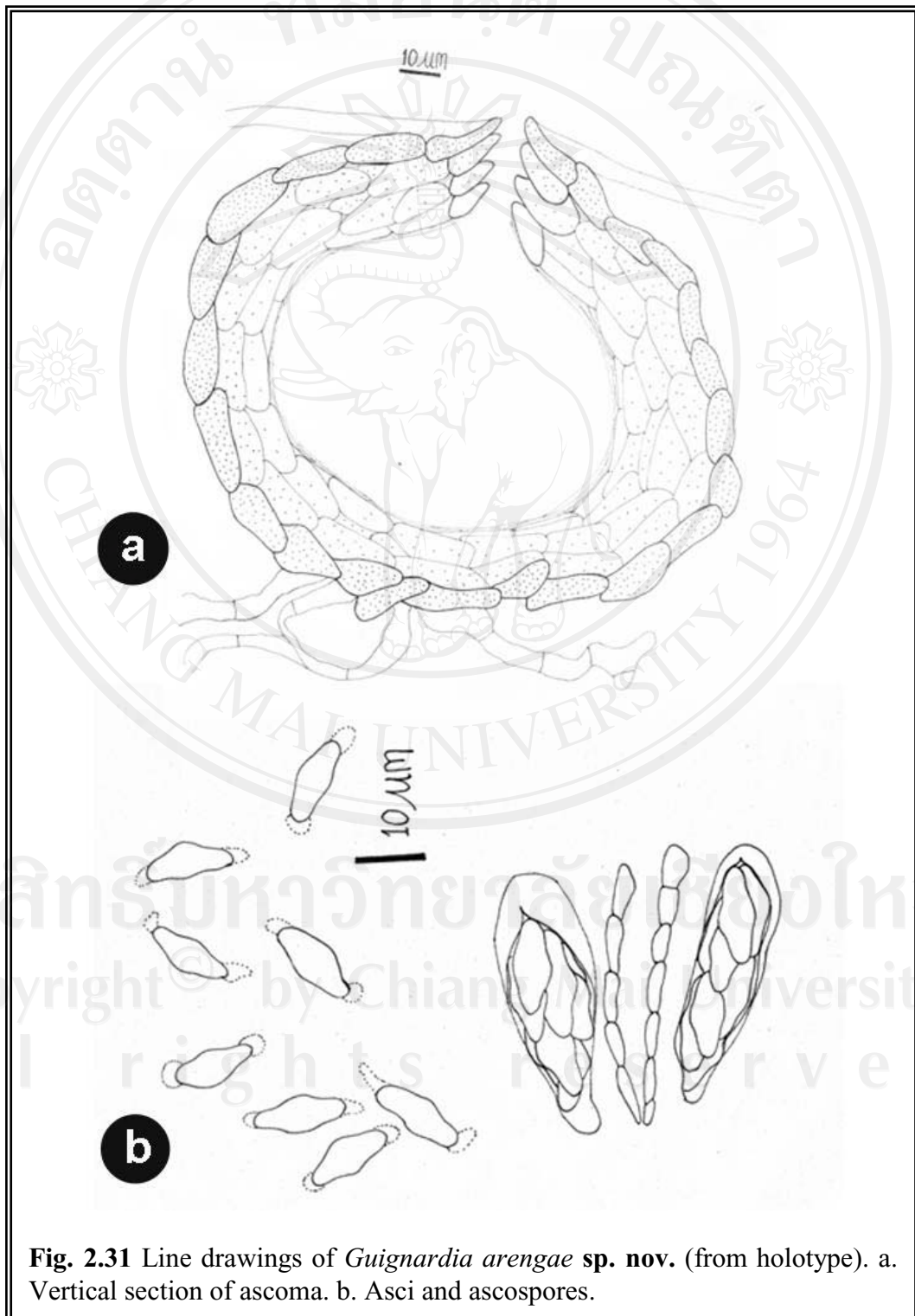


Fig. 2.31 Line drawings of *Guignardia arengae* **sp. nov.** (from holotype). a. Vertical section of ascoma. b. Asci and ascospores.

Material Examined: THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, Hua Kog Ma, on leaflets of *Arenga hookeriana* (Becc.) Whitmore (Arecaceae), 16 October 2005, Iman Hidayat, FIH 407 (**Holotype**). **Isotype:** *ibid*, on leaflets of *Livistona chinensis* R.Br. (Arecaceae), 26 October 2006, Iman Hidayat (FIH 327).

Host: On leaflets of *W. siamensis* and *L. chinensis*.

Distribution: Only known from the type locality.

Notes: Two species of *Guignardia* that having bipolar appendages have been reported from palms, viz, *G. cocogena* (Cooke) Punith. and *G. candeloflamma* J. Fröhl. & K. D. Hyde (Hyde, 1995a). However, this specimen is distinct from *G. candeloflamma* based on the characteristics of appendages and smaller asci ($35\text{-}55 \times 10\text{-}17.5 \mu\text{m}$ vs $91\text{-}140 \times 17.5\text{-}25 \mu\text{m}$ *G. candeloflamma*) and ascospores ($12\text{-}17.5 \times 5\text{-}7.5 \mu\text{m}$ vs $17.5\text{-}25 \times 7.5\text{-}11 \mu\text{m}$ of *G. candeloflamma*) (Hyde, 1995a). The present novel species also differs from *G. cocogena* in having broadly clavate asci and multiseriate ascospores arrangements inside the asci while the later species having cylindrical-clavate asci and uni to 2-seriate ascospores arrangement inside the asci (Punithalingam, 1974).

Linocarpon nonappendiculatum Hidayat & To-anun, **sp. nov.**

(Fig. 2.32)

Differt a Linocarpon elaeidis, L. carinispodium et L. livistonae, ascospori non appendiculati et implicatus cum Arecca catechu

Etymology: Refer to the absence of appendages on its ascospores.

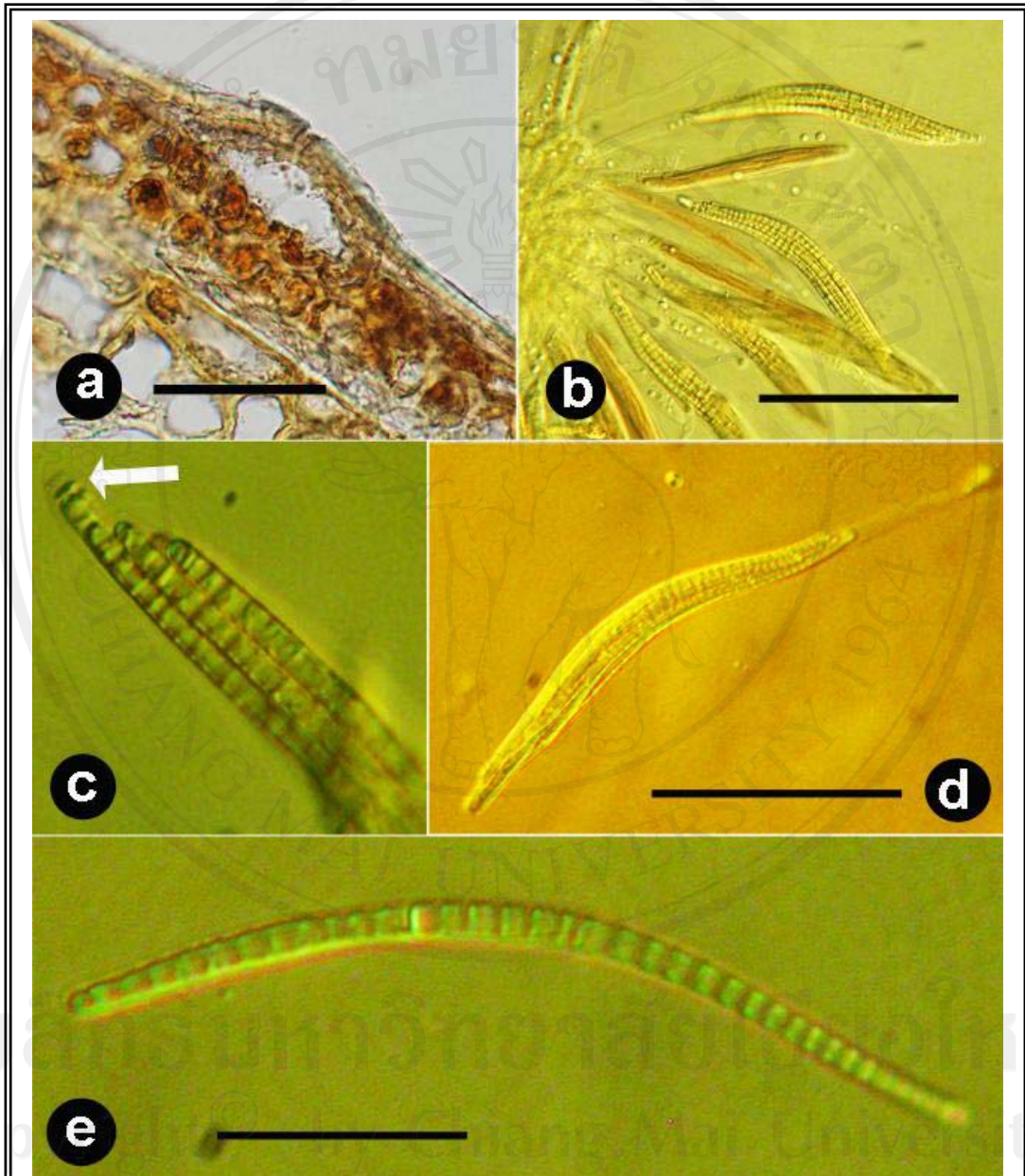


Fig. 2.32 Micrographs of *Linocarpon nonappendiculatum* **sp. nov.** (from holotype). a. Vertical section of ascoma. b. Asci and paraphyses. c. Ascus ring (showed by arrow). d. Ascus. e. Ascospore. Bars: a = 250 μm ; b = 125 μm ; d = 75 μm ; e = 25 μm .

Ascomata immersed beneath a clypeus, solitary, in section 262.5-300 μm diam., 75-125 μm high, subglobose to lenticular, with a central ostiole. *Peridium* 12.5-17.5 μm thick, outwardly comprising of several layers of compressed, ellipsoidal, brown-walled cells, inwardly composed of 1-2 layers of hyaline cells,. *Paraphyses* 0.5-2.5 μm , numerous, filamentous, hyaline, anastomosing between asci. *Asci* 137.5-187.5 \times 12.5-13.5 μm , unitunicate, 8-spored, clavate, long pedicellate, J- subapical ring. *Ascospores* 85-97.5 \times 2.5-3 μm , multiseriate, filiform, with refringent bands-like septum, hyaline, lacking of appendages at both ends.

Material examined: THAILAND, Chiang Mai, A. Pa pae, Bahn Phadeng, Mushroom Research Centre, on rachis of *Areca catechu* L. (Arecaceae), 5 September 2005, Iman Hidayat FIH 082 (**Holotype**). **Isotype:** *ibid.*, FIH 083.

Host: On rachis of *Areca catechu*.

Distribution: Only known from the type locality.

Notes: *Linocarpon nonappendiculatum* sp. nov. has a similar characteristics with *Linocarpon elaeidis* Petr, *L. carinispodium* K. D. Hyde and *L. livistonae* (Henn.) K. D. Hyde, in asci, and ascospores appearance and size (Taylor and Hyde, 2003).

However, the recent novel species is easily distinguishable from those similar species due to lacking of ascospores appendages and being associated with *Areca catechu*.

Because of the present or absent of ascospores appendages as well as the type of appendages are important characteristics in differentiating species within genus

Linocarpon, therefore, this fungus is proposed as a new species.

Lophiostoma livistonicola Hidayat & To-anun, **sp. nov.**

(Fig. 2.33)

Ascomata 110.5-184.5 μm diam., 123-164.5 μm , immersa, solitaria, ostiolata; *Asci* 72-97 \times 12.5-15 μm , clavati, 8-spore, bitunicati, pedicellati; *Ascosporei* 14.5-17 \times 4-5 μm , biseriati, fusiformis, 1-septata, hyalina, cum utrinque apicale appendiculati.

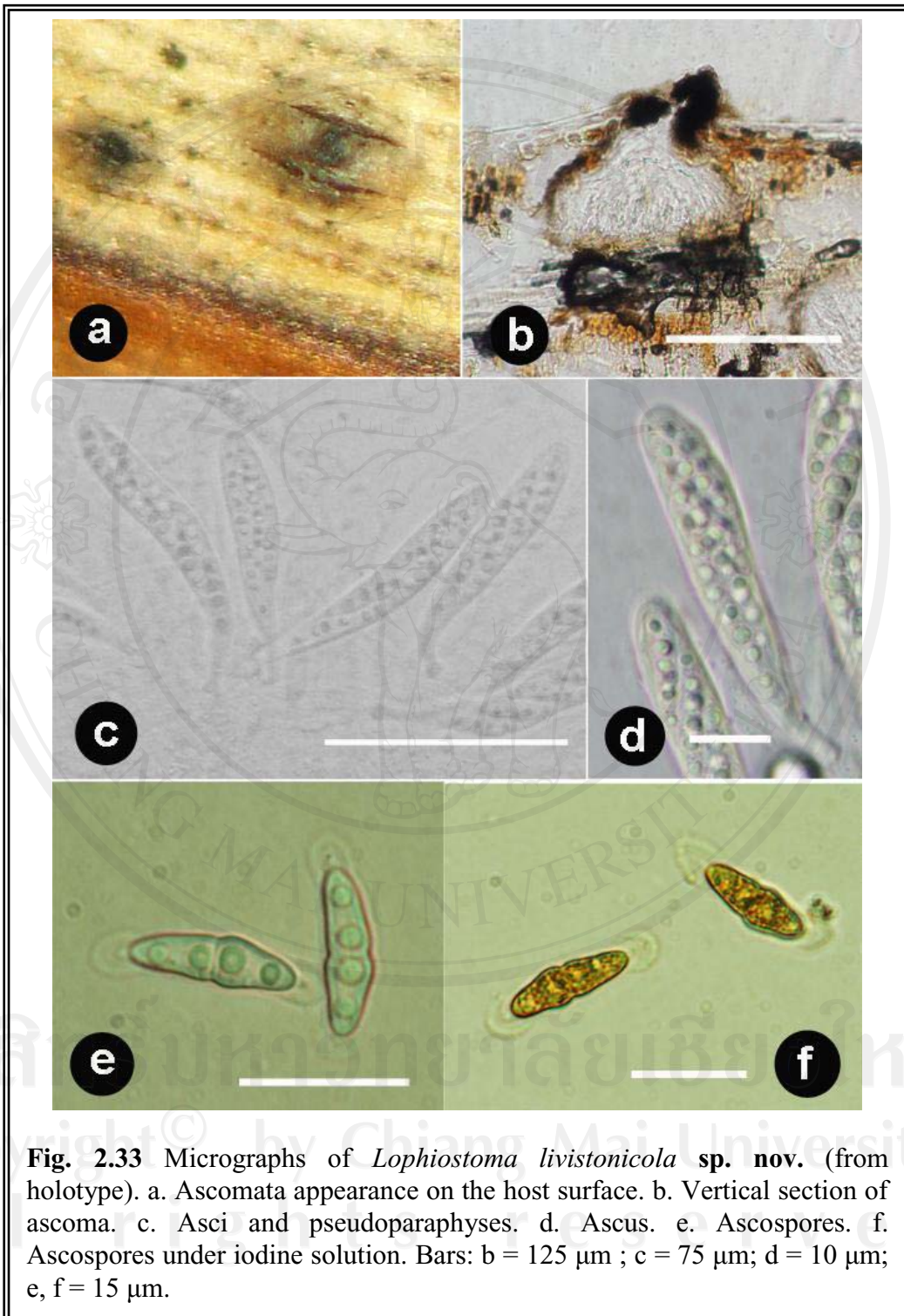
Etymology: Refers to the generic name of the host, *Livistona*.

Ascomata immersed, solitary, erumpent, aclypeus, in section 110.5-184.5 μm in diameter, 123-164.5 μm high, subglobose, with a slot-like and central ostiole. *Peridium* 5-12 μm thick, composed of compressed, brown-walled, ellipsoidal and angular cells. *Pseudoparaphyses* 1-2.5 μm , filamentous, cellular, hyaline, embedded in gelatinous matrix. *Asci* 72-97 \times 12.5-15 μm , bitunicate, 8-spored, clavate, short-pedicellate, *Ascospores* 14.5-17 \times 4-5 μm , overlapping biseriate, fusiform, hyaline, 1-septate, euseptate, constricted at the septum, smooth, with distinct appendages at both ends.

Material examined: THAILAND, Chiang Mai, Chiang Mai University, Palm Garden, on leaflets of *Livistona chinensis* R. Br. (Arecaceae), 29 October 2006, Tatiya takaew (**Holotype:** FIH 323).

Host: On leaflets of *Livistona chinensis*.

Distribution: Only known from the type locality.



Notes: This specimen belongs to genus *Lophiostoma* Ces. & De Not. due to bitunicate asci and slit-like ostiole of ascomata (Holm and Holm, 1988). *Lophiostoma rubi* (Fuckel) Liew, Aptroot & K. D. Hyde and *L. palmettum* (Cooke) Aptroot & K.D. Hyde are very similar in asci and ascospores dimension (Hyde and Aptroot, 1997; Aptroot, 1998). However, *L. palmettum* is distinct from this novel species due to its multilocular ascomata and very wide asci ($74-104 \times 28-32 \mu\text{m}$) (Hyde and Aptroot, 1997). A new species proposed in this study, *Lophiostoma livistoncola*, is also distinct from *L. rubii* due to the ascospores are ornamented with very distinct appendages at both ends (Aptroot, 1998).

***Mycosphaerella arecearum* Hidayat and To-anun, sp. nov.**

(Fig. 2.34)

Ascomata 45-70 μm diam., 43-75 μm alta, immersa, aggregata, globosa, ostiolata. *Asci* 15-25 \times 3.75-6 μm , bitunicati, 8-spore, obclavati, apedunculati, praediti *Ascosporeae* 5-8.5 \times 1.5-3 μm , ellipsoideae, bicellularis, asymmetrica, hyalinae, non-appendicum.

Etymology: Named after its genus name of host, *Areca*.

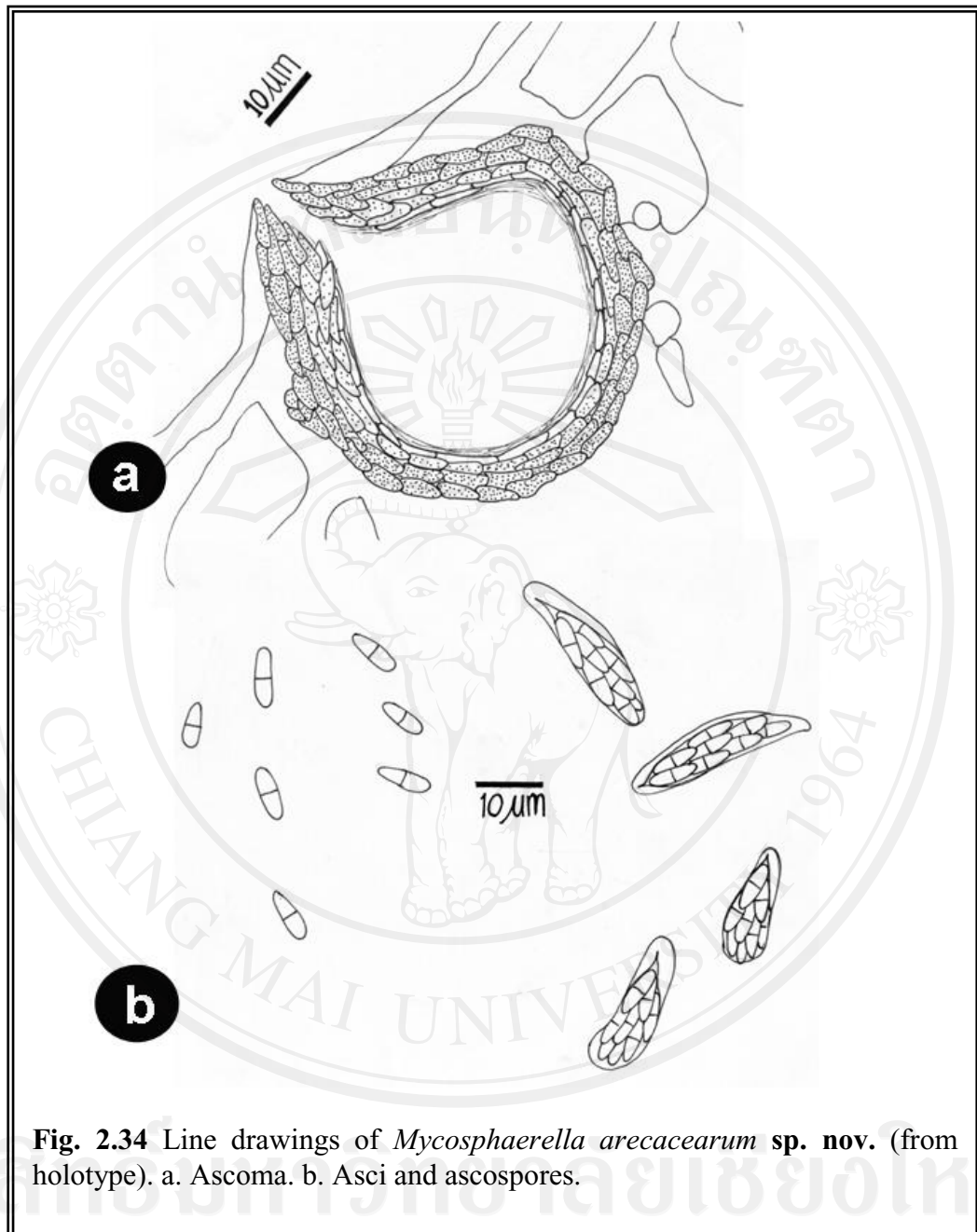


Fig. 2.34 Line drawings of *Mycosphaerella arecacearum* **sp. nov.** (from holotype). a. Ascoma. b. Asci and ascospores.

Leaf spots amphigenous, irregular, lesions brown. **Ascomata** visible as black ostiolar dots on the host surface, immersed, becoming erumpent, 6-8 aggregated or in groups, amphigenous, subepidermal, in section very small, 45-70 μm diam., 43-75 μm high, globose, pseudothecial, with central ostiole, periphysate. **Peridium** 7.5-10 μm

thick, composed of 4-6 layers of medium brown, polygonal cells, become hyaline inwardly. *Pseudoparaphyses* absent. *Asci* 15-25 × 3.75-6 µm, bitunicate, 8-spored, obclavate, apically rounded, apedicellate. *Ascospores* 5-8.5 × 1.5-3 µm, biseriate overlapping, 1-septate, slightly constricted at the septum, ellipsoidal, unequally bicelled, with obtuse ends, constricted at the septum, hyaline, thin-walled, straight to slightly curved, tapering towards the lower end, lacking a mucilagenous sheath.

Material examined: THAILAND, Payao, on leaflets of *Areca catechu* L. (Arecaceae), 17 September 2007, Iman Hidayat (**Holotype:** FIH 102).

Host: Leaflets of *Areca catechu*.

Distribution: Only known from the type locality.

Notes: Recently, none of *Mycosphaerella* species have been reported associated with plant genus *Areca* (Aptroot, 2006). The new species, *Mycosphaerella arecacearum*, is easily recognised by having obclavate, apedicellate asci with small ascospores as well as being associated with leaflets of *Areca catechu*.

***Mycosphaerella borassi* Hidayat and To-anun, sp. nov.**

(Fig. 2.35)

Ascomata 10-60 µm diam., 70-120 µm alta, immersa, aggregata, subglobosa, ostiolata. *Asci* 40-50 × 3.75-6 µm, bitunicati, 8-spore, obclavati vel saccati, pedunculati, praediti *Ascosporis* 8.5-12 × 2-3 µm, ellipsoidis, bicellularis, asymmetrica, hyalinae, cum uni appendicum.

Etymology: Refers to generic name of its host, *Borassus*.

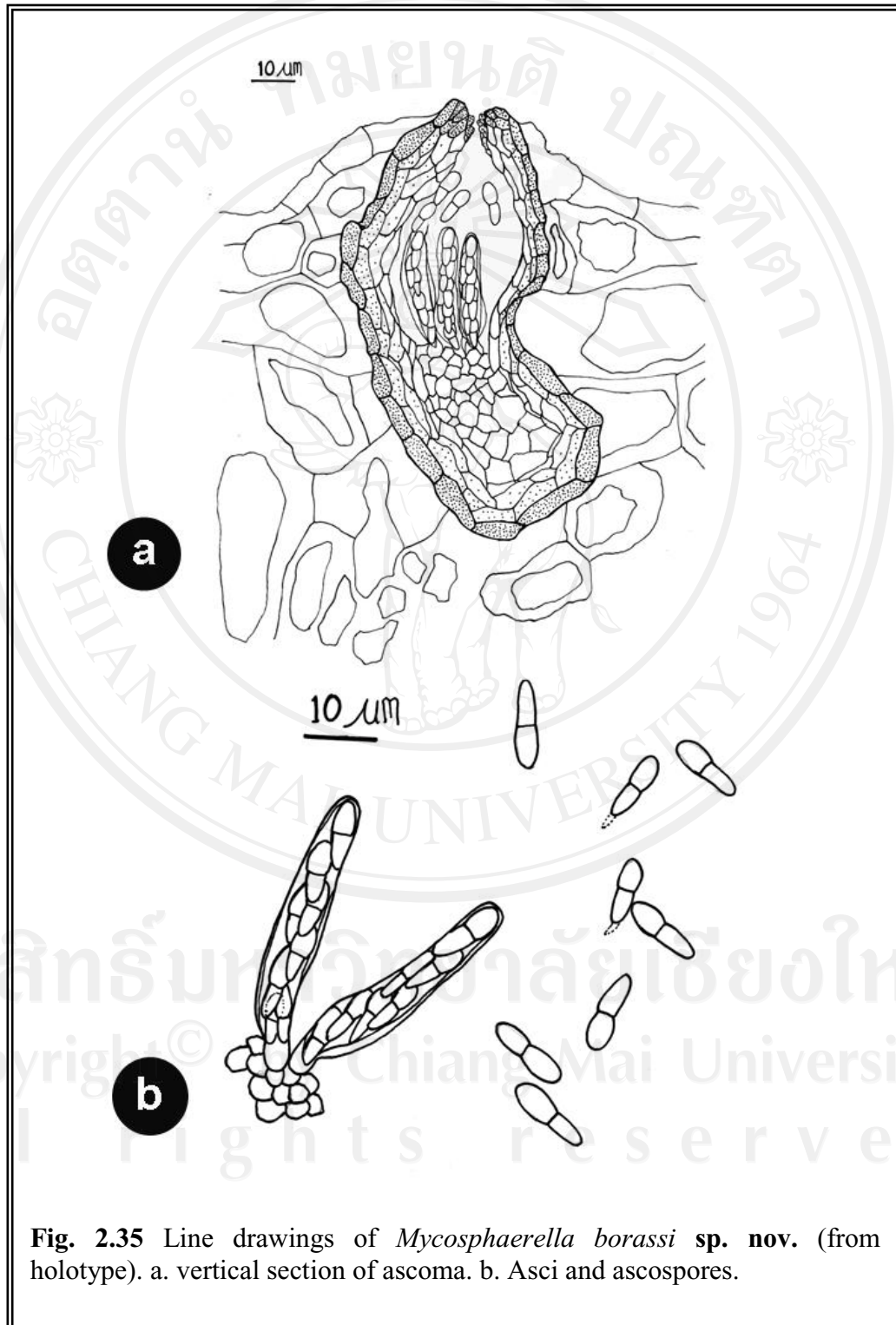


Fig. 2.35 Line drawings of *Mycosphaerella borassi* **sp. nov.** (from holotype). a. vertical section of ascoma. b. Asci and ascospores.

Leaf spots amphigenous, irregular, lesions brown. **Ascomata** visible as black ostiolar dots on the host surface, immersed, becoming erumpent, 6-8 aggregated or in groups, amphigenous, subepidermal, in section very small, 10-60 μm diam., 70-120 μm high, subglobose, pseudothecial, with central ostiole, periphysate. **Peridium** 5-14 μm thick, composed of 2-3 layers of medium brown, polygonal cells, become hyaline inwardly. **Pseudoparaphyses** absent. **Asci** 40-50 \times 3.75-6 μm , bitunicate, 8-spored, obclavate to saccate, apically rounded, short pedicellate. **Ascospores** 8.5-12 \times 2-3 μm , biseriate overlapping, 1-septate, slightly constricted at the septum, ellipsoidal, unequally bicelled, with obtuse ends, constricted at the septum, hyaline, thin-walled, straight to slightly curved, tapering towards the lower end, surrounding by a thin mucilaginous sheath, often with basal appendage.

Material examined: THAILAND, Payao, on lamina of *Borassus flabellifer* L. (Arecaceae), 27 May 2007, Iman Hidayat and Jamjan Meeboon (**Holotype:** FIH 059).

Host: On lamina of *Borassus flabellifer*.

Distribution: Only known from the type locality.

Notes: The genus *Mycosphaerella* is widely recognized as plant pathogen, although some species are also recognized as saprobes on various plants (Aptroot, 2006). Presently, none of *Mycosphaerella* species have been reported associated with plant genus *Borassus*. According to the Aptroot's key (2006), *Mycosphaerella borassi* belongs to section *Fusispora*, however, this novel species is distinct from the species within the section *Fusispora* by having very small ascospores ($< 12 \mu\text{m}$ long). Therefore, we proposed this specimen as a new species.

Oedocephalum formosus Hidayat & To-anun, **sp. nov.**

(Fig. 2.36)

Coloniae brunneae; Mycelia plerumque immersa, ramosa, hyalina, septata; Conidiophora 105-160 × 2-7 μm, solitaria, cylindricum, simplicia, hyalina; Ampulla 25-30 μm in diameter, globosa, in pagina integra conidiifera, basi septata; Cellulae conidiogenae 1.5-2 μm diam., 1-1.5 μm high, denticulatae, holoblasticae, schizolyticae; Conidia 32-40 × 14-16 μm, solitaria, ellispoida, aseptata, laevia, brunnea.

Etymology: Refers to its beautiful appearances.

Colonies on the natural substratum scattered, hyaline with dark-brown conidial mass at the apical part. **Mycelium** immersed, branched, hyaline, septate. **Conidiophores** 105-160 × 2-7 μm, solitary, cylindrical, erect, simple, hyaline, septate only present between ampulla and conidiophore. **Ampulla** 25-30 μm in diameter, globose, hyaline, solitary, terminal, with a septate at the basal part. **Conidiogenous cells** 1.5-2 μm diam., 1-1.5 μm high, denticulate, with pimple-shape denticles. **Conidia secession** blastic, holoblastic, schizolytic. **Conidia** 32-40 × 14-16 μm, solitary, ellipsoidal, 1-celled, brown, smooth.

Material examined: THAILAND, Payao, on seed of *Borassus flabellifer* L.

(Arecaceae), 27 May 2007, Iman Hidayat and Jamjan Meeboon (**Holotype:** FIH 127).

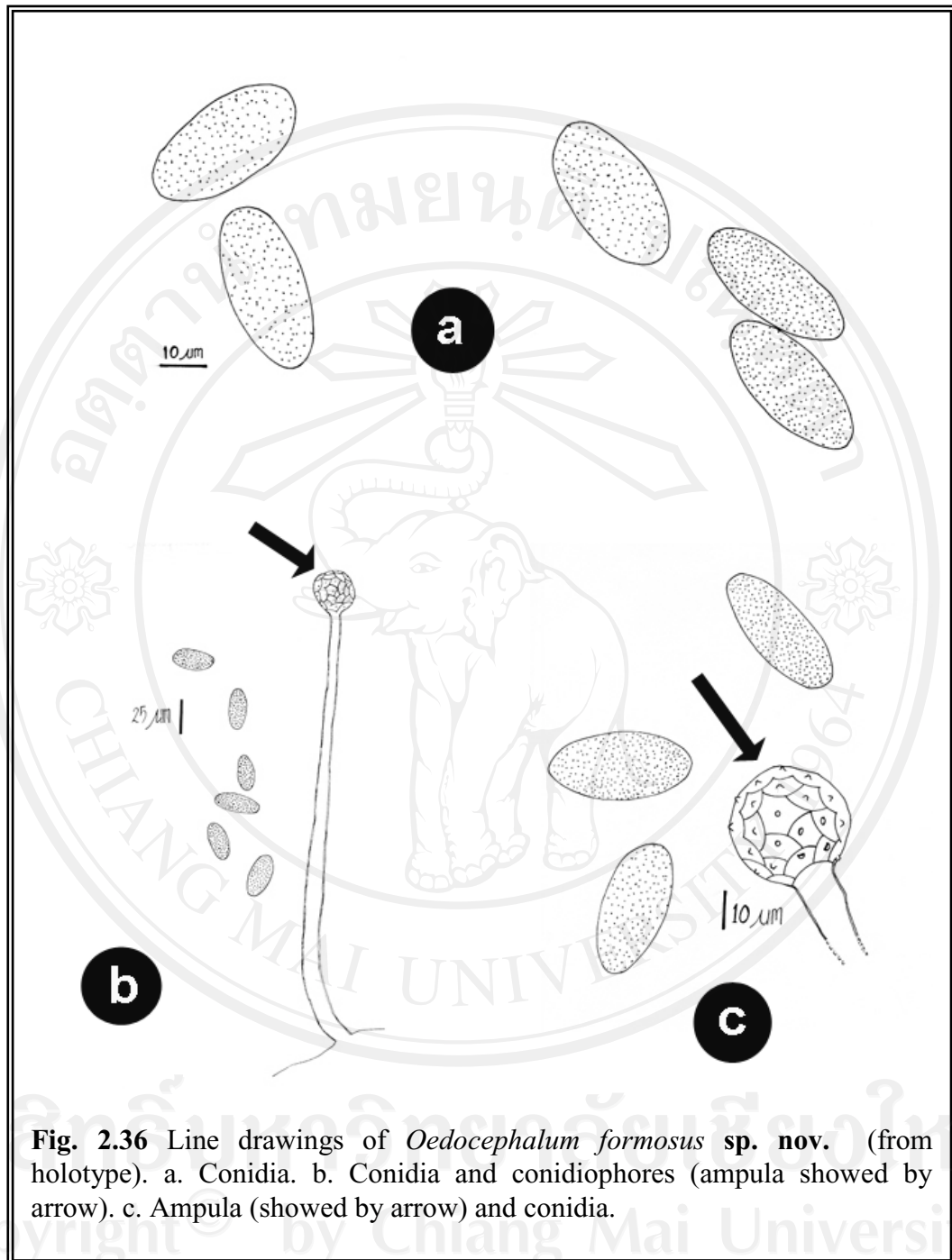


Fig. 2.36 Line drawings of *Oedocephalum formosus* sp. nov. (from holotype). a. Conidia. b. Conidia and conidiophores (ampula showed by arrow). c. Ampula (showed by arrow) and conidia.

Host: On seed of *Borassus flabellifer*.

Distribution: Only known from its type locality.

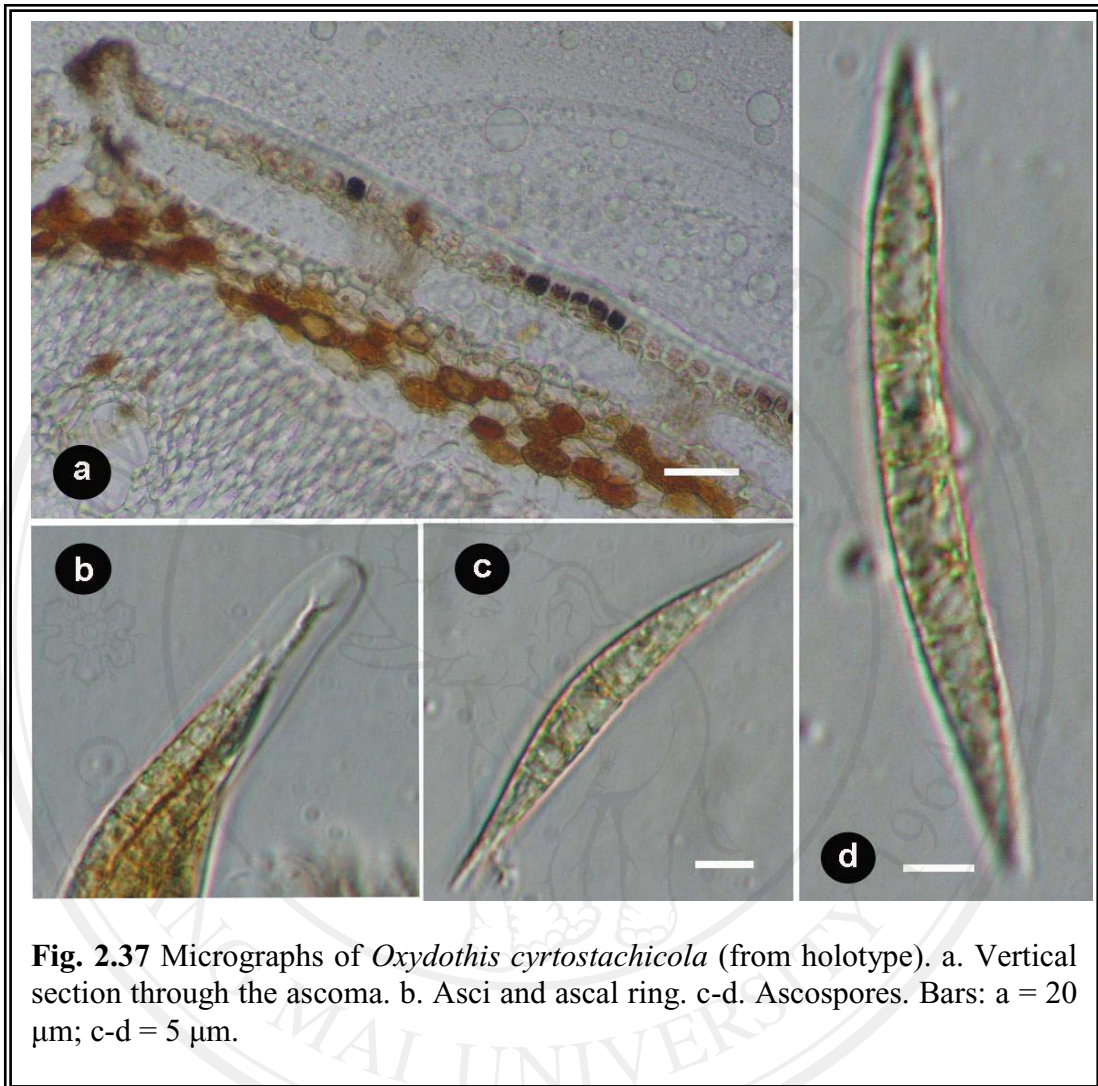
Notes: The novel species is easily distinguished from other species of *Oedocephalum* by having pimple-shape denticles, aseptate conidiophores, as well as brown and large conidia ($> 30 \mu\text{m}$).

Oxydothis cyrtostachicola Hidayat & To-anun, *Fungal Diversity* **23**: 164 (2006)
(Fig. 2.37)

Ascomata 130–155 μm diam, 20–34 μm alta, immersa, subglobosa, ostiolata.
Asci 102–120 \times 12–13 μm , 8-spore, pedunculati, aparatu apicale J-, praediti
Ascospores 48–52 \times 5–6 μm , hyalinae, fusiformis, bicellulares.

Etymology: In reference to the host genus, *Cyrtostachys*.

Ascomata forming under slightly raised, ellipsoidal regions on the host surface, black border, solitary or in groups 2–3; in section immersed, subglobose, ostiole eccentric, long axis horizontal to that of the host surface with neck at one end, forming *ca* 130–155 μm diam. \times 20–34 μm high. *Peridium* comprised of 2–3 layers outer layers of oblong, dark-brown cells and with an additional inner layer of oblong, hyaline cells. *Paraphyses* deliquesce early. *Asci* 102–120 \times 12–13 μm , 8-spored, unitunicate, clavate, short pedicellate, J-, refractive subapical ring, has a canal leading to the apex. *Ascospores* 48–52 \times 5–6 μm , fusiform, 1-septate, hyaline, tapering gradually from the central septum to pointed processes, without spine-like form.



Material examined: THAILAND, Chiang Mai, Chiang Mai University garden, on petioles of *Cyrtostachys renda* Blume (Arecaceae), 30 October 2005, Iman Hidayat, FIH 151 (**Holotype:** MRC 0007). **Isotype:** *ibid.*, HKU (M) 17170.

Host: Saprobic on petioles of *Cyrtostachys renda*.

Distribution: Northern Thailand.

Notes: The morphology and molecular elucidation of this species is presented in chapter 3.

Terriera livistonae Hidayat & To-anun, **sp. nov.**

(Fig. 2.38)

Differt a Terriera nematoidea et T. asteliae paraphysae ramosa et asci amplius (78.5-92 × 3.5-5 μm).

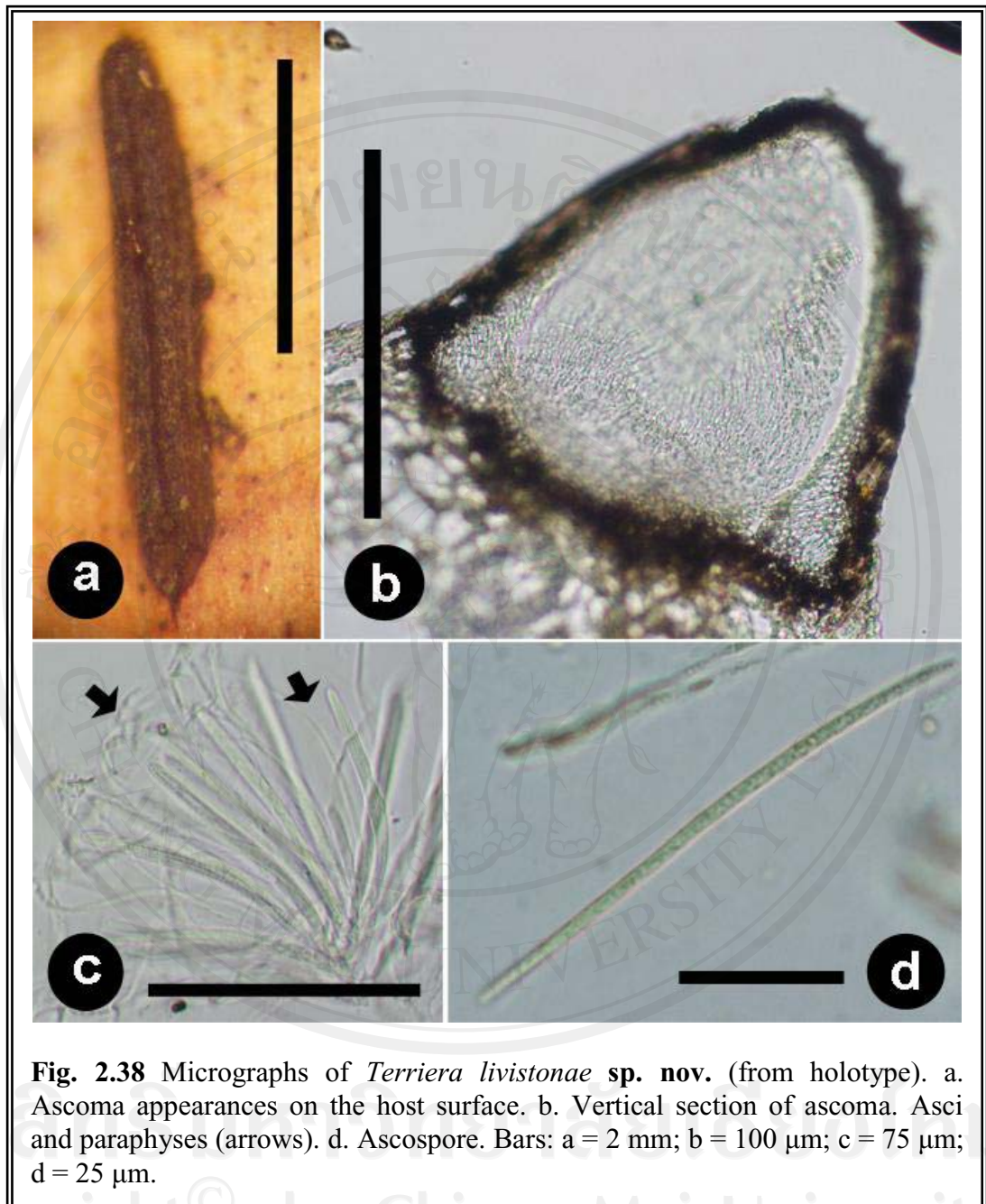
Etymology: Refers to its generic host name, *Livistona*.

Ascomata 2-4 mm long, 0.25-0.75 mm high, superficial, lip-like cells, lacking of zones border surrounded the ascomata, in section triangular in shape, with central ostiole, 110-160 μm in diameter, 95-160 μm in height. **Peridium** 14.5-29.5 μm, composed of several layers, slight thick walls, dark brown walls. **Paraphyses** 1–1.5 μm in diameter, hypha-like, branched near apex slightly swollen, hyaline, septate. **Asci** 78.5-92 × 3.5-5 μm, unitunicate, 8-spored, long cylindrical with subtruncate apex, short pedicellate, with a J- apical ring. **Ascospores** 66-73 × 1 μm, filiform, aseptate, hyaline, lack of gelatinous sheath.

Material examined: THAILAND, Chiang Mai, Chiang Mai University garden, on living leaflets of *Livistona chinensis* R.Br. (Arecaceae), 16 October 2005, Iman Hidayat (**Holotype:** FIH 133).

Host: On living leaflets of *Livistona chinensis*.

Distribution: Only known from the type locality.



Notes: This species belongs to genus *Terriera* due to lip cells of ascomata do not lining with the ascomata opening, well differentiated paraphyses, and ascospores lack of gelatinous sheaths. *Terriera nematoidea* (P. R. Johnst.) P. R. Johnst., and *T. asteliae* (P. R. Johnst.) P. R. Johnst. were reported as *Terriera* species that

characterized by subtruncate apex of asci (Johnston, 2001). However, this species differs from *T. nematoidea* and *T. asteliae* in having branched paraphyses near the apex and longer asci ($> 70\mu\text{m}$).

***Venturia frondicola* Hidayat & To-anun, sp. nov.**

(Fig. 2.39)

Differt a Venturia populina ascosporae hyalinae, verruculosae et implicare cum palmae.

Etymology: In reference to the substrate where this species was collected.

Ascomata superficial, erumpent, black, solitary, in section $94\mu\text{m}$ in diameter, $78\mu\text{m}$ in height, subglobose, brown to dark-brown, ostiole central, papillate, ornamented with setae around ostiole. **Peridium** $10\text{-}15\mu\text{m}$ thick, comprising several layers, compressed, angular to ellipsoidal, brown to dark brown cells.

Pseudoparaphyses ca $1.25\mu\text{m}$, trabeculate, numerous, cellular, hyaline. **Asci** $85\text{-}115 \times 12.5\text{-}16.25\mu\text{m}$, bitunicate, 8-spored, cylindrical, with ocular chamber near the apex, short pedicellate, apically rounded. **Ascospores** $17.5\text{-}22.5 \times 7.5\text{-}10\mu\text{m}$, apiosporous, 1-septate, verrucose, hyaline, biseriate, constricted at the medium or submedium septum, upper cell wider and longer than lower cell.

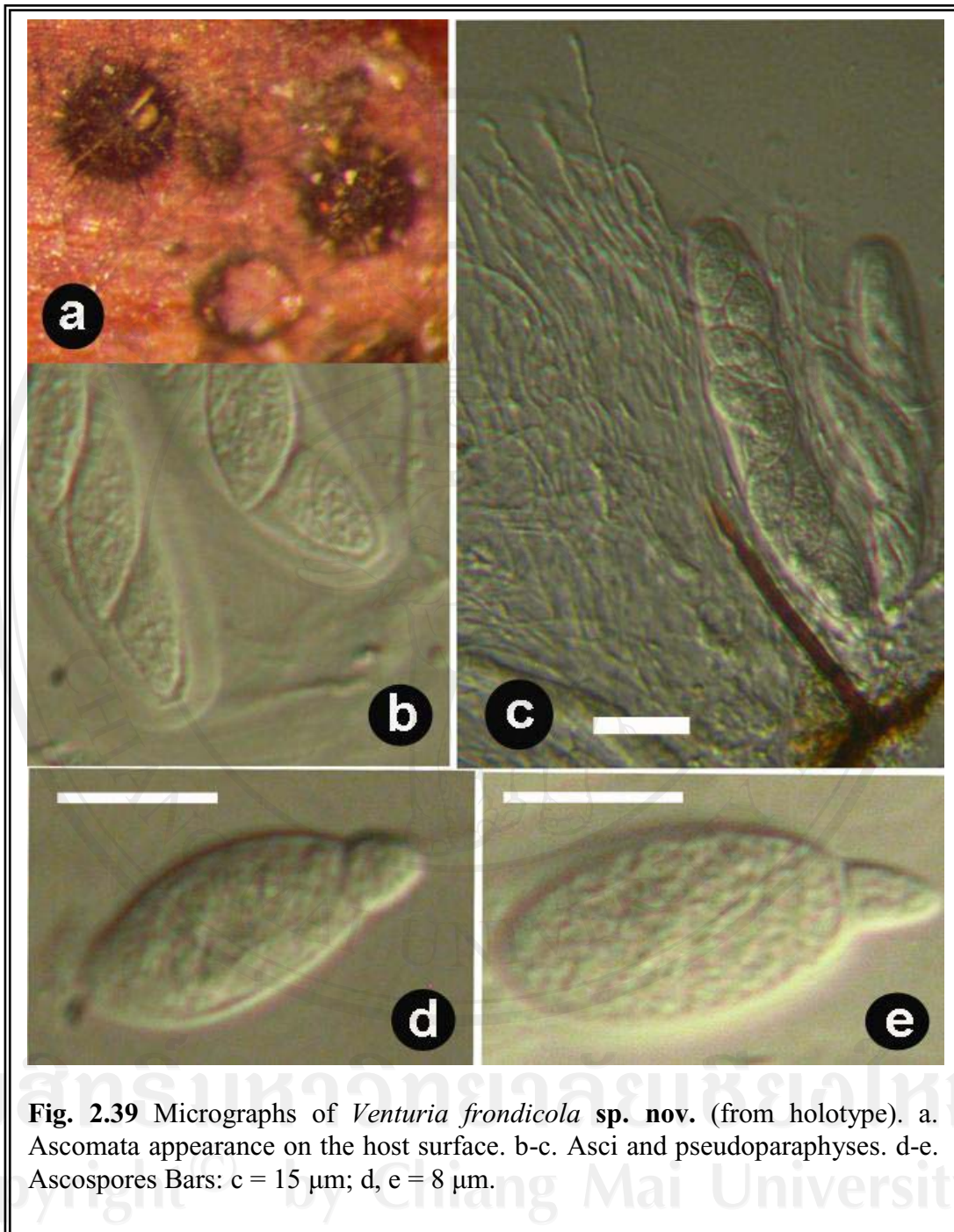


Fig. 2.39 Micrographs of *Venturia frondicola* **sp. nov.** (from holotype). a. Ascomata appearance on the host surface. b-c. Asci and pseudoparaphyses. d-e. Ascospores Bars: c = 15 μ m; d, e = 8 μ m.

Material examined: THAILAND, Chiang Mai, T. Pa Pae, Bahn Pha Deng, Mushroom Research Centre, on rachis of *Areca catechu* L. (Arecaceae), 5 September 2005, Iman Hidayat (**Holotype:** FIH 082).

Host: On petioles of *Areca catechu*.

Distribution: Only known from the type locality.

Notes: This novel apiosporous fungus belongs to family Venturiaceae. The superficial ascomata, apiosporous cell, and bitunicate asci of this specimen are closed to genus *Apiosporina* (Barr, 1989; Sivanesan, 1984). However, the setose ascomata of this specimen is distinct from the genus *Apiosporina* which is not lacking of setae. Barr (1989) considered setose and superficial ascomata as important characters in differentiating between genera of *Apiosporina* and *Venturia*. The later genus belongs to family Venturiaceae that characterized by having superficial setose ascomata and apiosporous ascospores (Sivanesan, 1984). The present new species, *Venturia frondicola*, is closed to *V. populina* (Vuill.) Fabric. based on the key to *Venturia* species (Sivanesan, 1984), however, the novel species differs in having hyaline and verruculose ascospores as well as being recorded from palms petioles.