Pontoporeia mangrovei sp. nov, a new marine fungus from an Indian mangrove along with a new geographical and host record of Falciformispora lignatilis

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Devadatha B, Sarma VV 2018 – Pontoporeia mangrovei sp. nov, a new marine fungus from an Indian mangrove along with a new geographical and host record of Falciformispora lignatilis. Current Research in Environmental & Applied Mycology 8(2), 238–246, Doi 10.5943/cream/8/2/8

Abstract

Pontoporeia mangrovei, a new marine fungal species is reported from Muthupet mangroves, southeast coast of India. Pontoporeia mangrovei is characterized by cleistothecial, dark brown to black, carbonaceous, semi-immersed to superficial, non-ostiolate ascomata with broadly clavate, ovoid, or ellipsoidal asci. Ascospores are 1-septate, biturbinate to ellipsoidal, hyaline to purple when young and dark brown to black at maturity. The new species differs from Pontoporeia biturbinata in having shorter ascomata, ascis and ascospores dimensions and by occurring on Avicennia marina and Suaeda monoica in mangrove environments, in contrast to a sea grass host (Posidonia oceanica) of the latter. Falciformispora lignatilis is reported from an Indian mangrove for the first time and hence the present collection expands its geographical range. Aegiceras corniculatum is a new host record for this fungus.

Key words – 1 new species – Avicennia marina – Aegiceras corniculatum – Pleosporales – Suaeda monoica – Taxonomy

Introduction

The genus Pontoporeia Kohlm., was established by Kohlmeyer (1963) based on Pontoporeia biturbinata (Durieu & Mont.) Kohlm. The new genus was characterized by broadly clavate, ovate or ellipsoidal asci, filiform septate pseudoparaphyses, irregular peridium and biturbinate to sub-ellipsoidal ascospores having 2-layered walls with a germ pore at each end and occurrence in marine environment (Kohlmeyer & Kohlmeyer 1979). Pontoporeia was treated as a synonym of Zopfia Rabenh. by Malloch & Cain (1971), which was also followed by Hawksworth & Booth (1974). Pontoporeia biturbinata and Halothia posidoniae (Durieu & Mont.) Kohlm., are monotypic genera sharing similar morphological characters such as large ascomata enclosed within stromata or hypostroma, narrow cellular pseudoparaphyses, and single septate, thickened, dark-brown ascospores (Kohlmeyer & Kohlmeyer 1979, Suetrong et al. 2009). Both Pontoporeia biturbinata, and Halothia posidoniae are host-specific and frequently occur on Posidonia oceanica in Mediterranean coasts (Kohlmeyer & Kohlmeyer 1979, Cuomo et al. 1982, 1985) and Cyprus (Jones et al. 2009, 2015).

Molecular phylogenetic studies by Suetrong et al. (2009) revealed that the three monotypic marine genera: Halothia Kohlm., Mauritiania Poonyth, K.D. Hyde, Aptroot & Peerally, and
Pontoporeia formed a separate clade with moderate support in Pleosporales. However, they did not assign these three genera to any family. Later, Zhang et al. (2012) introduced the family Halothiaceae Y. Zhang, J. Fourn. & K.D. Hyde, typified by Halothia, to accommodate monotypic genera Mauritiana, Phaeoseptum Y. Zhang, J. Fourn. & K.D. Hyde and Pontoporeia with dark coloured spores. Halothia posidoniae and Pontoporeia biturbinata share similar morphological characters and they also grouped together as a sister group to Mauritiana rhizophorae in phylogenetic studies (Zhang et al. 2012).

We are investigating the biodiversity of marine fungi in Muthupet mangroves along south east coast of India. In our recent collections and microscopic examination of mangrove specimens we found a novel taxon Pontoporeia mangrovei sp. nov. which belongs in Halothiaceae and shares similar characters with Pontoporeia biturbinata. This new taxon is described in this paper supported by photomicrographs. A dichotomous key to the closely related genera has been provided in addition to a table that has a synopsis of important characteristics of the closely related genera considered.

Falciformispora K.D. Hyde, has been established to accommodate F. lignitilis K.D. Hyde, a new species colonizing unknown mangrove wood by Hyde (1992). Not many reports are available on this species after its report from mangroves. This species is reported for the first time from India and on a new host Aegiceras corniculatum. The fungus is illustrated with photomicrographs.

Materials & Methods

Sample collection, Isolation and morphological studies

Decaying mangrove wood pieces of Aegiceras corniculatum, Avicennia marina and Suaeda monoica were collected from Muthupet mangroves (10.4°N, 79.5°E), Kaveri River Delta, Tiruvarur district, Tamil Nadu, southeast coast of India. Direct examination method outlined by Kohlmeyer & Kohlmeyer (1979) was followed and it has been detailed in Devadatha et al. (2017). Briefly the decaying samples were examined under a stereo zoom microscope after moisture chamber incubation and micro slides were prepared by teasing out the fungal fruiting structures and transferring on to Lactophenol with or without cotton blue. Photomicrographs were taken employing Nikon ECLIPSE TiU upright microscope with DIC objectives connected to Nikon DS-Fi2 digital camera.

Our attempts to isolate single spore cultures did not yield positive results as the spores did not germinate. The herbarium material of holotype was deposited at Ajrekar Mycological Herbarium (AMH), Agharkar Research Institute (ARI), Pune, India. Index fungorum number is provided.

Results

Taxonomic description

Pontoporeia mangrovei Devadatha, V.V Sarma, sp. nov.  

Index Fungorum number: IF554084  
Etymology – In reference to the habitat where the fungus lives  
Holotype – AMH-9913

Saprobic on decaying wood of Suaeda monoica and Avicennia marina. Sexual morph: Ascomata 300–700 μm high, 330–670 μm in diameter (x̅= 400 × 460 μm, n= 10), solitary to gregarious, globose, dark brown to black carbonaceous, semi-immersed to superficial, with poorly developed hypostromata, fused with the host tissue, non-ostiolate, smooth. Peridium 25–85 μm (x̅ = 35 μm, n=10) thick, outer layer of small irregular, dark brown, thick-walled cells, inner layer of cells with larger lumina, arranged in a textura angularis. Hamathecium composed of numerous, 1–2 μm wide, filiform, branched, septate pseudoparaphyses, anastomosing above the asci, embedded in a gelatinous matrix. Asci 145–200 × 55–85 μm (x̅ = 175 × 70 μm, n=30), 8-spored, bitunicate, long pedunculate, persistent broadly clavate, ovoid or ellipsoidal, apically rounded and thickened at the apex lacking an ocular chamber. Ascospores 47–58 × 25–31 (x̅ = 54 × 28 μm, n=50), 1–3 seriate, 1-septate, constricted at the septum, thickened in the septum region with a band, initially hyaline turning purple, becoming dark brown to blackish brown at maturity, biturbinate to subellipsoidal, papillate

Fig. 1
at both ends with germ pores, lacking sheath or appendages. Ascospore walls bilayered, outer hyaline to light brown, thick exospore and an inner dark brown, thin endospore. Asexual morph: Undetermined

Known distribution – India

Material examined – India, Tamil Nadu, Tiruvarur, Muthupet mangroves (10.4°N 79.5°E), on decaying wood of *Suaeda monoica* (Amaranthaceae) (Holotype) and *Avicennia marina* (Acanthaceae) (Isotype) 24 December 2016, B. Devadatha (AMH-9913, holotype) and (PUHD-90, isotype). Isotype is maintained at Pondicherry University, Pondicherry.

Notes – Pontoporeia mangrovei and Pontoporeia biturbinata share similar morphological features. These include cleistotheial ascomata, with a weakly developed hypostromata, a thick peridium, filiform pseudoparaphyses, long pedunculated, broadly clavate, ovoid or ellipsoidal ascii, and 1-septate ascospores, constricted and thickened at the septum with a band-like appearance, dark-brown to blackish, biturbinate to sub ellipsoidal (Fig. 1). However, Pontoporeia mangrovei is distinct from *P. biturbinata* in having shorter ascomata, ascii and ascospore dimensions and being saprobic on *Suaeda monoica* and *Avicennia marina* in mangroves (Table 1). Pontoporeia biturbinata is host-specific and saprobic or perthophytic on living and drift rhizomes of *Posidonia oceanica* (Jones et al. 2009, 2015). The woody nature of mangrove substrata on which *P. mangrovei* thrive, are different from somewhat soft nature of the sea grass (*Posidonia oceanica* on which *P. biturbinata* occurs. These differences warrant a new species and hence a new species (*Pontoporeia mangrovei*) has been proposed to be accommodated in *Pontoporeia*.

A Dichotomous Key to similar species of *P. mangrovei* prepared broadly based on Kohlmeyer and Volkmann-Kohlmeyer 1991

1. Ascospores with one septum at maturity.................................................................2
   1′. Ascospores with one and more septa at maturity, 40-54 × 18-22µm, ascomata osiolate, papillate
   ..................................................................................................................Coronopapilla mangrovei

2. Ascospores verrucose to verruculose, shorter than 30 µm..............Caryosporella rhizophorae
2′. Ascospores smooth, longer than 30 µm .................................................................3

3. Ascospores with a dark band around the septum, without distinct germ pores or apical papillae,
   ascomata osiolate ......................................................................................................Halothia posidoniae
   3′. Ascospores thickened around the septum giving a band-like appearance, with distinct germ pores
   and apical papillae, ascomata non-osiolate ................................................................4

4. Ascospores longer than 65µm; with hyaline apical papillate cells and germ pores, on
   seagrasses...............................................................................................................Pontoporeia biturbinata
   4′. Ascospores shorter than 65µm; with hyaline light brownish apical papillate cells and germ pores, on
   mangroves............................................................................................................Pontoporeia. mangrovei

*Falciformispora lignalitis* K.D. Hyde

Saprobic on dead wood of *Aegiceras corniculatum*. Sexual morph: Ascomata 150–300 µm high, 200–300 µm in diameter (x̅= 215 × 240 µm, n= 10), aggregated, rarely solitary, erumpent to superficial, depressed globose to ovoid, brown to black, ostiolate. Ostiole short papillate, pale brown coloured. *Peridium* 25–40 µm (x̅= 30 µm, n=10), comprising 4–6 layers of thick walled pale brown to reddish brown cells of *textura angularis*, internally hyaline to light brown, externally merged with the host tissue. *Hamathecium* long and composed of numerous branched septate pseudoparaphyses and anastomosing above the asci, 1.5–3 µm wide, cellular hyaline pseudoparaphyses embedded in a gelatinous matrix. *Asci* 85–125 × 20–25 µm (x̅= 102 × 22 µm, n=30), 8-spored, bitunicate, fissitunicate, broadly clavate to fusoid, with a short thick pedicel, apically rounded and thickened at the apex with an ocular chamber. *Ascospores* 37–50 x 5–10 (x̅= 45 × 7 µm, n=50), biseriate to triseriately arranged, overlapping, hyaline, fusoid to moderately clavate, slightly curved, smooth-walled, 6–7 transverse septate, mostly 6-septate, surrounded by a thin gelatinous sheath longer at the base when compared to apical part, with a single scythe like appendage at the terminal end.
**Fig. 1** – *Pontoporeia mangrovei* (AMH-9913, holotype). a Ascomata semi-immersed on the decaying wood of *Suaeda monoica*. b Horizontal section of ascoma. c Longitudinal section of ascoma. d Section of peridium. e Filiform, branched, septate pseudoparaphyses. f–i Immature and mature asci. j–m Ascospores. Scale bars: c = 100 μm, f,g = 50 μm, d,e,h-m = 10 μm.
Table 1 Synopsis of morphological characters of *Pontoporeia mangrovei* and other closely related species in the same genus and other related genera

<table>
<thead>
<tr>
<th>Species</th>
<th>Host and habitat</th>
<th>Ascomata (μm)</th>
<th>Peridium (μm)</th>
<th>Asci (μm)</th>
<th>Ascospores (μm)</th>
<th>Source References</th>
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</thead>
<tbody>
<tr>
<td><em>Pontoporeia biturbinata</em></td>
<td>Saprobic on</td>
<td>805–1120 high</td>
<td>110–137</td>
<td>225–360 × 72–110, clavate</td>
<td>66–90 × 31.5–43.5, biturbinate, hyaline apical papillae with germ pores</td>
<td>Kohlmeyer &amp; Kohlmeyer 1979</td>
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<td></td>
<td><em>Posidonia oceanica</em></td>
<td>585–1375</td>
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<td><em>Pontoporeia mangrovei</em></td>
<td>Saprobic on</td>
<td>300–480 high, 330–670 diam</td>
<td>25–85</td>
<td>145–200 × 55–85, clavate</td>
<td>47–58 × 25–31, biturbinate, light brown apical papillae with germ pores</td>
<td>This study</td>
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<td><em>Saueda monoica</em> and <em>Avicennia marina</em></td>
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<td><em>Rhizophora mangle</em></td>
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Material examined – India, Tamil Nadu, Tiruvarur, Muthupet mangroves (10.4°N 79.5°E), on decaying wood of *Aegiceras corniculatum*. PUHD-61, Isotype is maintained at Pondicherry University, Pondicherry.

Notes – The genus *Falciformispora* was first established by Hyde (1992) as a monotypic genus and placed it under *Pleosporaceae* by comparing with *Setosphaeria*. Raja & Shearer (2008) collected *Falciformispora* species in freshwater in Florida and found that it is closely related to *Chaetomastia* than *Setosphaeria*, but is distinct in having hyaline ascospores. Suetrong et al. (2009) recorded it from the terrestrial oil palm (*Elaeis guineensis*) in Thailand. Later the family Trematosphaeriaceae was established to include the genera *Falciformispora*, *Halomassarina* and *Trematosphaeria* based on the morphology and phylogenetic characterization (Suetrong et al 2011, Hyde et al 2013). Recently we have recorded *F. lignatilis* for the first time on dead wood of *Aegiceras corniculatum* from Muthupet mangroves, south-east coast of India. Morphologically our collection is similar to the type species of *Falciformispora lignatilis* thought it has some overlapping dimensions of ascomata, asci and ascospore (Fig. 2).
Fig. 2 – *Falciformispora lignalitis* (PUFD-61, Isotype). a Ascomata superficial on the dead wood of *Aegiceras corniculatum*. b–d Longitudinal section of ascoma. e Section of peridium. f, g, i Immature and mature asci. h Cellular pseudoparaphyses. j–k Ascospores with scythe like appendage. l–m Ascospores with thin gelatinous sheath. Scale bars: c = 100 μm, d= 50 μm, e-m = 10 μm.
Culture characteristics – Ascospores germinating on seawater agar within 24 hours, germ tubes arising from apical end of the ascospore. Colonies on malt extract agar, slow growing, reaching 30–40 mm diameter after 25 days of incubation at room temperature, olive gray at center and olivaceous black at margin, reverse deep mouse gray, moderate, granular, undulate, surface raised, irregular.

Known distribution – Mexico, Thailand, USA (Florida), India

Material examined – India, Tamil Nadu, Tiruvarur, Muthupet mangroves (10.4°N 79.5°E), on dead wood of Aegiceras corniculatum (L.) Blanco (Primulaceae), 28 November 2015, B. Devadatha (PUFD-61, Isotype at Pondicherry University; ex-type living culture, PUFD-61)

Discussion

Studies on salt marsh plants like Spartina alterniflora, Juncus roemerianus and Phragmites australis have resulted in a rich diversity of marine fungi akin to many mangrove plants (Jones 1963, Poon & Hyde 1998, Fell & Hunter 1979, Wong & Hyde 2002, Kohlmeyer & Kohlmeyer 2002, Barata 2002, Ryckegem & Verbeken). To our knowledge Suaeda monoica, coming under the category of mangrove associated plants, has so far not been explored for marine fungi. With this in mind we collected and examined the decaying samples of Suaeda monoica which resulted in a novel taxon Pontoporeia mangrovei. Further, this fungus has also been recorded from the typical mangrove plant Avicennia marina. The monotypic genus Pontoporeia typified with P. biturbinata had been reported to be frequent on Posidonia oceanica (Kohlmeyer & Kohlmeyer 1979, Jones et al. 2009). In our recent collections of decaying mangrove specimens and their examination, we found a morphologically similar taxon described here as P. mangrovei which colonizes decaying twigs of Suaeda monoica and Avicennia marina. Pontoporeia mangrovei fits well into the genus Pontoporeia as it has ascospores that are biturbinate or sub-ellipsoidal, papillate with germ pores, 1-septate, dark brown to blackish brown (Fig. 1). P. mangrovei could be easily distinguished from P. biturbinata based on the shorter ascomata, asci and ascospore dimensions and also by occurring on Suaeda monoica and Avicennia marina in a mangrove habitat. A synopsis of important characteristics of closely related taxa of P. mangrovei is presented in Table 1. As could be seen from the table and the dichotomous key proposed, P. mangrovei could be easily delineated based on the non-ostiolate ascomata, with ascospores that are uniseptate having a constriction and thickening at the septum, apical papillate structures and pores. Our attempts to isolate single spore pure cultures failed as the spores did not germinate. After several field collections we also found this taxon on Avicennia marina with a very few ascomata that turned out to be insufficient for isolations and molecular studies. Hence we have proposed the new species P. mangrovei based on the morphological characteristics alone.

So far there are no reports of Falciformispora lignatilis from India. In the present study we have recorded this species (Fig. 2) for the first time from India and hence the present collection extends the geographical range of this fungus. Further, the occurrence of this taxon on decaying twigs of Aegiceras corniculatum extends its host range also.

Acknowledgments

This Project was funded by Ministry of Earth sciences, Govt. of India (Sanction order: MOES/36/OO1S/Extra/40/2014/PC-IV dt.14.1.2015). The authors thank District Forest Office, Tiruvarur, Tamil Nadu and PCCF (Head of Forest Force), Chennai, Tamil Nadu Forest Department for providing permission to collect samples from Muthupet mangroves. Department of Biotechnology, Pondicherry university is acknowledged for providing the facilities. B. Devadatha would like to thank the Ministry of Earth Sciences, Govt. of India for providing a fellowship and Professor. E.B. Gareth Jones is thanked for encouragement.

References


