



A new species of *Fusticeps* from Thailand

Chuaseeharonnachai C^{1*}, Somrithipol S¹ and Boonyuen N^{1,2}

¹National Center for Genetic Engineering and Biotechnology (BIOTEC), 113 Thailand Science Park, Phahonyothin Road, Klong 1, Klong Luang, Pathumthani 12120, Thailand; e-mail: charuwan.chu@biotec.or.th

²Department of Plant Pathology, Faculty of Agriculture, Kasetsart University, 50 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand

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Abstract

Fusticeps multiseptata sp. nov., collected from submerged leaves in Thailand, is described and illustrated. It produces pale brown, clavate, transversely multi-septate conidia with conspicuous cup-shaped projections. It differs from the all other *Fusticeps* species in having numerous branched conidiophores. The morphology of this new taxon is compared with all accepted species in the genus and key to the *Fusticeps* species is provided.

Key words – Aero-aquatic fungi – freshwater environment – submerged substrata – systematics

Introduction

The genus *Fusticeps* was erected by Webster & Davey (1980) with the type species, *F. bullatus*, isolated from unidentified submerged leaves from Malaysia. This genus characterized by: dark, septate mycelium; erect, septate, branched or occasionally branched conidiophores; and integrated, solitary, dark, transversely septate, holoblastic conidia with epispore fracture arising from the spore wall for entrapping air. This is an aero-aquatic species (Webster & Davey 1980).

Subsequently, Matsushima (1993) introduced a second species of *Fusticeps*, *F. laevisporus*, found on submerged decaying leaves from a lake in Ecuador. Subsequently, *F. lampadiformis* and *F. papillatus* were described from unidentified submerged leaves from Brazil. Based on the updated generic concept of this genus, the two species with smooth-walled spores, *F. laevisporus* and *F. papillatus*, were included (Monteiro & Gusmão 2013). Species of *Fusticeps* are mostly found on submerged decaying substrata in static to slow-flowing freshwater environments (Webster & Davey 1980, Matsushima 1993, Monteiro & Gusmão 2013).

This work originates from an ongoing investigation of hyphomycetes from aquatic habitats in Thailand. *Fusticeps multiseptata* found on submerged decaying leaves in a waterfall in Thailand is described here. Our species differs from other *Fusticeps* species in having several branched conidiophores and in spore shape and size and is therefore described as a new taxon.

Materials & Methods

Two collections were made at: 1) Tat Ta Phu Waterfall (14°09'N, 101°16'E) and 2) a tiny ditch at Mo Sing To Nature Trail (17°42'N, 104°25'E) in Khao Yai National Park, Thailand. Naturally submerged litter (leaves and twigs) were randomly collected, placed in polythene bags and transported to the laboratory. The collected samples were incubated in a moist chamber at room temperature (~20°C) for at least 2 weeks.

Isolates and morphology

As outlined by Chuaseeharonnachai et al. (2013), samples were periodically examined under a stereo microscope for the presence of fungi. Single spores were picked up with a fine needle and inoculated on to potato carrot agar (PCA, extract from 40 g/L potatoes, extract from 40 g/L carrots, 15 g/L agar) supplemented with antibiotics (streptomycin 0.5 g/l and penicillin G 0.5 g/l). Germinated conidia were then transferred to potato dextrose agar plates (PDA, from Criterion™ Dehydrated Culture Media, Santa Maria, California). For morphological identification, conidiophores and conidia were mounted in a drop of lactophenol and examined using the higher magnification of compound microscope (OLYMPUS CX31). Measurements were taken from fresh material mounted in water and the fungus was photographed using a Nomarski differential interference contrast microscope (OLYMPUS DP70). Permanent slides are deposited at the BIOTEC Bangkok Herbarium (BBH, Thailand) as BBH37958 (holotype) and BBH37959 (paratype). An asexual state of isolate is maintained in BIOTEC Culture Collection (BCC, Thailand) as BCC46472.

Toxonomy

Fusticeps multiseptata Chuaseeharonnachai, Somrithipol & Boonyuen, **sp. nov.** Figs. 1–6
Mycobank 808167

Etymology – The specific epithet reflects the characteristic conidial septation.

Colonies on natural substrata, effuse, olivaceous to brown. Mycelium mostly immersed in the substrata, composed of branched, septate, smooth, pale brown hyphae, 2.5 µm diam. Conidiophores micronematous, erect or ascending, with numerous branches, septate, smooth, pale brown to brown, up to 75 µm, 2.5–3.75 µm wide. Conidiogenous cells monoblastic, integrate, determinate, terminal, cylindrical, pale brown. Conidial secession rhexolytic. Conidia holoblastic, solitary, clavate, with 4–6 (–7) transverse septa (n=50), with cup-shaped projections (2.5 × 2.5 µm) arising from the conidial wall, pale brown, 37.5–42.5 (–45) × 6.25–7.5 (–10) µm; basal scar 2–2.5 µm.

Sexual state – Unknown.

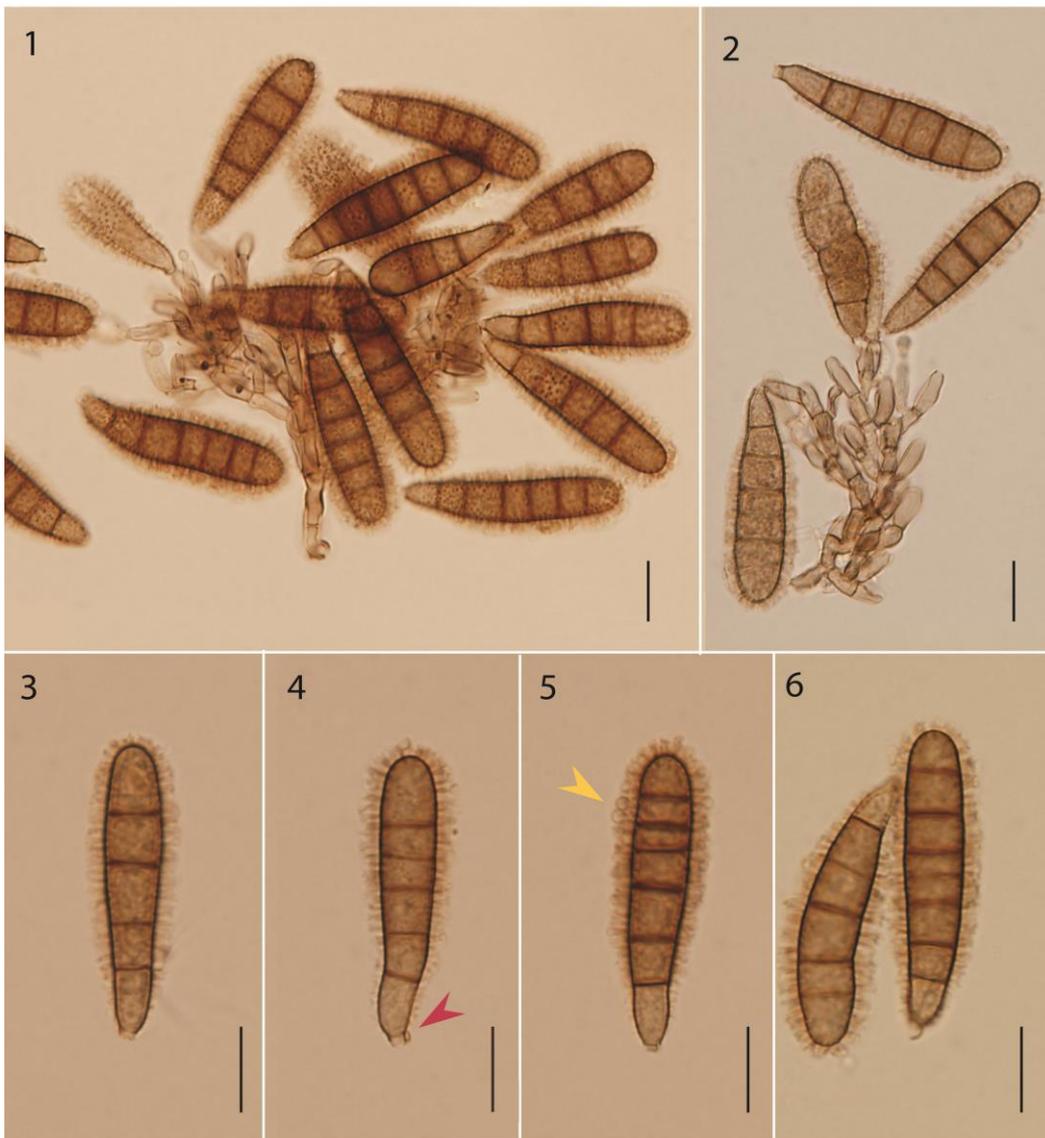
Material examined – Thailand, Nakhon Nayok, Tat Ta Phu Waterfall in Khao Yai National Park, 14°09'N, 101°16'E, on unidentified submerged leaves, 6 Apr 2010, N. Boonyuen & C. Chuaseeharonnachai, BBH37958 (BBH, holotype) – BCC46472 culture in BCC; Thailand, Nakhon Ratchasima, tiny ditch at Mo Sing To Nature Trail in Khao Yai National Park, 17°42'N, 104°25'E, on unidentified submerged twigs, 12 Jul 2011, P. Promkiam–on, BBH37959 (BBH, paratype).

Notes – The type species of the genus, *F. bullatus* an aero-aquatic fungus, is characterized by the mushroom-shaped projection on the conidial wall, which serves to entrap air between the projections for floatation on the water surface (Webster & Davey 1980).

Based on the general concept of aero-aquatic fungi, they have multicellular dispersal structures to entrap the air between their cells during development and floatation on the water surface (Beverwijk 1951, Park 1972, Abdullah & Webster 1980). Thus, *F. lampadiformis* and our new species are referred to as aero-aquatic fungi because they share the same feature of conspicuous projections on the surface of the conidia. Also, both species have been frequently isolated from submerged decaying litter in aquatic environment.

Discussion

Fusticeps multiseptata is characterised by the clavate conidia with 4–7 transverse septa, conidial wall with conspicuous cup-shaped ornamentation, and conidiophores with numerous branches resembling a tree (Figs. 1–6). Our new species is morphologically similar to *F. bullatus* and *F. lampadiformis* in having conidial projections. However, it differs from *F. lampadiformis* in conidial shape and conidiophore branching. Conidia of *F. multiseptata* are clavate and longer than those of *F. lampadiformis* which are always pyriform to lampadiform. Conidiophores of *F. lampadiformis* are unbranched or occasionally branched (Monteiro & Gusmão 2013) while those of



Figs 1–6 – *Fusticeps multiseptata* (BBH37958). 1–2 Conidiophores with cylindrical conidiogenous cells and conidia. 3–6 Detached mature conidia with variable septation, red arrow indicated rhexolytic conidial secession and yellow arrow indicated a conidium with cup-shaped projections. – Bars = 10 μ m.

Key to *Fusticeps* species

- 1. Conidial wall smooth..... 2
- 1. Conidial wall rough with projections 3

- 2. Conidia with apical round and 2–4 transverse septa. *F. laevisporus*
- 2. Conidia with apical papilla and 4–6 transverse septa... .. *F. papillatus*

- 3. Conidia clavate 4
- 3. Conidia pyriform to lampadiform with 2–3 transverse septa... .. *F. lampadiformis*

- 4. Conidia with 2–4 transverse septa, 23.5–35 \times 8–13 μ m diam.; conidiophores unbranched or occasionally branched..... *F. bullatus*
- 4. Conidia with 4–7 transverse septa, 37.5–45 \times 6.25–10 μ m diam.; conidiophores with numerous branches..... *F. multiseptata*

Table 1 Synopsis of characteristics of *Fusticeps* species.

Species	Conidiophore morphology	Conidium morphology				Habitat	References
		Size (μm)	Shape	Septa	Projection		
<i>F. bullatus</i>	24–65 \times 3–4 μm , unbranched or occasionally branched	28–34 \times 9–12	clavate	3–4	mushroom-shaped	on unidentified submerged leaves, Malaysia	Webster & Davey (1980)
<i>F. bullatus</i>	3–4 μm wide, unbranched or occasionally branched	23.5–35 \times 8–12.5	clavate	2–3	1–2 μm long	on decaying broad-leaved-tree submerged leaves, Ecuador	Matsushima (1993)
<i>F. bullatus</i>	20–22.5 \times 2.5–3.75 μm , unbranched	23.5–34 \times 10–13	clavate	2–3	2.5 μm long, mushroom-shaped to cup-shaped	on unidentified submerged leaves, Brazil	Monteiro & Gusmão (2013)
<i>F. laevisporus</i>	unbranched or occasionally branched	30–44 \times 9.5–13	clavate	2–3	absent	on decaying broad-leaved-tree submerged leaves, Ecuador	Matsushima (1993)
<i>F. laevisporus</i>	20–47.5 \times 2.5–3.75 μm , unbranched	25–40 \times 10–20	clavate	3–4	absent	on unidentified submerged leaves, Brazil	Monteiro & Gusmão (2013)
<i>F. lampadiformis</i>	22.5–62.5 \times 2.5–5 μm , unbranched or occasionally branched	21.5–35.5 \times 12.5–18	pyriform to lampadiform	2–3	3–5 \times 1.5–2.5 μm , cup-shaped	on unidentified submerged leaves, Brazil	Monteiro & Gusmão (2013)
<i>F. papillatus</i>	17.5–67.5 \times 2.5–3.8 μm , unbranched or occasionally branched	35–45.5 \times 11.5–15	clavate	4–6	absent	on unidentified submerged leaves, Brazil	Monteiro & Gusmão (2013)
<i>F. multiseptata</i>	up to 75 \times 2.5–3.75 μm , numerous branched	37.5–45 \times 6.25–10	clavate	4–7	2.5 \times 2.5 μm , cup-shaped	on unidentified submerged leaves and twigs, Thailand	This paper

F. multiseptata are numerous branched. *Fusticeps multiseptata* is distinguished from *F. bullatus* by its longer conidia 37.5–45 \times 6.25–10 μm diam., more septa 4–7, and conidiophores with numerous branches (Table 1). In *F. bullatus*, it is defined by the conidia that are 2–4 transverse septa, 23.5–35 \times 8–13 μm diam. In addition, conidiophores of *F. bullatus* are unbranched or occasionally branched (Webster & Davey 1980, Matsushima 1993, Monteiro & Gusmão 2013).

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