Cercosporoid fungi from Thailand II. New species of *Cercospora* and *Passalora*

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This report is a part of comprehensive study of cercosporoid fungi in Thailand. In this paper, 15 species are examined and identified. Two species, *Cercospora neobougainvilleae* and *Passalora myricae* are new to science. Thirteen other species are reported as new records for Thailand. In detail, 10 species belong to *Cercospora*, one species belongs to *Passalora*, and four species belong to *Pseudocercospora*. Five species of *Cercospora* are *C. apii* sensu lato.

Keywords: anamorphic fungi, biodiversity, Chiang Mai, dematiaceous hyphomycetes, leaf spot.

Cercosporoid fungi is one of the largest group of hyphomycetes and the number of specific epithets once placed in the group exceeds 5,500 (Crous & Braun 2003). The fungi are commonly associated with leaf spots, but can also cause necrotic lesions on flowers, fruits, bracts, seeds and pedicels of numerous hosts in most climatic regions (Agrios 2005). Crous & Braun (2003) summarized several primary characters that have to be employed while treating the cercosporoid species, such as structure of conidiogenous loci (scars) and hila, and the presence or absence of pigmentation in conidiophores and conidia.

In Thailand, one hundred and seventeen species of *Cercospora* and allied genera were recorded (Giatgong 1980; Sontirat *et al.* 1980; Petcharat & Kanjanamaneesathian 1989); however, these reports were based on Chupp's wide generic concept (Chupp 1954). Additions to the cercosporoid fungi in Thailand, based on current taxo-

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nomic concepts summarized by Crous & Braun (2003), were published by Braun *et al.* (2006), Hunter *et al.* (2006), and Meeboon *et al.* (2007a, b, c). In this paper, two new species and 13 new records of cercosporoid fungi from Chiang Mai are reported. The new species are described and illustrated here.

Materials and Methods

Specimens with disease symptoms of cercosporoid fungi on leaves were collected during field trips by using a 10X magnifying lens. Detailed observations of morphological characters were carried out by means of an Olympus CX31 light microscope using oil immersion (1000X).

Specimens for microscopic observation were prepared by hand sectioning. Water and lactophenol were used as mounting media. Thirty conidia, hila, conidiophores, conidiogenous loci and 10 stromata were measured for each specimen. Line drawings were prepared at a magnification of 1000 ×. Voucher specimens are deposited in the Chiang Mai University Herbarium (CMU), Faculty of Science, Chiang Mai University, Chiang Mai, Thailand.

Taxonomy

New Species of Cercosporoid Fungi from Thailand

Cercospora neobougainvilleae Meeboon, Hidayat & C. Nakash., **sp. nov.** – Fig. 1.

MycoBank No. MB 510475

Maculae amphigenae, orbiculares, centro pallide brunneo, margine atro-brunneae, 2–8 mm diam. Caespituli epiphylli. Stromata intraepidermalia, bene evolutis, (11.5) 37.25 ± 11.5 (71.5) µm diam., ex cellulis, globosis vel subglobosis, atro-brunneis. Conidiophora 4–20, laxe vel dense fasciculata, per stroma emergentia, 1-3-septata, apicem versus coangusto, non-ramosa, 1-2-geniculata, tenuitunicata vel leviter crassitunicata, (13.7) 90.2 ± 27.8 (165.3) x (0.9) 5.1 ± 1.6 (9.1) µm, basi brunnea, apicem versus pallidiora. Cellulae conidiogenae (1.8) 16.3 ± 5.2 (30.2) x (1.1) 5.1 ± 1.4 (8.9) µm, integratae, terminales, sympodiales. Loci conidiogeni conspicui, incrassati et fuscati, (1.1) 2.2 ± 0.4 (3.4) µm diam. Conidia solitaria, obclavata, recta vel leviter curvata, basi truncata vel obconica truncata, apicem acuta vel subobtusa, (3.9) 53.2 ± 14.6 (112.1) x (4.2) 6.3 ± 0.8 (8.3) µm, 4-5-septata, hyalina, tenuitunicata, levia, hila incrassata et fuscata, (0.9) 2.25 ± 0.6 (4.1) µm diam.

Holotypus. – THAILAND, Chiang Mai Province, Chiang Mai University, on leaves of *Bougainvillea spectabilis* Willd. (Nyctaginaceae), 30 Nov 2005, Jamjan Meeboon (CMU 27930).

Leaf spots amphigenous, orbicular, center pale brown, with dark brown margin, 2–8 mm diam. – Caespituli epiphyllous. – Stromata

intraepidermal, well-developed, (11.5) 37.25 ± 11.5 (71.5) µm diam. (n = 10), composed of globose to subglobose, dark brown cells. – Conidiophores 4–20, loosely to densely fasciculate, arising from stromata, 1-3-septate, narrower toward the apex, unbranched, geniculate 1-2 times near the apex, thin-walled to slightly thickened, smooth, (13.7) 90.2 ± 27.8 (165.3) x (0.9) 5.1 ± 1.6 (9.1) µm (n = 30), brown at the base and paler towards the apex. – Conidiogenous cells (1.8) 16.3 ± 5.2 (30.2) x (1.1) 5.1 ± 1.4 (8.9) µm (n = 30), integrated, terminal, sympodial proliferation. – Conidiogenous loci conspicuous, thickened, darkened, (1.1) 2.2 ± 0.4 (3.4) µm diam. (n = 30). – Conidia solitary, obclavate, straight to mildly curve, truncate to obconically truncate at base, acute to subobtuse at the apex, (3.9) 53.2 ± 14.6 (112.1) x (4.2) 6.3 ± 0.8 (8.3) µm (n = 30), 4-5-septate, hyaline, thin-walled, smooth, hila thickened and darkened, (0.9) 2.25 ± 0.6 (4.1) µm diam. (n = 30).

Etymology. – The epithet refers to the genus name of the host.

Habitat or Host plant. – *Bougainvillea spectabilis* Willd. (Nyctaginaceae).

Distribution. – Known only from type locality.

Comments. – Four species of genus *Cercospora* are hitherto known associated with Nyctaginaceae, viz, *Cercospora canescens* Ellis & G. Martin, *C. furfurella* Speg., *C. mirabilis* Tharp, and *C. salpianthi* Chupp & A.S. Mull. (Crous & Braun 2003). Two species, *C. canescens* and *C. salpianthi* belong to the species complex *C. apii sensu lato* (Crous & Braun 2003). *Cercospora neobougainvilleae* differs from the plurivorous *C. apii s. lat.* by having obclavate conidia and well-developed stromata [(11.5) 37.25 ± 11.5 (71.5) µm diam.].

Cercospora neobougainvilleae sp. nov. differs from *C. furfurella* in leaf spots appearances, stromata, and septation characteristics. The symptoms of *C. neobougainvilleae* are pale at the center with dark brown margin, but *C. furfurella* symptoms are almost lacking or dark purple to almost black with gray center. The stromata of *C. neobougainvilleae* are well-developed but *C. furfurella* stromata are small or sometimes lacking. The conidia septation in *C. neobougainvilleae* are distinct with 3-6-septa, but *C. furfurella* is characterized by 4-5-indistinct septa. Moreover, the conidia sizes of *C. neobougainvilleae* are different [(3.9) 53.2 ± 14.6 (112.1) x (4.2) 6.3 ± 0.8 (8.3) µm vs 30–120 x 2–4.5 µm of *C. furfurella*].

Cercospora mirabilis Tharp, described from *Mirabilis jalapa*, is characterized by having amphigenous caespituli, small or lacking stromata, short branches conidiophores, and acicular conidia with indistinct septation (Chupp 1954). *Cercospora neobougainvilleae* differs from *C. mirabilis* by having epiphyllous caespituli, well-

developed stromata, unbranched conidiophores, and obclavate conidia with distinct septation.

As the result of our comparative study, *C. neobougainvilleae* is recognized as an independent species from other *Cercospora* species associated with plants from Nyctaginaceae. Therefore, we propose *C. neobougainvilleae* as a new species.

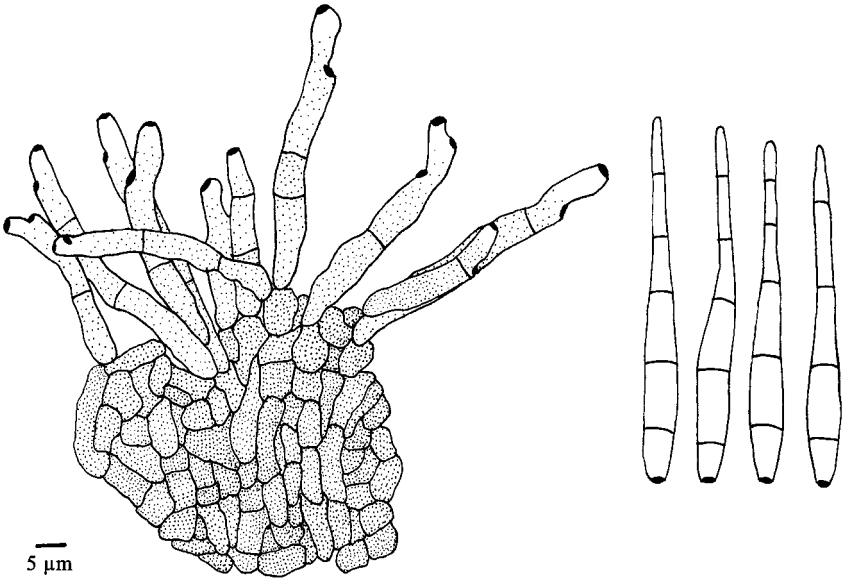

Fig. 1. Conidia, conidiophores, and stroma of *Cercospora neobougainvilleae* (holotype).

Passalora myricae Meeboon, Hidayat & C. Nakash., **sp. nov** – Fig. 2.

MycoBank No. MB 510476

Maculae amphigenae, orbiculares, centro pallide brunneae vel fumosae, margine fuscae, 0.5–5 mm diam. Caespituli amphigeni. Stromata intraepidermalia, parva, (0.5) 12.2 ± 4.5 (26.5) µm diam., ex cellulis, globosis vel subglobosis, brunneis vel atro-brunneis. Conidiophora 2-14-fasciculata, per stroma emergentia, cylindrica, 0-1-septata, non-ramosa, recta, ad apicem leviter truncata, tenuitunicata, levia, (7.6) 22.3 ± 5.4 (36.4) x (1.8) 4.1 ± 0.7 (5.7) µm, basi brunnea, apicem versus pallidiora. Cellulae conidiogenae (5.9) 7.5 ± 0.6 (9.1) x (1.7) 4.1 ± 0.8 (5.8) µm, integratae, terminales, monoblastic, sympodiales. Loci conidiogeni conspicui, incrassati et fuscati, (0.6) 1.3 ± 0.4 (2.4) µm diam. Conidia solitaria, obclavata, recta vel leviter curvata, basi truncata, apicem acuta vel subacuta, protuberantia, (13.6) 40.1 ± 9.9 (66.9) x (1.8) 4.2 ± 0.7 (5.7) µm, 4-5-septata, pallide brunneae, tenuitunicata, levia, hila incrassata et fuscata, (0.6) 1.3 ± 0.4 (2.4) µm diam.

Holotypus. – THAILAND, Chiang Mai Province, Chiang Mai University, Doi Suthep-Pui national Park (latitude 18.48.00; longitude 98.56.00), On leaves of *Myrica esculenta* Buch.-Ham. ex D.Don. (Myricaceae), 2 Nov 2004, Jamjan Meeboon (CMU 27932).

Leaf spots amphigenous, orbicular, pale brown to dingy gray at center, with a darker margin, 0.5–5 mm diam. – Caespituli amphigenous. – Stromata intraepidermal, small, (0.5) 12.2 ± 4.5 (26.5) µm diam. (n = 10), composed of globose to subglobose, brown to dark brown cells. – Conidiophores 2–14 in a divergent fasciculate, arising from stromata, cylindrical, 0-1-septate, unbranched, straight, slightly truncated at the apex, thin-walled, smooth, (7.6) 22.3 ± 5.4 (36.4) x (1.8) 4.1 ± 0.7 (5.7) µm (n = 30), brown at the base and paler towards to the apex. – Conidiogenous cell (5.9) 7.5 ± 0.6 (9.1) x (1.7) 4.1 ± 0.8 (5.8) µm (n = 30), integrated, terminal, monoblastic, sympodial proliferation. – Conidiogenous loci conspicuous, thickened, and darkened, (0.6) 1.3 ± 0.4 (2.4) µm diam. (n = 30). – Conidia solitary, obclavate, straight to slightly curved, truncate at the base, acute to subacute at the apex, protuberant, (13.6) 40.1 ± 9.9 (66.9) x (1.8) 4.2 ± 0.7 (5.7) µm (n = 30), 4-5-septate, pale brown, thin-walled, smooth, hila thickened and darkened, (0.6) 1.3 ± 0.4 (2.4) µm diam. (n = 30).

Etymology. – The epithet refers to the genus name of the host.

Habitat or Host plant. – *Myrica esculenta* Buch.-Ham. ex D.Don. (Myricaceae).

Distribution. – Known only from type locality.

Comments. – *Pseudocercospora penicillus* (Ellis & Everh.) U. Braun & Crous (synonym: *Cercospora penicillus* Ellis & Everhart), is the only species of cercosporoid fungi recorded from *Myricaceae* (Crous & Braun 2003). In the previous publication, Chupp (1954) placed *C. dispersa* Ellis & Everhart and *C. myricae* Tracy & Earle as synonyms of *C. penicillus*, the latter being characterized by stromata lacking or up to 50 µm in diameter; non fasciculate conidiophores (50–150 x 4–5.5 µm) and obclavate to cylindro-obclavate conidia with pale olivaceous in colour (30–125 x 3–5.5 µm). Crous & Braun (2003) noted that the morphological characteristics of *C. penicillus* are typical of *Pseudocercospora* Speg. by having inconspicuous conidiogenous loci, and unthickened, non-pigmented conidial hila, with long conidiophores arising from external hyphae or stromata. The specimen examined here is a typical member of the genus *Passalora* Fr. due to conspicuous, darkened, and thickened scars and hila, with pigmented conidia. Therefore, we propose *P. myricae* as a new species.

New Records of Cercosporoid Fungi from Thailand

Cercospora beticola Sacc., Nuovo Giorn. Bot. Ital. 8: 189. 1876.

[***Cercospora apii s. lat.*** fide Crous & Braun (2003)]

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Spinacia*

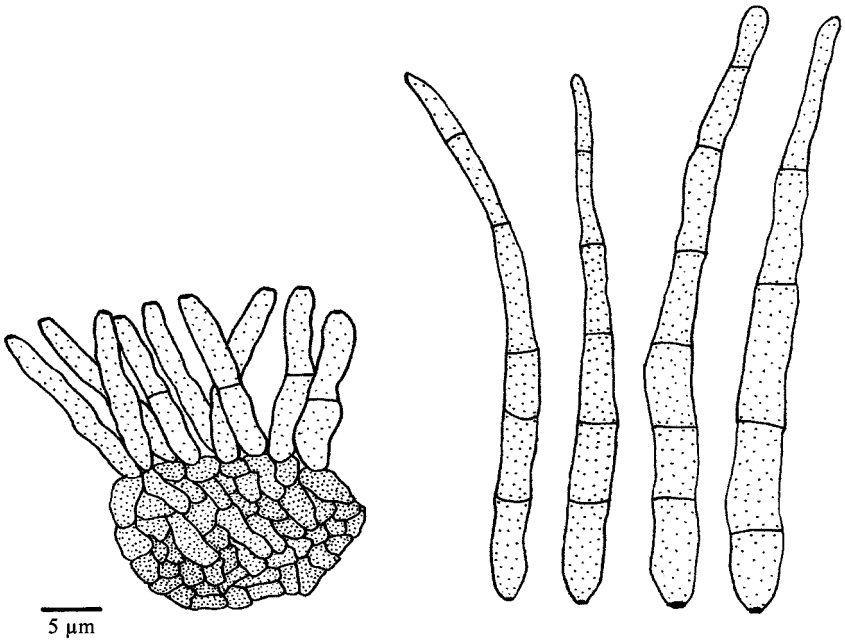

Fig. 2. Conidia, conidiophores, and stroma of *Passalora myricae* (holotype).

oleracea L. (Chenopodiaceae), 10 Oct 2005, Jamjan Meeboon and Iman Hidayat (CMU 27931).

Cercospora fuchsiae Chupp & A.S. Mull., Bol. Soc. Venez. Ci. Nat. 8: 45. 1942.

[***Cercospora apii*** *s. l.* fide Crous & Braun (2003)]

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Fuchsia* sp. (Onagraceae), 3 Nov 2005, Jamjan Meeboon (CMU 27935).

Cercospora jatrophigena U. Braun, Fungal Diversity 7: 51. 2001.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Jatropha curcas* L. (Euphorbiaceae), 3 Nov 2005, Jamjan Meeboon (CMU 27933).

Cercospora malayensis F. Stevens & Solheim, Mycologia 23: 394. 1931.

[***Cercospora apii*** *s. l.* fide Crous & Braun (2003)]

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Hibiscus rosa-sinensis* L. (Malvaceae), 3 Nov 2005, Jamjan Meeboon (CMU 27936).

Cercospora mikaniicola F. Stevens, Trans. Illinois Acad. Sci. 10: 213. 1917.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Mikania cordata* B.L.Rob. (Asteraceae), 31 Oct 2004, Jamjan Meeboon (CMU 27934).

Cercospora physalidis Ellis, Amer. Naturalist 16: 810. 1882.

[***Cercospora apii*** *s. l.* fide Crous & Braun (2003)]

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Capsicum annuum* L. (Solanaceae), 2 Oct 2005, Jamjan Meeboon (CMU 27938).

Cercospora physalidis-angulatae J.M. Yen, Cah. Maboké 9: 112. 1971.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Physalis angulata* L. (Solanaceae), 2 Oct 2005, Jamjan Meeboon (CMU 27937).

Cercospora tagetis-erectae Thirum. & Govindu, Sydowia 10: 262. 1957.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Tagetes erecta* L. (Asteraceae), 31 Oct 2004, Jamjan Meeboon (CMU 27939).

Cercospora volkameriae Speg., Revista Mus. La Plata 15: 47. 1908.

[***Cercospora apii*** *s. l.* fide Crous & Braun (2003)]

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Clerodendrum paniculatum* L. (Verbenaceae), 1 Nov 2005, Jamjan Meeboon (CMU27929 and 27941).

Pseudocercospora contraria (Syd. & P. Syd.) Deighton, Mycol. Pap. 140: 30. 1976.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Dioscorea alata* L. (Dioscoreaceae), 28 Nov 2005, Jamjan Meeboon (CMU 27943).

Pseudocercospora fuligena (Roldan) Deighton, Mycol. Pap. 140: 144. 1976.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Lycopersicon esculentum var. pyriforme* (Dunal) C.H.Müll. (Solanaceae), 5 Feb 2005, Jamjan Meeboon (CMU 27942).

Pseudocercospora musae (Zimm.) Deighton, Mycol. Pap. 140: 148. 1976.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00),

on leaves of *Musa acuminata* Colla (Musaceae), 3 Nov 2005, Jamjan Meeboon (CMU 27945).

Pseudocercospora nymphaeacea (Cooke & Ellis) Deighton, Trans. Brit. Mycol. Soc. 88: 390. 1987.

Material examined. – THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park (latitude 18.48.00; longitude 98.56.00), on leaves of *Nymphaea stellata* Willd. (Nymphaeaceae), 20 Nov 2005. Jamjan Meeboon (CMU 27944).

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