



## Taxonomic novelties of hysteriform Dothideomycetes

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### Abstract

Hysteriaceae ascomycetes are an interesting and important group of fungi belonging to a small number of families and orders in the class Dothideomycetes. They can be saprobes, endophytes and/or ectomycorrhizal. Hysteriaceae fungi mainly occur on twigs or bark of various woody and herbaceous plants in terrestrial and aquatic environments worldwide. They have evolved convergently at least five times, and further studies are needed to resolve the taxonomic placement of new and previously described taxa. In this study, we introduce a new order, Gloniales, to accommodate *Glonium*, a new family, Acrogenosporaceae, to accommodate *Acrogenospora*, five new species (*Hysterium doirmaensis*, *H. thailandica*, *Hysterobrevium hakeae*, *Hy. rosae* and *Mytilinidion didymospora*) and a new combination (*Purpurepithecium minus*). New records are provided with descriptions and illustrations are given for *Gloniopsis subrugosa*, *Hysterium angustatum* and *Hysterographium fraxi*. The findings are supported by morphological and phylogenetic analyses of LSU SSU, *RPB2* and *TEF1* sequence data. In addition, amino acid sequences of *RPB2* were phylogenetically analyzed.

**Keywords** – Acrogenosporaceae – Gloniales – hysteriaceae – *Hysterium* – *Hysterobrevium* – *Hysterographium*

### Introduction

We are studying the diversity of fungi on various hosts in Thailand and have investigated the phylogenetic relationships among taxa of Dothideomycetes (Ariyawansa et al. 2015, Liu et al. 2015, Boonmee et al. 2016, Doilom et al. 2017). The hysteriform taxa in Dothideomycetes are the focus of the present study. In our previous studies of this group, we have introduced a new family, two new genera, seven new species, as well as three new records from different hosts and localities (Hyde et al. 2013, Liu et al. 2015, Hyde et al. 2016, Jayasiri et al. 2016, 2017, Li et al. 2016, Thambugala et al. 2016, Doilom et al. 2017). This manuscript provides a further contribution to the hysteriform Dothideomycetes with updated backbone trees.

In general different terminologies are used for this group of fungi based on their ascomatal morphology; there are called “hysteriaceous”, “hysteriform” and “hysterothecioid” ascomycetes (Boehm et al. 2009a, b). Hysteriaceous ascomycetes incorporate those fungi having lirelliform ascomata, generally called hysterothecia (Clements & Shear 1931). They are found worldwide as saprobes and occur on twigs or bark of various woody and herbaceous plants in terrestrial and aquatic environments (Boehm et al. 2009a, b, Hyde et al. 2013, Liu et al. 2015, Hyde et al. 2016, Li et al. 2016, Doilom et al. 2017). However, some taxa may also be endophytes (Xu et al. 2015), or ectomycorrhizae (Spatafora et al. 2012).

There have been numerous studies on hysteriform Dothideomycetes and a large number of epithets in this group have been introduced, mostly in the 20<sup>th</sup> century. During this time various researchers tried to identify these fungi by ascomatal macroscopic features, and host occurrence (Boehm et al. 2009a, b). Zogg (1962) emphasized the colour, number of septa and size of ascospores as the main criteria for separating species and genera. At the ordinal level, the Hysteriaceae have been classified in Pseudosphaerales (Gäumann 1949), Dothiorales (Müller & von Arx 1950), Dothideales (von Arx & Müller 1975), Pleosporales (Barr 1987) or in its own order, Hysteriales (Luttrell 1955, Kirk et al. 2001, 2008). Hysteriaceous fungi producing conchate or dolabrate, thin-walled, laterally compressed ascomata with an evaginated slit, were segregated from Hysteriaceae and placed in Mytiliniaceae, under Melanommatales (Barr 1990a), because of their trabeculate pseudoparaphyses. This character, which occurs in most hysteriform taxa, was later shown to have evolved in many groups of Dothideomycetes (Liew et al. 2001). The family Mytiliniaceae has also been placed in Pleosporales (Kirk et al. 2008) or Mytiliniales (Boehm et al. 2009b, Lumbsch & Huhndorf 2010). Boehm et al. (2009b) were the first to study the group at the molecular level and produce a phylogenetic outline. Phylogenetic studies based on molecular data have shown that hysteriaceous fungi do not form a monophyletic group (Boehm et al. 2009a, b, Mugambi & Huhndorf 2009).

Currently, hysteriform ascomycetes are known from four orders of ascomata, namely Hysteriales, Mytiliniales, Pleosporales, and Stigmatodiscales (Boehm et al. 2009a, b, Voglmayr et al. 2017). Hysteriales and Mytiliniales exclusively only contain hysterothecioid taxa. Anteglioniaceae is a family with hysterothecia found in the order Pleosporales. *Stigmatodiscus pruni* is a hysteriform species in the order Stigmatodiscales. Boehm et al. (2009b) placed Gloniaceae in Pleosporomycetidae families, *incertae sedis*, because of inadequate sequence evidence to raise the family to ordinal status. Jayasiri et al. (2017), however, introduced a new genus, thus increasing the numbers of taxa for this group supported by molecular data.

Currently two hysteriform Dothideomycetes genera are placed in Pleosporomycetidae genera *incertae sedis*: *Farlowiella* (asexual morph: *Acrogenospora*) and *Hysterographium* (Goh et al. 1998, Boehm et al. 2009a). *Acrogenospora* is protected over *Farlowiella*, based on the wider use and fewer name changes required, rather than following the principle of priority (Rossman et al. 2015). In this study we revisit this group with novelties based on morphology and phylogenetic data. We introduce a new order, a new family, five new species, a new combination and document three new records.

## Material and Methods

### Sample collection and specimen examination

Fresh materials were received and collected from Australia, Italy, Russia and Thailand in 2012, 2015 and 2016. Specimens were observed using a Motic SMZ 168 series microscope. Hand sections of fruiting structures were mounted in water for microscopic studies and photomicrography. The fungi were examined with a Nikon ECLIPSE 80i compound microscope and photographed with a Canon 450D digital camera connected to the microscope. Measurements were made with the Tarosoft (R) Image Frame Work program and images used for the figures were processed with Adobe Photoshop CS6 Extended version 10.0 software (Adobe Systems, USA).

Isolations were obtained from single ascospores, following a modified method of Chomnunti et al. (2014).

Voucher specimens are deposited in the herbarium of Mae Fah Luang University (Herb. MFLU) and New Zealand Fungal & Plant Disease Collection (PDD) or Herbarium of Cryptogams, Kunming Institute of Botany Academia Sinica (HKAS). Living cultures are deposited in the culture collection of Mae Fah Luang University (MFLUCC), Thailand with a duplicate set at the Culture Collection of Kunming Institute of Botany (KUMCC) or BIOTEC Culture Collection (BCC), Bangkok, Thailand. Faces of fungi and IF numbers were registered as in Jayasiri et al. (2015), Index Fungorum (2018).

### **DNA extraction, PCR amplification and sequencing**

Genomic DNA was extracted from the mycelium after growing for 14 days on MEA at 18°C using the Biospin Fungus Genomic DNA Extraction Kit (BioFlux®) and following the manufacturer's protocol (Hangzhou, P.R. China). DNA was extracted directly from ascomata using a DNA extraction kit (E.Z.N.A.® Forensic DNA kit, D3591-01, Omega Bio-Tek) following the manufacturer's instructions. DNA was amplified by Polymerase Chain Reaction (PCR). The partial large subunit nuclear rDNA (LSU) was amplified with primer pairs LROR and LR5 (Vilgalys & Hester 1990). The small subunit nuclear rDNA (SSU) was amplified with primer pairs NS1 and NS4 (White et al. 1990). The RNA polymerase II second largest subunit (*RPB2*) gene was amplified with primers fRPB2 and fRPB2-7cR (Liu et al. 1999, Sung et al. 2007). The translation elongation factor 1-alpha gene (*TEF1*) was amplified by using primers EF1-983F and EF1-2218R (Rehner 2001).

The PCR was carried out in a 50 µl reaction volume containing 2 µl DNA, 25 µl PCR mix, 19 µl distilled water and 2 µl of each primer. Amplifications of LSU, SSU, *RPB2* and *TEF1* were performed under standard conditions (White et al. 1990). Purification and sequencing of PCR products were carried at Shanghai Sangon Biological Engineering Technology and Services Co. (China).

### **Sequence alignment and phylogenetic analyses**

Sequences generated from the LSU, SSU, *RPB2* and *TEF1* gene regions were carefully verified using blast result in GenBank, before further analyses. All introns and exons were aligned individually. Ambiguously aligned regions with many leading or trailing gaps were excluded from the alignments prior to phylogenetic reconstructions. Multiple sequence alignments were produced with MAFFT v. 6.864b (<http://mafft.cbrc.jp/alignment/server/index.html>) and further improved manually where necessary. The final phylogenetic tree used to infer the taxonomic placement of our new taxon was generated based on DNA sequence analyses of a concatenated dataset of LSU, SSU, *RPB2* and *TEF1* gene sequences. A maximum likelihood analysis was performed at CIPRES using RAxML v.7.2.8 as part of the "RAxMLHPC2 on TG" tool (Stamatakis et al. 2008). The general time reversible model (GTR) using proportion of invariable sites was applied with a discrete gamma distribution and four rate classes. The sequences of novel species and other newly generated sequences were deposited in GenBank (Appendix 1) and the final matrices used for phylogenetic analyses were saved in TreeBASE (ID 22543).

The most suitable model of evolution was estimated using MrModeltest 2.2 (Nylander 2004). Posterior probabilities (PP) (Rannala & Yang 1996, Zhaxybayeva & Gogarten 2002) were determined by Markov Chain Monte Carlo sampling (MCMC) in MrBayes v. 3.0b4 (Huelsenbeck & Ronquist 2001). Six simultaneous Markov chains were run for 10,000,000 generations and trees were sampled every 100th generation. The first 100,000 trees, representing the burn in phase of the analyses, were discarded, while the remaining trees (80000) were used for calculating posterior probabilities in the majority rule consensus tree. Bayesian Posterior Probabilities (BYPP) equal or greater than 0.90 are indicated on the resulting tree topology (Fig. 1). Phylogenetic trees were drawn using FigTree v. 1.4 (Rambaut & Drummond 2008).

## Amino acid sequence analysis

The *RPB2* gene sequences were translated into protein sequences using ARB (Ludwig et al. 2004, Perera et al. 2018, Thambugala et al. 2018). The phylogenetic analysis was conducted with RAxML and the Blosum62 amino acid substitution model. Only amino acids 291 to 472 according to ACJ60608 (*Mytilinidion andinense*) were used for the analysis.

## Results

### Phylogenetic analyses of DNA sequences

Three hundred and one strains were included in the combined LSU, SSU, *RPB2* and *TEF1* gene analyses with *Schismatomma decolorans* (AFTOL-ID 307) as the outgroup taxon. Tree topology of the Bayesian analysis was compatible with the ML tree and was not significantly different (data not shown). The best scoring RAxML tree with a final likelihood value of -117967.323834 is shown in Fig. 1. Five clades are represented in the figure: Clade A represents the main family of hysteriform Dothideomycetes (Hysteriaceae), Clade B is the new order Gloniales, Clade C Mytilinidiales, Clade D *Hysterographium* sp. and Clade E represents a new family Acrogenosporaceae. Our isolates and new findings are described in these groups based on morphology and phylogenetical data.

The nine strains included in the combined LSU, SSU, *RPB2* and *TEF1* gene analyses for the new family Acrogenosporaceae with *Hysterographium fraxini* (CBS 242.32 and CBS 109.43) as the outgroup taxon. The best scoring RAxML tree with a final likelihood value of -8652.600999 is shown in Fig. 2. Original names are used in here for the better interpretation of this group.

### Phylogenetic analyses of amino acid sequences

Amino acid sequence analysis of *RPB2* was conducted for the same data set as used for multigene phylogenetic analyses. Except for hysteriform Dothideomycetes species others were collapsed to order level in the resulting tree (Fig. 3). Based on this tree (Fig. 3) we have identified the main orders of the class Dothideomycetes. Among the hysteriform group's new family Acrogenosporaceae (Part E), Mytilinidiales (Part C) and the order Stigmatodiscales (Part F) are monophyletic and have the same topology as phylogenetic analyses of DNA sequences. However, Gloniales (Part D), Hysteriales (Part A) and Pleosporales (part B) are paraphyletic in here and a few Pleosporales species are polyphyletic.

### Phylogenetic analyses – ordinal level

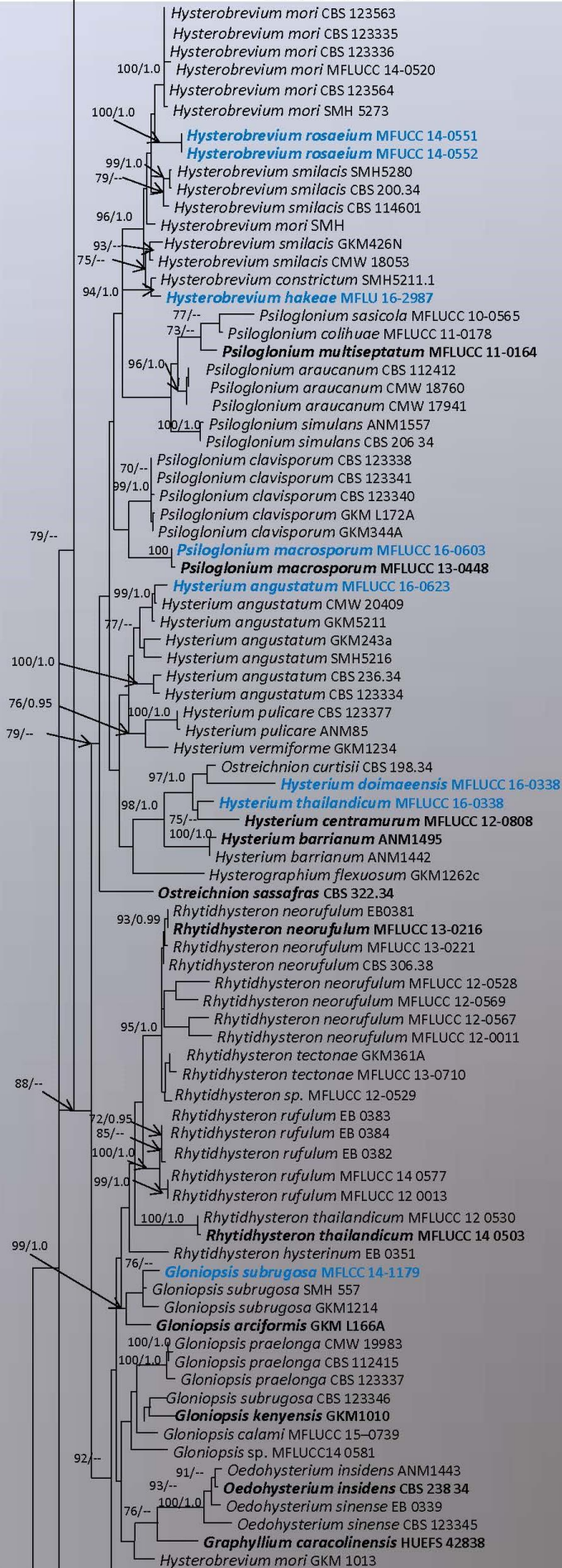
#### **Minutisphaerales** Raja, Oberlies, Shearer & A.N. Mill., Mycologia 107: 854 (2015)

Notes – Based on phylogenetic analyses of combined SSU and LSU data, Raja et al. (2015) introduced new order Minutisphaerales within the Dothideomycetes. The *Minutisphaera* spp. clade is a monophyletic, strongly supported clade of freshwater Dothideomycetes (Raja et al. 2013, 2015). In the present study further confirmed placement of order Minutisphaerales with the Minutisphaeraceae and a new family Acrogenosporaceae.

Minutisphaeraceae is characterized by erumpent to superficial, pseudothecioid or apothecioid ascomata with ostioles, a thin-walled peridium and clavate, fusiform to ellipsoidal, multi-guttulate ascospores surrounded by a gelatinous sheath.

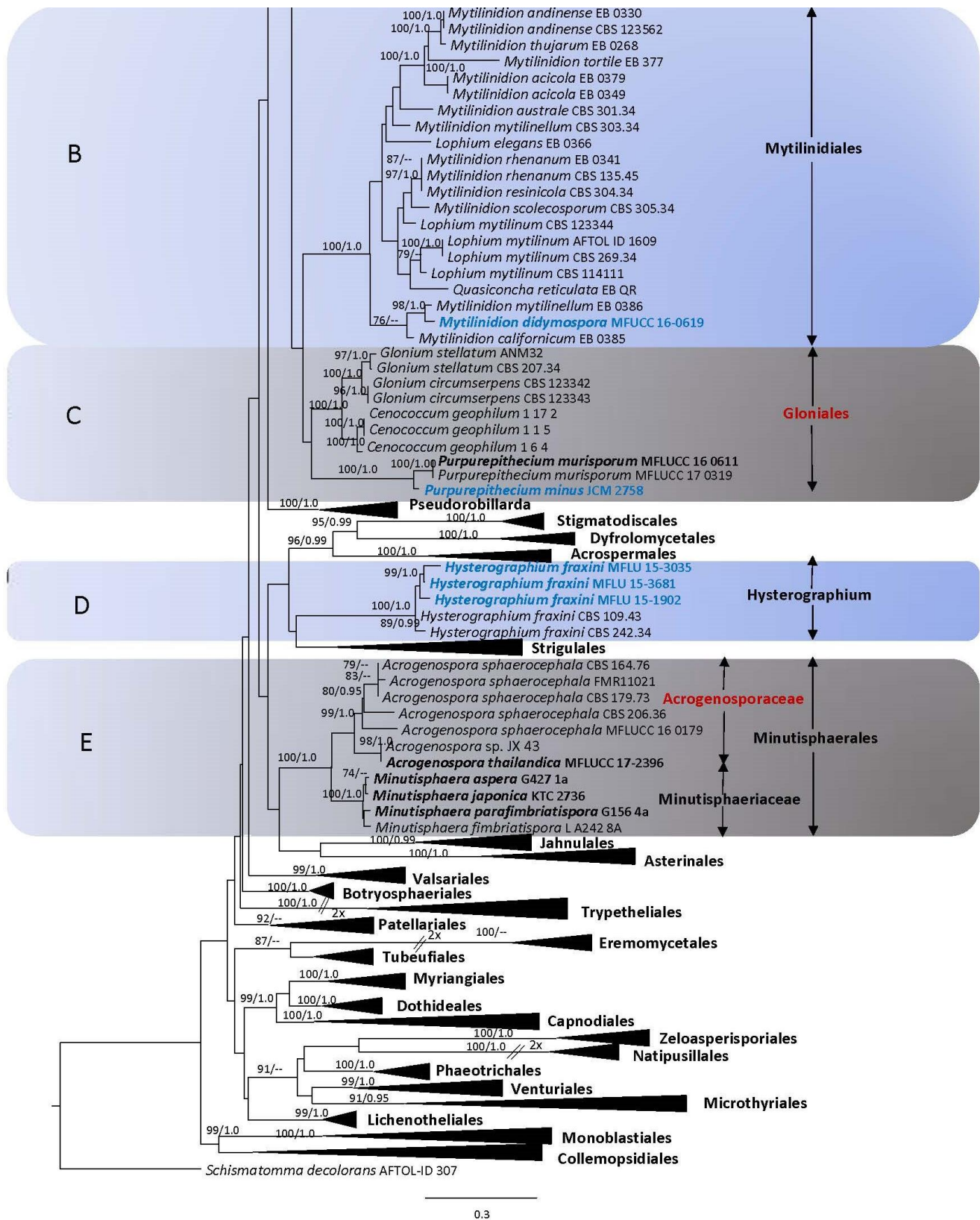
All currently described *Minutisphaera* spp. (*M. fimbriatispora*, *M. japonica*, *M. aspera* and *M. parafimbriatispora*) have been isolated from submerged wood in freshwater habitats (Ferrer et al. 2011, Raja et al. 2013, 2015). Therefore, this order comprises freshwater saprobic fungi. This ecological group plays an important role in nutrient cycling and organic matter decomposition in freshwater habitats (Simonis et al. 2008, Shearer et al. 2009, Hyde et al. 2016).

86/0.95 **Pleosporales**



A





**Figure 1** – Simplified phylogram showing the best RAxML maximum likelihood tree obtained from the combined multigene (LSU, SSU, *RPB2* and *TEF1*) matrix of 301 taxa including major orders in Dothideomycetes, *Schmatomma decolorans* (AFTOL-ID 307) is selected as the outgroup taxon. Except for Gloniales, Hysteriales, *Hysterographium* spp., Minutisphaerales and Mytilinidiales, other lineages were collapsed to ordinal level. ML bootstrap support equal or greater than 70 % and Bayesian posterior probabilities equal or greater than 0.95 are given near to each branch. Newly generated strains are in blue and type species are in bold.

**Acrogenosporaceae** Jayasiri & K.D. Hyde, fam. nov.

Index Fungorum number: IF554451; Facesoffungi number: FoF04575

*Saprobic* on bark and wood. Sexual morph: *Hysterothecia* laterally compressed, thick-walled, with a prominent sunken slit, solitary to gregarious, erect and elevated, presenting an almost stipitate appearance. *Ascospores* 1-celled, pedicellate, slightly laterally compressed asexual, hyaline or moderately pigmented. Asexual morph: Described in the genus *Acrogenospora* (Goh et al. 1998).

Type – *Acrogenospora sphaerocephala* (Berk. & Broome) M.B. Ellis, Dematiaceae Hyphomycetes: 114 (1971)

≡ *Monotospora sphaerocephala* Berk. & Broome, Annals and Magazine of Natural History 3: 361, t. 9:5 (1859)

Notes – Using the concept of “one name one fungus” Rossman et al. (2015) suggested to keep *Farlowiella* as a synonym of *Acrogenospora*. *Acrogenospora* was favored as it would contribute to nomenclatural stability (Rossman et al. 2015). The generic name *Acrogenospora*, typified by *A. sphaerocephala*, includes two of the eleven species that have sexual morphs placed in *Farlowiella* typified by *F. repanda* (also considered to be *F. carmichaeliana*) (Rossman et al. 2015). Hyde et al. (2018) re-examined and introduced molecular data for the type species (*Acrogenospora sphaerocephala*) and another new *Acrogenospora* species. In our study, we used seven isolates related to this group, but many strains do not have any associated morphological descriptions (CBS 164.76, FMR 11021 and JX 43). *A. sphaerocephala* (MFLUCC 16-0179) clusters with *Farlowiella carmichaeliana* (CBS 206.36, CBS 179.73, JX FMR 11021) and *A. sphaerocephala* (CBS 164.76) with high statistical support in both DNA and protein trees. Therefore, this study supports *Farlowiella* as a synonym of *Acrogenospora*. *Farlowiella* (*Acrogenospora*) is placed in Pleosporomycetidae genera *incertae sedis* in Boehm et al. (2009b), Schoch et al. (2009), Hyde et al. (2013), Wijayawardene et al. (2018). However, in the present study, *Acrogenospora* (type: *Acrogenospora sphaerocephala*) groups in Minutisphaeraceae /Minutisphaerales clade. Raja et al. (2013, 2015) showed that *Acrogenospora sphaerocephala* (CBS 206.36) grouped in a clade close to Minutisphaerales (Ferrer et al. 2011, Raja et al. 2013). *Minutisphaera* is the type genus of Minutisphaeraceae and differs from Acrogenosporaceae in having erumpent to superficial, pseudothecioid or apothecioid ascomata with ostioles, a thin-walled peridium and clavate, fusiform to ellipsoidal, multiguttulate ascospores with a gelatinous sheath. However, Acrogenosporaceae has hysterothecial ascomata with thick-walls, a prominent sunken slit and 1-celled, pedicellate, hyaline or moderately pigmented ascospores. Therefore, based on morphological and phylogenetic differences we placed *Acrogenospora* sp. in new family Acrogenosporaceae in the order Minutisphaerales.

**Gloniales** Jayasiri & K.D. Hyde, ord. nov.

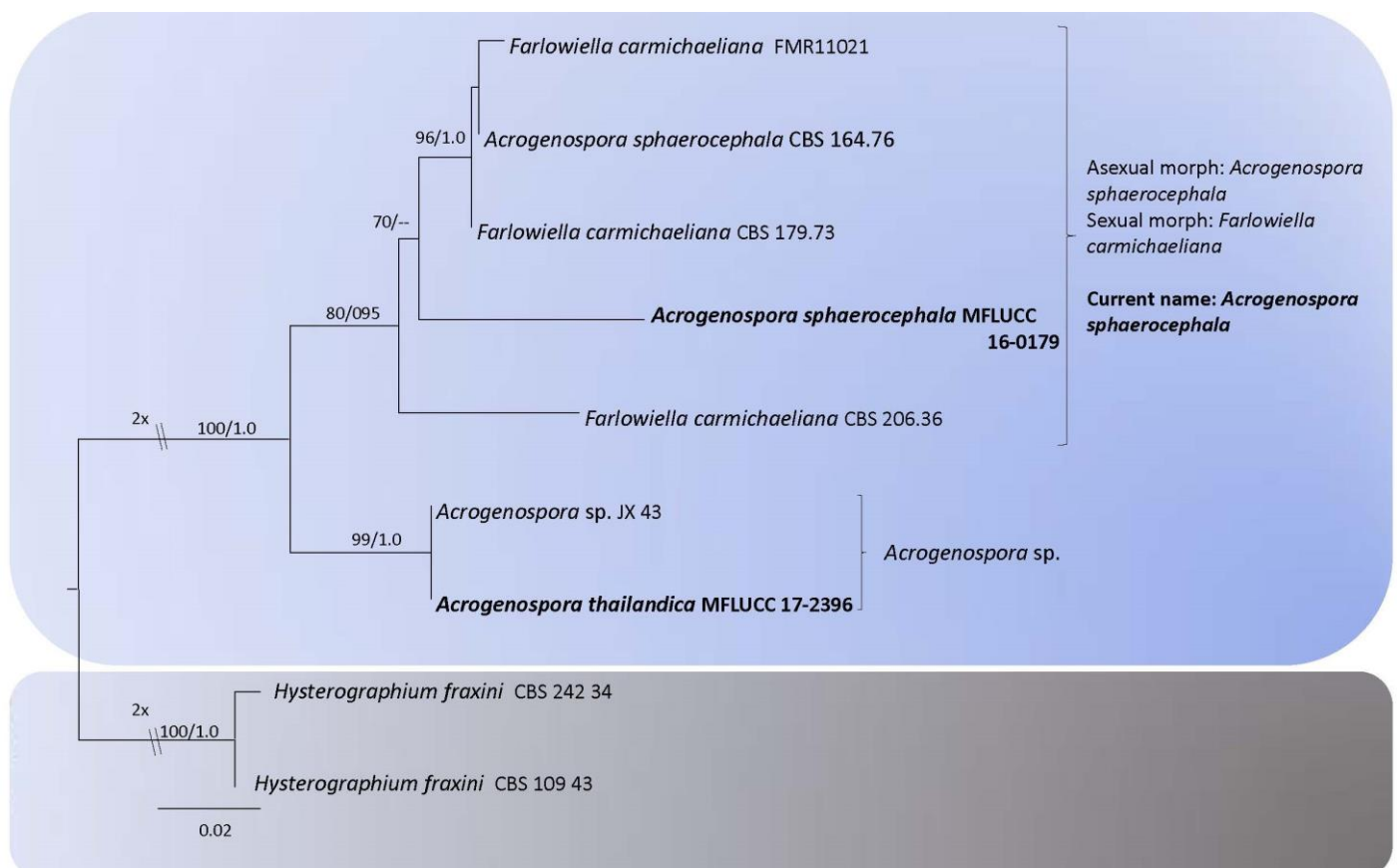
Index Fungorum number: IF553002; Facesoffungi number: FoF03250

*Saprobic* or *ectomycorrhizal* on bark, wood, pine cone or soil. Sexual morph: *Hysterothecia* dark, erumpent to superficial, progressively dichotomously branched or scattered to gregarious, *Peridium* wide, thick, carbonaceous and brittle when dry. *Pseudoparaphyses* cellular, septate, persistent, wide, hyaline, branched with darkened apices, in a gel matrix. *Asci* 8-spored, fissitunicate, clavate to cylindrical. *Ascospores*, overlapping biseriate, hyaline, lightly pigmented to dark brown, 2-celled to muriform. Asexual morph: psilogonium stygium-like (Boehm et al. 2009a, Jayasiri et al. 2017).

Type family – Gloniaceae (Corda) E.W.A. Boehm, C.L. Schoch & J.W. Spatafora, Mycol Res. 113(4): 468 (2009)

Notes – Boehm et al. (2009b) introduced the family Gloniaceae based on the genus *Glonium* and accommodated in Pleosporomycetidae family, *incertae sedis*. Boehm et al. (2009a) added the genus *Cenococcum* to this family. Recently, *Purpurepithecium* was added to the family by Jayasiri et al. (2017). In the present study, we place this family in a new order Gloniales, which forms a distinct sister clade to the Mytilinidiales clade (Fig. 1) and is also supported by several significant

morphological differences. However, this is not supported in the protein tree of *RPB2* where as *Purpurepithecium* forming a separate clade (Fig. 3). Mytilinidiales and Gloniales morphologically differ as follows: Mytilinidiales (type: *Mytilinidion*) is characterized by fragile persistent carbonaceous ascumata, which range from globoid to obovoid to strongly laterally compressed erect, bivalve shell-shaped structures, standing on edge, with lateral walls more or less connivant, and extended vertically; Gloniales (type: *Glonium*) has modified hysterothecia, progressively dichotomously branched or scattered to gregarious. Lumbsch & Huhndorf (2010) placed the closely related Gloniaceae in Mytilinidiales based to multigene data. However, Boehm et al. (2009a, b), Schoch et al. (2009) placed it in Pleosporomycetidae, family *incertae sedis*, because of the highly divergent morphology associated with the genus *Glonium*. Spatafora et al. (2012) provided strong multigene phylogenetic evidence that *Cenococcum* is a member of Gloniaceae (*incertae sedis*, Pleosporomycetidae, Dothideomycetes).



**Figure 2** – Simplified phylogram showing the best RAxML maximum likelihood tree obtained from the combined multigene (LSU, SSU, *RPB2* and *TEF1*) matrix of nine taxa representing the family Acrogenosporaceae with their original name. *Hysterographium fraxini* (CBS 242.32 and CBS 109.43) is selected as the outgroup taxon. ML bootstrap support equal or greater than above 70 % and Bayesian posterior probabilities above 0.95 are given near to each branch.

***Purpurepithecium minus*** (N. Amano) Jayasiri & K.D. Hyde, comb. nov.

Index Fungorum number: IF554452; Facesoffungi number: FoF04576

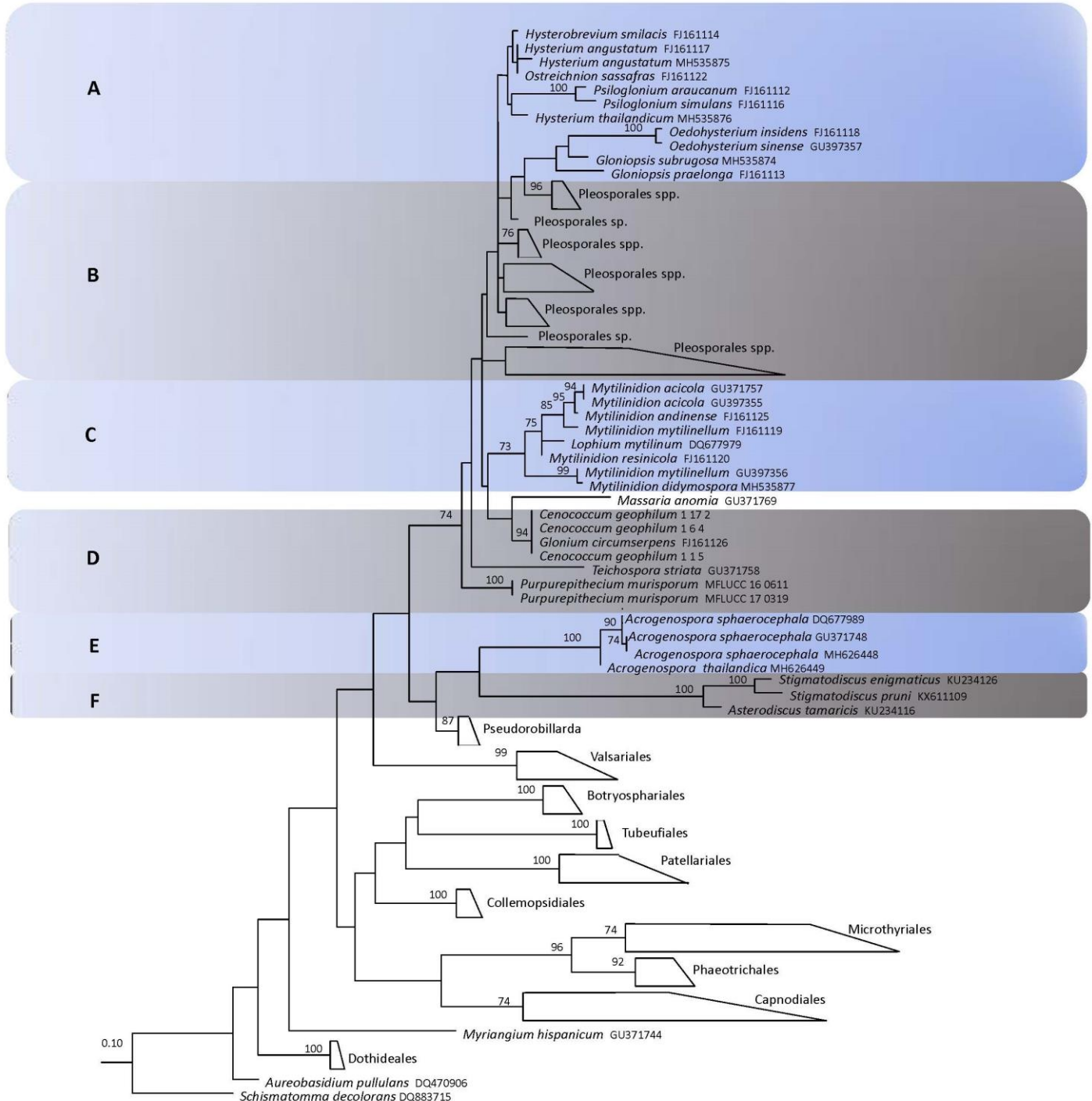
≡ *Hysterographium minus* N. Amano, Trans. Mycol. Soc. Japan 24(3): 293 (1983)

Notes – *Hysterographium minus* (JCM 2758) clusters with *Purpurepithecium murisporum* and is distantly placed from the *Hysterographium* clade in our multigene phylogenetic analyses. *Hysterographium minus* is therefore placed in new combination as *Purpurepithecium minus*, based on morphological and phylogenetic similarities. *Hysterographium minus* is morphologically similar to *Purpurepithecium murisporum* in having pigmented dictyospores with a brick-red epithecium (Boehm et al. 2009a, Jayasiri et al. 2017).



**Hysteriales** Lindau, Natürl. Pflanzenfam.: 265 (1896)

Notes – The order Hysteriales was introduced by Lindau (1897) and has been placed among the pyrenomycetes and the discomycetes at different times (Rehm 1897). Molecular data places Hysteriales in Dothideomycetes (Boehm et al. 2009a, b, Shearer et al. 2009, Suetrong et al. 2009, in this study). Furthermore, Hysteriales is strongly supported with specific morphological features and multigene phylogenetic analysis of LSU, SSU, *RPB2* and *TEF1* gene sequence data.



**Figure 3** – Simplified phylogram showing the best protein RAxML maximum likelihood tree obtained from the *RPB2* gene product translated to amino acid sequences. Major orders in Dothideomycetes are represented by the 95 taxa with available sequence data. Arthoniomycetes (*Schmatomma decolorans*, DQ883715) was selected as the outgroup. MLBS equal or above 70 % are given near to each branch. Other lineages were collapsed to ordinal level.

**Hysteriaceae** Chevall. 1826, Flore Générale des Environs de Paris 1: 432 (1826)

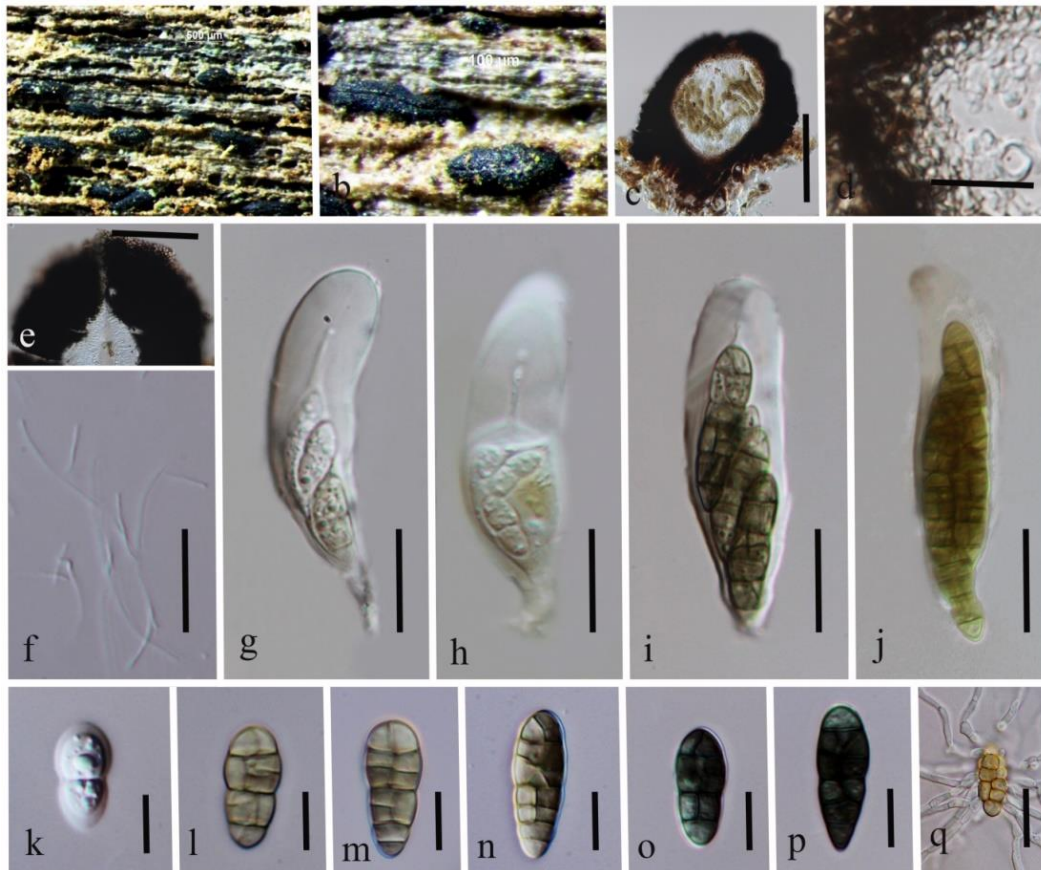
Notes – In recent morphological and phylogenetic studies (Boehm et al. 2009a, b, de Almeida et al. 2014), this family comprises nine genera: *Glioniopsis*, *Graphyllum*, *Hysterium*, *Hysterobrevium*, *Hysterodifractum*, *Oedohysterium*, *Ostreichnion*, *Psiloglonium* and *Rhytidhysterion* based on morphological and phylogenetic data. However only based on morphology *Actidiographium*, *Glioniella*, *Hysterocharina* and *Hysteropycnis* also belong to family Hysteriaceae (Boehm et al. 2009a, b, Wijayawardene et al. 2018). In this study, we propose *Hysterium curtisii* (Basionym) as the current name for *Ostreichnion curtisii*, because genus *Ostreichnion* type (*O. sassafras*) is distantly clades with *O. curtisii*. In addition to study of Tibpromma et al. 2017 also confirmed this placement introducing a new species *Hysterium centramurum* which is clade with *Ostreichnion curtisii*. Thambugala et al. (2016) have outlined the genus *Rhytidhysterion* and redefined the genus in Hyde et al. (2017).

***Glioniopsis subrugosa*** (Cooke & Ellis) E. Boehm & C.L. Schoch, Studies in Mycology 64: 65 (2009) Figs 4, 5

Basionym: *Hysterium subrugosum* Cooke & Ellis, Grevillea 5: 54.1876.

=*Hysterographium subrugosum* (Cooke & Ellis) Sacc., Sylloge Fungorum 2: 780 (1883)

Facesoffungi number: FoF04582



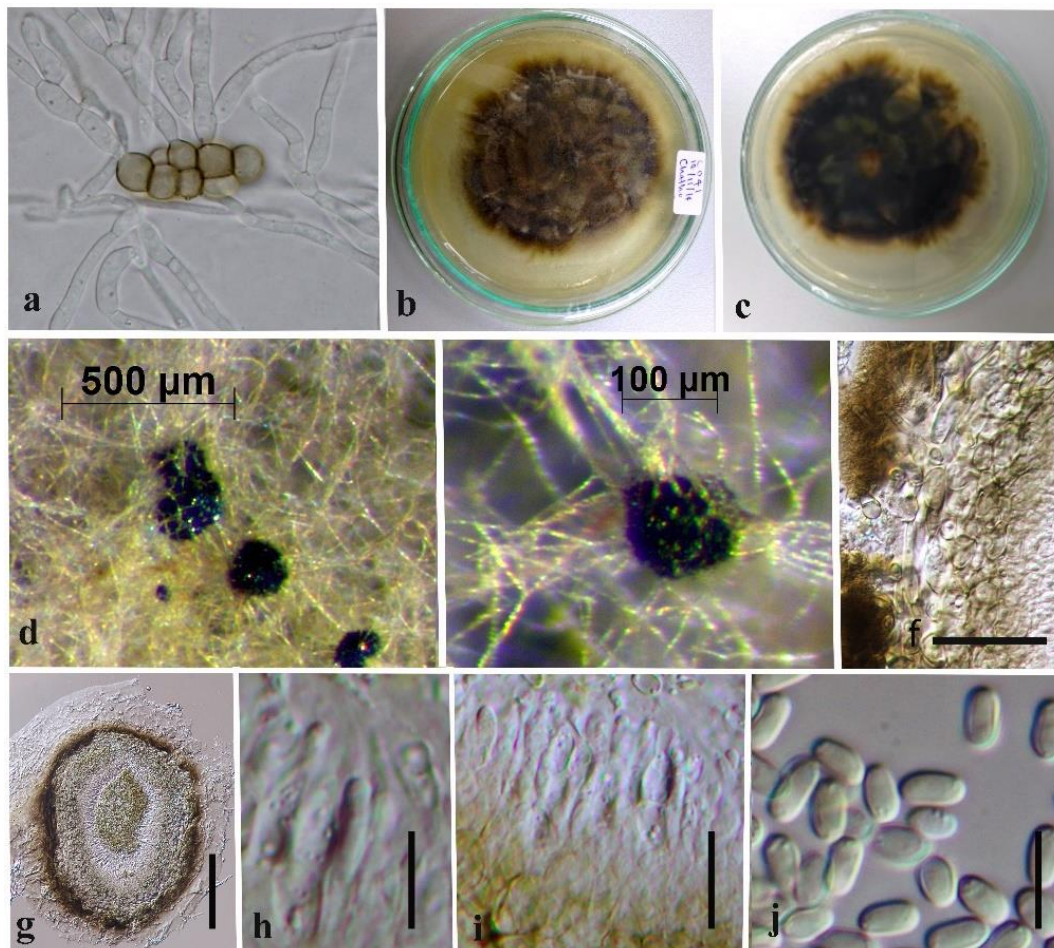
**Figure 4** – *Glioniopsis subrugosa*. a–b Hysterothecia on host. c Vertical section through hysterothecium. d Peridium. e Section through the longitudinal slit. f Pseudoparaphyses. g–j Asci with 8-spores. k–p Ascospores. q Germinated spore. Scale bars: c = 100  $\mu$ m, d, e = 30  $\mu$ m, f = 10  $\mu$ m, g, h = 20  $\mu$ m, k–q = 30  $\mu$ m.

*Saprobic* on dead wood. Sexual morph: *Hysterothecia* 347–371  $\mu$ m high, 199–232  $\mu$ m diam., 800–1000  $\mu$ m long ( $\bar{x}$  = 365  $\times$  220  $\times$  900  $\mu$ m, n = 10), navicular, straight to flexuous, with tapered ends, erumpent to superficial, scattered, with a prominent longitudinal slit. *Peridium* 24–33  $\mu$ m



wide ( $\bar{x} = 29 \mu\text{m}$ ,  $n = 10$ ), carbonaceous, brittle, heavily pigmented, of small, prosenchymatous cells. *Hamathecium* 1–1.5  $\mu\text{m}$  wide, persistent, septate, hyaline, not branched above the asci, borne in a gelatinous matrix. *Asci* 50–75  $\mu\text{m}$  high  $\times$  13–16  $\mu\text{m}$  diam. ( $\bar{x} = 68 \times 14 \mu\text{m}$ ,  $n = 25$ ), 8-spored, bitunicate, cylindrical to clavate, short-pedicels, with a prominent apical ocular chamber. *l* 18–20  $\times$  13–16  $\mu\text{m}$ , ( $\bar{x} = 19 \times 15 \mu\text{m}$ ,  $n = 30$ ), crowded to biseriata, immature hyaline, mature brown to greenish brown pigmented dictyosporus, with 7–11 transverse and 1–2 vertical septa, hardly constricted at septa, slightly asymmetric in outline. Asexual morph: *Pycnidia* 230–260  $\mu\text{m}$  high  $\times$  110–190  $\mu\text{m}$  diam ( $\bar{x} = 245 \times 180 \mu\text{m}$ ,  $n = 5$ ), globose to subglobose, on upper surface of the agar, olivaceous to brick coloured, then olivaceous black, solitary or aggregated, lacking setose-like outgrowths, with or without distinct ostiole, pycnidial wall consisting brown outer layers to hyaline inner cell layers. *Conidiogenous cells* 10–12  $\times$  2–3  $\mu\text{m}$  ( $\bar{x} = 11 \times 2.5 \mu\text{m}$ ,  $n = 10$ ), ampulliform to filiform. *Conidia* 4–6  $\times$  2–3  $\mu\text{m}$  ( $\bar{x} = 5 \times 2.5 \mu\text{m}$ ,  $n = 30$ ), ellipsoidal to allantoid, greenish brown, aseptate.

Culture characteristics – Colonies on MEA attaining 20–30 mm diam. after 7 days at 25 °C, with irregular edge, brown coloured, with dense aerial mycelium on the surface with black, gregarious conidiomata; reverse black.



**Figure 5** – *Gloniopsis subrugosa* asexual morph. a Germinated spore. b–c Culture from above and reverse. d, e Fruiting body in culture. f Peridium. g Vertical section of conidioma. h, i Conidiogenous cells. j Conidia. Scale bars: f = 30  $\mu\text{m}$ , g = 100  $\mu\text{m}$ , h, i = 20  $\mu\text{m}$ , j = 10  $\mu\text{m}$ .

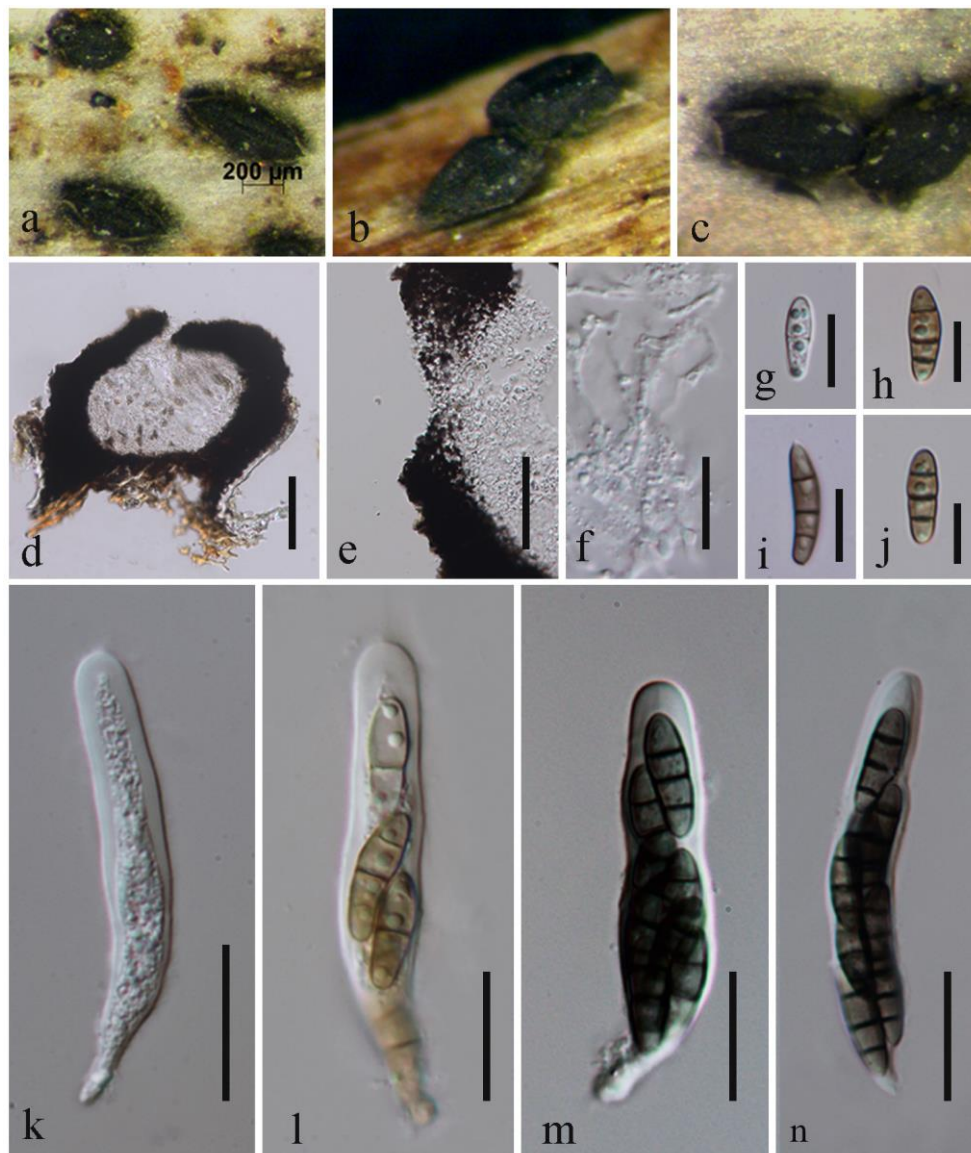
Material examined – THAILAND, Doi Mae Salong on dead wood, 5 October 2014, Subashini C. Jayasiri, C 041 (MFLU 16–2984; HKAS96308), living cultures MFUCC 14–1179.

Known distribution – Cuba (Boehm et al. 2009b), Kenya (Boehm et al. 2009b), South Africa (van der Linde 1992) and Thailand (this study).

Notes – The genus *Gloniopsis* was introduced by Boehm et al. (2009b). This genus is characterized by multi-septate, hyaline to yellow dictyospores, with one or more longitudinal septa. Currently, there are six species in this genus with morphological and molecular data (Boehm et al. 2009a, b, Hyde et al. 2016). Index Fungorum (2018) lists 66 species epithets under *Gloniopsis*. However, most of these epithets have been synonymized under a few taxon accounts and some of them do not have molecular data for DNA based comparisons. Three *Gloniopsis subrugosa* strains (GKM 1214, SMH 557 and CBS 123346) are comprised and there were no any morphological differences. However, in the multigene phylogenetic analysis *Gloniopsis subrugosa* (CBS 123346) distantly associated with other two strains with genetic heterogeneity within the taxon (Boehm et al. 2009b). Our isolate also do not have any distinct morphological features and clade with *Gloniopsis subrugosa* GKM 1214 and SMH 557. Therefore, in here we have documented a new record of *Gloniopsis subrugosa* from Thailand. In previous studies *Gloniopsis subrugosa* was recorded from Cuba (SMH 557), Kenya (GKM 1214) and South Africa (CBS 123346) (Boehm et al. 2009a).

*Hysterium angustatum* Alb. & Schwein., Consp. fung. (Leipzig): 55 (1805)  
 Facesoffungi number: FoF04579

Fig. 6



**Figure 6** – *Hysterium angustatum*. a–c View of hysterothecia on host surface. d Section through hysterothecium. e Peridium. f Pseudoparaphyses. g–j Ascospores. k–m Asci. Scale bars: d = 100  $\mu$ m, e = 50  $\mu$ m, g–j = 10  $\mu$ m, k–m = 20  $\mu$ m.

*Saprobic* on *Rubus* sp. (Rosaceae). Sexual morph: *Hysterothecia* 208–232 µm high × 256–284 µm wide × 500–600 µm long ( $\bar{x}$  = 218 × 268 × 560 µm, n = 10), elongate and depressed conchate, scattered, superficial, base immersed in substrate, surface black, shiny, longitudinally striate, apex compressed, opening by a longitudinal slit. *Peridium* 40–60 µm ( $\bar{x}$  = 51, n = 15) carbonaceous, brittle, of heavily pigmented, small prosenchymatous cells. *Hamathecium* 0.5–1.5 µm wide, trabeculate, aseptate, branched, pseudoparaphyses, borne in a gel matrix. *Asci* 59–66 × 7.6–9.2 µm ( $\bar{x}$  = 63 × 8.6 µm, n = 15), 8-spored, bitunicate, oblong to clavate, with a short narrow pedicel, apically thickened, with a distinct ocular chamber. *Ascospores* 14–17 × 4–5.3 µm ( $\bar{x}$  = 15.5 × 4.6 µm, n = 25), crowded to biseriate to triseriate, fusiform, hyaline when young and becoming brown at maturity, 3-septate, smooth-walled, ornamented, mucilaginous sheath absent. Asexual morph: Undetermined.

Culture characteristics – Ascospores germinating on MEA within 24 h. slow growing at 18°C reaching 2 cm in 14 days, yellow at first, becoming ash when mature and reverse yellow.

Material examined – ITALY, Province of Forlì-Cesena [FC]), near Fiumana di Predappio, on dead aerial branch of *Rubus* sp. (Rosaceae), 20 January 2016, E. Camporesi, IT 2794 (MFU 16–0468; HKAS96320), living culture MFLUCC 16–0623.

Distribution – Kenya, New Zealand, Tennessee, United States (Boehm et al. 2009a); Italy (in this study).

Notes – In here we re-describe and illustrated of *Hysterium angustatum* with new a strain. This is the first report of *Hysterium angustatum* from Italy. *Hysterium angustatum* strains have little variability in their spore morphology, may be because of indicate early stages of speciation within the taxon, with sequence variation preceding morphologic change (Boehm et al. 2009a).

***Hysterium doimaensis* Jayasiri & K.D. Hyde, sp. nov.**

Fig. 7

Index Fungorum number: IF554456; Facesoffungi number: FoF04581

Holotype: MFLU 16–0954

Etymology: In reference place where specimen was collected.

*Saprobic* on decaying wood. Sexual morph: *Hysterothecia* 480–550 µm high, 380–420 µm diam., 600–800 µm long ( $\bar{x}$  = 510 × 400 × 700 µm, n = 10), scattered, superficial, base immersed in substrate, elongate and depressed conchate, surface black, shiny, longitudinally striate, apex compressed, opening by longitudinal slit. *Periphyses* along the slit, aseptate, hyaline, swollen, with blunt ends. *Peridium* 50–80 µm wide ( $\bar{x}$  = 65 µm, n = 10), comprising carbonaceous, brittle, heavily pigmented, small, prosenchymatous cells. *Hamathecium* 1–1.5 µm wide, persistent, trabeculate, hyaline, aseptate, branched, borne in a gel matrix, which is brownish granular above the asci, longer than asci. *Asci* 139–225 × 22–44 µm ( $\bar{x}$  = 180 × 36 µm, n = 20), 8-spored, bitunicate, arising from base, oblong to clavate, with a short pedicel, apex thickened, with refractive ring around cytoplasmic protrusion. *Ascospores* 60–73 × 12–13 µm ( $\bar{x}$  = 66 × 12.5 µm, n = 30), crowded to biseriate, fusiform when young, oblong at maturity, hyaline to light yellow, 1–3-septate, with prominent central septum, wall greatly thickened towards the apex, wall smooth. Sheath absent. Asexual morph: Undetermined.

Culture characteristics – Ascospores germinating on MEA within 24 hours. Colonies on MEA, white, circular, smooth margin, slow growing, attaining 1 cm diameter within 30 days at 18° C, tightly arranged, short, aerial mycelium. Orange brownish exudates was released to the media when mycelium growing. The mycelial mats were produced erumpent, globose, thick, less stromatic, light brownish viscous droplets and later become lighter in the colour of the superficial hyphae with copious dark brown.

Material examined – THAILAND, Chiang Rai Province, Doi Mae Salong, on dead branch, 27 April 2015, Subashini C. Jayasiri, C 051 (MFLU 16–0954, holotype; HKAS96310, isotype); ex-type living culture, MFLUCC 16–0338, BCC

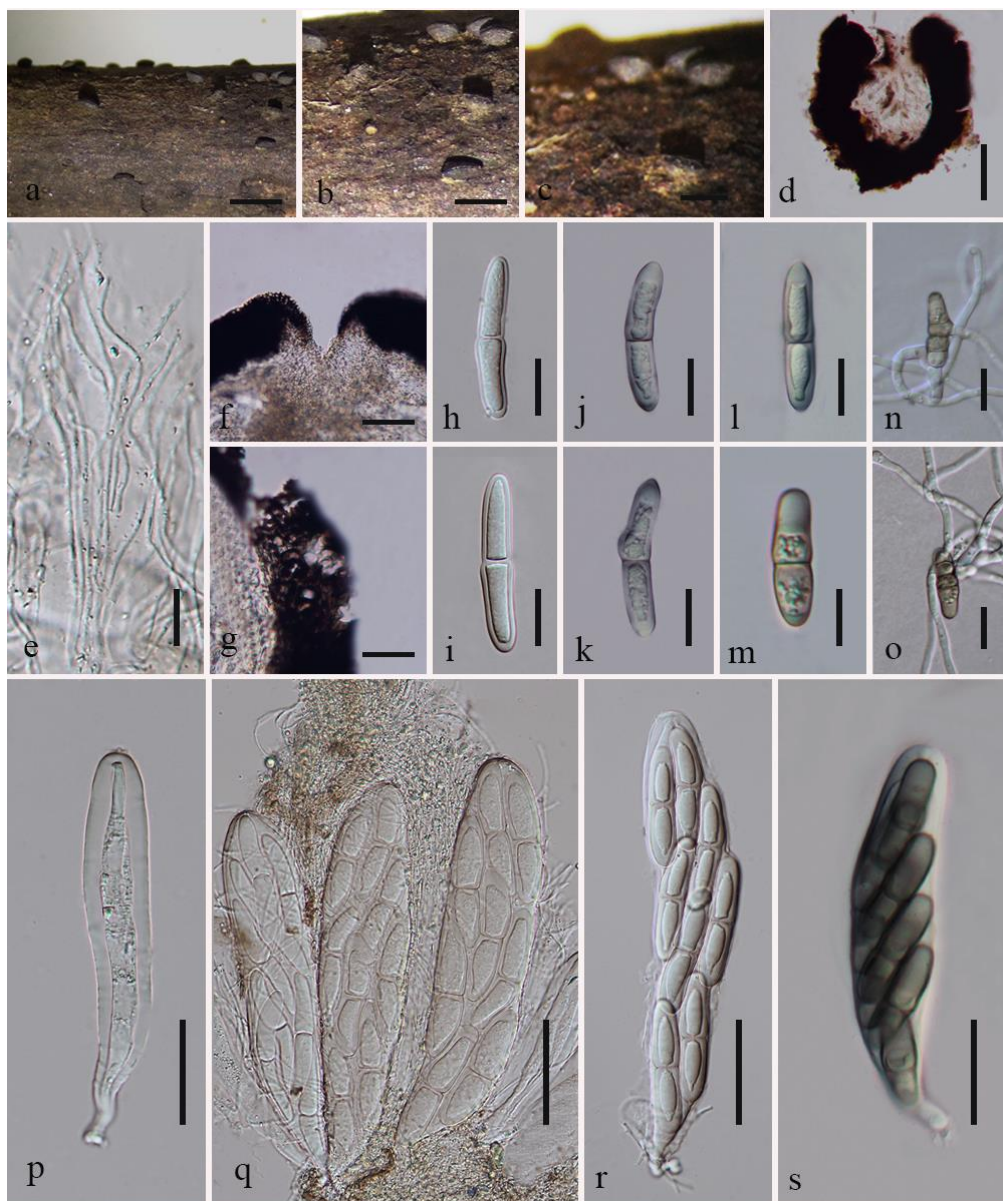
Notes – *Hysterium doimaensis* resembles *Hy. Curtisii* and *Hy. centramurum* in having hysterothecia, appearing as black, scattered, superficial, carbonaceous ascomata and bitunicate asci, but *Hy. curtisii* differs from *Hy. doimaensis* in having both vertical and transverse septate



ascospores (Boehm et al. 2009b). *Hysterium doimaeensis* differs from *Hy. centramurum* in having smaller ascospores. Phylogenetical data also confirm that they are distinct (97% MLBS/1.00 BPP). We have accounted base pair differences of LSU gene sequences between *Hysterium centramurum*, *Hy. curtisii*, *Hy. doimaeensis* and *H. thailandica*. *Hysterium doimaeensis* have 33, 30 and 35 base pair differences with *Hy. centramurum*, *Hy. curtisii* and *H. thailandica* respectively.

**Key to four species of *Hysterium***

1. Ascospore size more than 100  $\mu\text{m}$  ..... *Hysterium centramurum*
1. Ascospore size less than 100  $\mu\text{m}$  ..... 2
2. Ascospore size equal or less than 60  $\mu\text{m}$  ..... *Hysterium thailandica*
2. Ascospore size more than 60  $\mu\text{m}$  ..... 3
3. 1-septate, under different stains appears subdivided into numerous compartments ..... *Hysterium curtisii*
4. 1-3 septate, germinated spores appear 3-septate ..... *Hysterium doimaeensis*



**Figure 7** – *Hysterium doimaeensis* (holotype). a–c Hysterothecia on host surface. d Hand section of hysterothecium. e Hamathecium. f Ostiole through the longitudinal slit. g Peridium. h–m Ascospores. n, o Germinated spores. p Immature ascus. q–s Asci with ascospores. Scale bars: a = 1 cm, b, c = 500  $\mu\text{m}$ , d = 150  $\mu\text{m}$ , e = 10  $\mu\text{m}$ , f, g = 100  $\mu\text{m}$ , h–o = 20  $\mu\text{m}$ , p–s = 50  $\mu\text{m}$ .

*Hysterium thailandica* Jayasiri & K.D. Hyde, sp. nov.

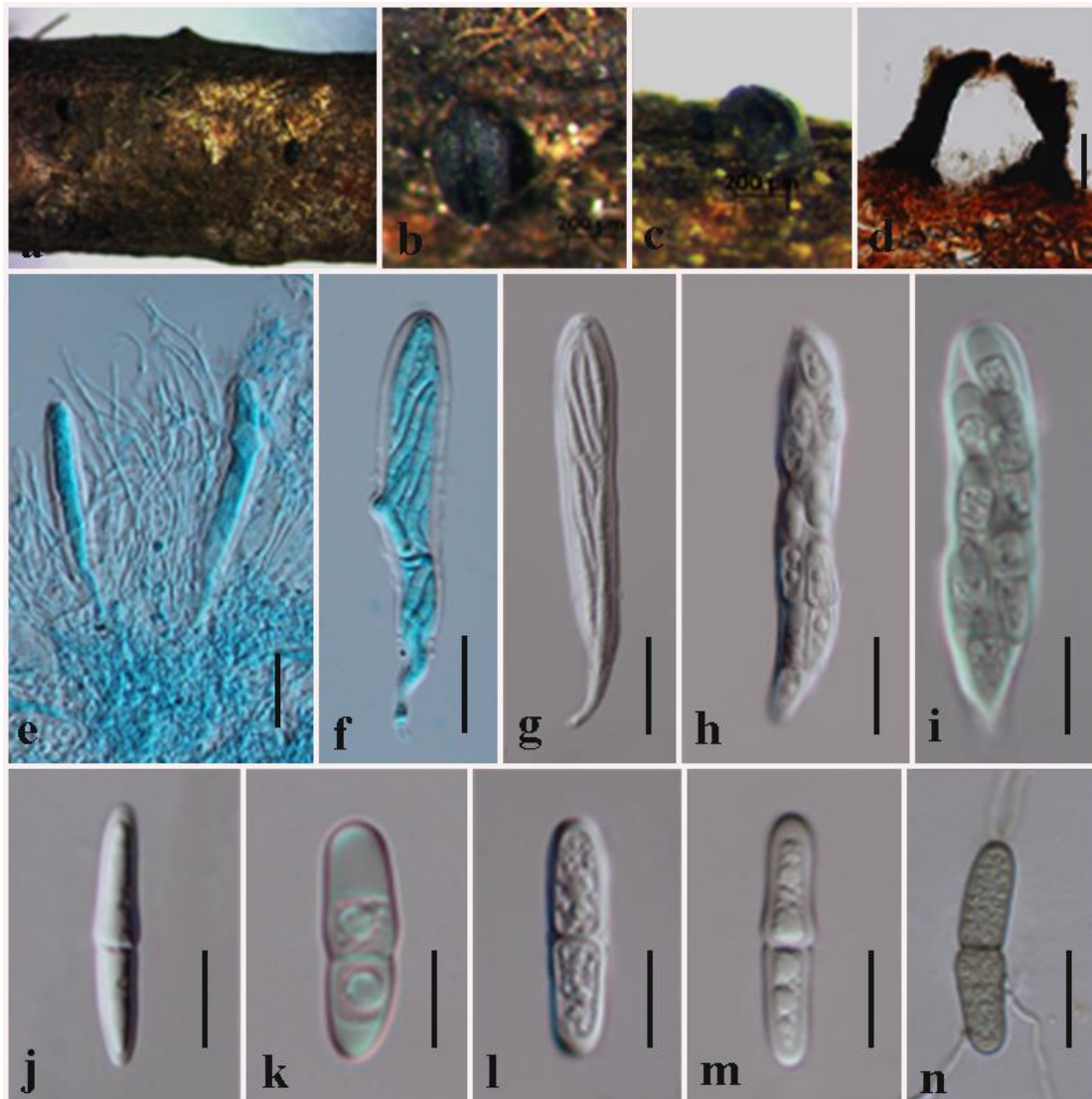
Fig. 8

Index Fungorum number: IF554455; Facesoffungi number: FoF04580

Holotype: MFLU 16–2986

Etymology: In reference where the specimen was collected.

*Saprobic* on dead branches of an unknown plant. Sexual morph: *Hysterothecia* 203–350  $\mu\text{m}$  high, 190–310  $\mu\text{m}$  diam., 500–600  $\mu\text{m}$  long ( $\bar{x}$  = 260  $\times$  240  $\times$  600  $\mu\text{m}$ ,  $n$  = 10), elongate and depressed conchate, solitary, scattered, superficial, base immersed in substrate, black, shiny, longitudinally striate, apex compressed, opening by longitudinal slit. *Peridium* 22–60  $\mu\text{m}$  wide ( $\bar{x}$  = 45  $\mu\text{m}$ ,  $n$  = 10), carbonaceous, brittle, thick-walled, heavily pigmented, of small, prosenchymatous cells. *Hamathecium* 1–1.5  $\mu\text{m}$  wide, dense, filamentous, trabeculate, cellular pseudoparaphyses, aseptate, embedded in a hyaline gelatinous matrix. *Asci* 155–210  $\times$  19–34  $\mu\text{m}$  ( $\bar{x}$  = 180  $\times$  27  $\mu\text{m}$ ,  $n$  = 20), 8-spored, bitunicate, oblong to clavate, with a short pedicel, apically thickened, with a distinct ocular chamber. *Ascospores* 40–60  $\times$  8–12  $\mu\text{m}$  ( $\bar{x}$  = 52  $\times$  10  $\mu\text{m}$ ,  $n$  = 30), overlapping bi-seriate to parallel, ellipsoidal to fusiform with rounded ends, hyaline to light yellow, 1-septate when young, becoming multiseptate, deeply constricted at the central septum, nearly symmetrical, smooth-walled, guttulate. Asexual morph: Undetermined.



**Figure 8** – *Hysterium thailandica* (holotype). a Hysterothecia on host surface. b, c View of hysterothecium on the host surface. d Section through the longitudinal slit. e Immature asci and pseudoparaphyses stain with Lactophenol cotton blue. f, g Immature asci. h, i Asci. j–m Ascospores. n Germinated ascospore. Scale bars: d = 100  $\mu\text{m}$ , e–i = 50, j–n = 20  $\mu\text{m}$ .

Culture characteristics – Ascospores germinating on malt extract agar (MEA) within 24 hours and germ tubes produced from ascospore (Fig. 7). Colonies growing slowly on MEA, reaching 4 mm in 1 weeks at 18°C, brown to dark brown. Mycelium superficial and partially immersed, branched, septate, hyaline to pale brown, smooth.

Material examined – THAILAND, Chiang Mai Province, dead stem of unknown plant, 22 July 2015, Subashini C. Jayasiri, C 073 (MFLU 16-2986, holotype; HKAS96311, isotype); ex-type living culture, MFLUCC 16–0338, BCC

Notes – *Hysterium thailandica* fits with the generic concept of the genus, *Hysterium* in having pigmented versicolorous or concolorous asymmetric phragmospores, three- or more transversely-septate, borne in hysterothecia (Boehm et al. 2009b). This species is phylogenetically and morphologically close to *Hy. centramurum*, *Hy. curtisii* and *Hy. doimaeensis*. A comparison of the morphological features of these four species is presented in the key. *Hysterium thailandica* groups in a sister clade to *Hy. centramurum* with 75 % MLBS statistical support. *Hy. centramurum* and *H. thailandica* are different from, *H. thailandica* in having short and narrow ascospores ( $52 \times 10 \mu\text{m}$  vs.  $125 \times 23 \mu\text{m}$ ) (Tibpromma et al. 2017). We have considered base pair differences of LSU gene sequences between *Hysterium centramurum*, *Hy. curtisii*, *Hy. doimaeensis* and *H. thailandica*. *Hysterium thailandica* have 8, 11 and 35 base pair differences with *Hy. centramurum*, *Hy. curtisii* and *Hy. doimaeensis* respectively.

***Hysterobrevium hakeae*** Jayasiri, E.B.G. Jones & K.D. Hyde, sp. nov.

Fig. 9

Index Fungorum number: IF554453; Facesoffungi number: FoF04577

Etymology: With reference to host genus “Hakea”

Holotype: MFLU 16–2987

*Saprobic* on exocarp of *Hakea actites* (Proteaceae) fruits. Sexual morph: *Hysterothecia* 234–345  $\mu\text{m}$  high  $\times$  285–392  $\mu\text{m}$  diam.  $\times$  800–1000  $\mu\text{m}$  long ( $\bar{x} = 296 \times 337 \times 900 \mu\text{m}$ ,  $n = 10$ ), elongate, superficial, gregarious, longitudinally striate, opening by a longitudinal slit. *Periphyses* along the slit, v-shaped, with brown cells. *Peridium* 27–67  $\mu\text{m}$  wide ( $\bar{x} = 49 \mu\text{m}$ ), carbonaceous, brittle, heavily pigmented. *Hamathecium* 1–1.5  $\mu\text{m}$  wide, trabeculate, hyaline, septate, branched, longer than asci. *Asci* (48–) 65–105  $\times$  10–14  $\mu\text{m}$  ( $\bar{x} = 84.5 \times 12 \mu\text{m}$ ,  $n = 20$ ), 8-spored, bitunicate, oblong to clavate, with a short pedicel, apically thickened. *Ascospores* 18–22  $\mu\text{m} \times$  (5.4–)8.5–11.5  $\mu\text{m}$  ( $\bar{x} = 20 \times 10 \mu\text{m}$ ,  $n = 20$ ), uniseriate to biseriate, oblong, with prominent median septate, hyaline, thick-walled, wall smooth, sheath absent. Asexual morph: Undetermined.

Material examined – AUSTRALIA, Melbourne, Mornington Peninsula, on *Hakea actites* fruits (Proteaceae), 10 March 2015, E.B.G. Jones, GJ 106 (MFLU 16-2987, holotype); (isotype in PDD)

Notes – *Hysterobrevium* comprises three species with morphological and molecular data: *Hysterobrevium constrictum* (N. Amano) E.W.A. Boehm & C.L. Schoch, *H. mori* (Schwein.) E. Boehm & C.L. Schoch and *H. smilacis* (Schwein.) E. Boehm & C.L. Schoch. *Hysterobrevium hakeae* fits the generic concept of *Hysterobrevium* in having navicular hysterothecia with a prominent longitudinal slit, bitunicate, cylindrical to clavate asci, ovoid to obovoid hyaline dictyospores with either obtuse or acuminate ends and ascospores constricted at the median septum. In the multigene phylogenetic analyses *Hy. hakeae* groups with *H. constrictum* (SMH 5211.1) with high statistical support (94% MLBS/1.00 BPP). *Hysterobrevium hakeae* shares similar characters of the genus *Hysterobrevium*, but differs from *H. constrictum* in having ascospores with a sheath and longitudinal septa of *H. constrictum* (Boehm et al. 2009b).

***Hysterobrevium rosae*** Jayasiri, Camporesi & K.D. Hyde, sp. nov.

Figs 10, 11

Index Fungorum number: IF554454; Facesoffungi number: FoF04578

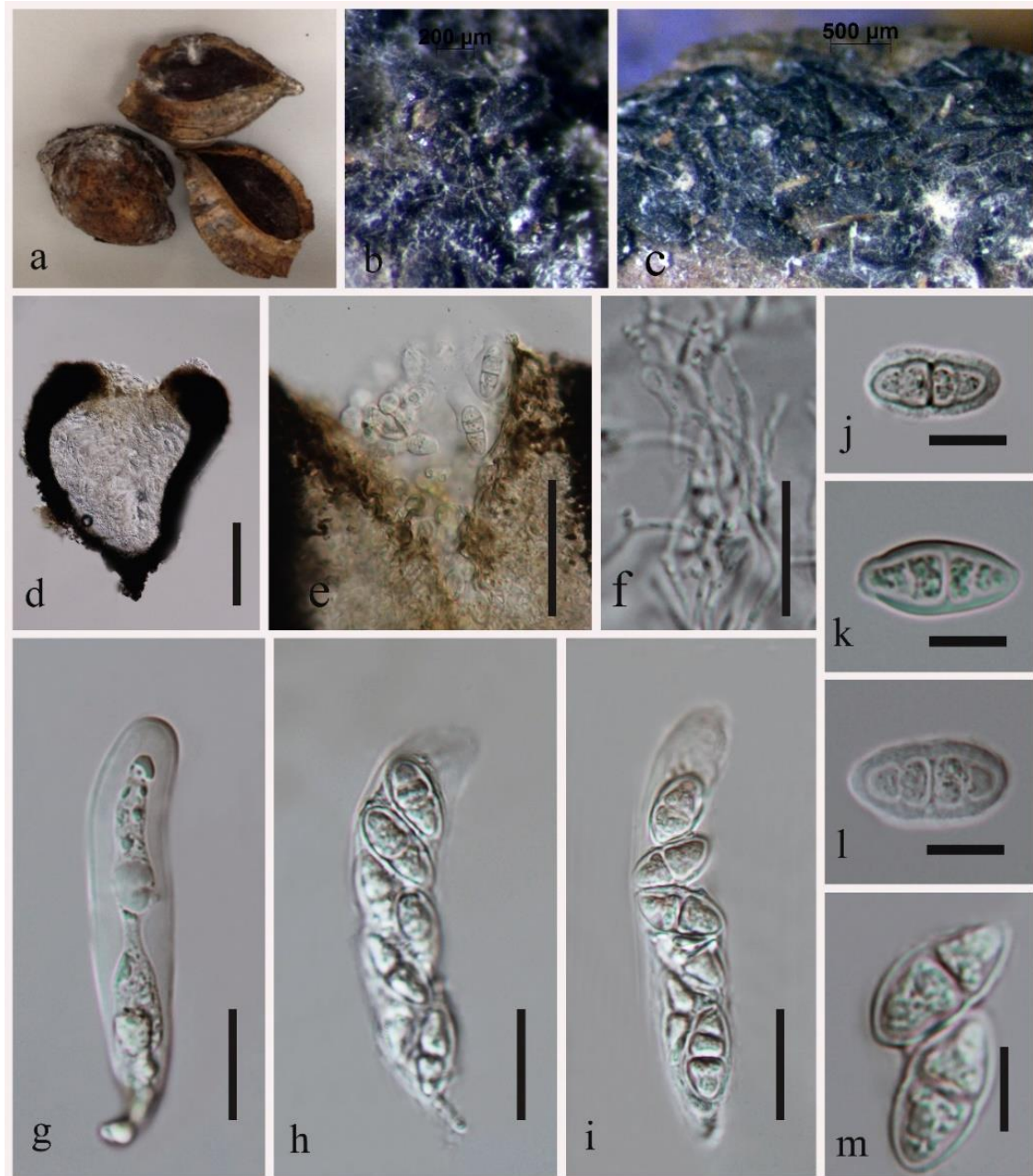
Holotype: MFLU 16–2989

Etymology: Referring to the host genus *Rosa*.

*Saprobic* on *Rosa canina* (Rosaceae). Sexual morph: *Hysterothecia* 180–240  $\mu\text{m}$  high, 150–200  $\mu\text{m}$  diam., 500–1500  $\mu\text{m}$  long ( $\bar{x} = 210 \times 175 \times 1200 \mu\text{m}$ ,  $n = 10$ ), erumpent, ellipsoidal,



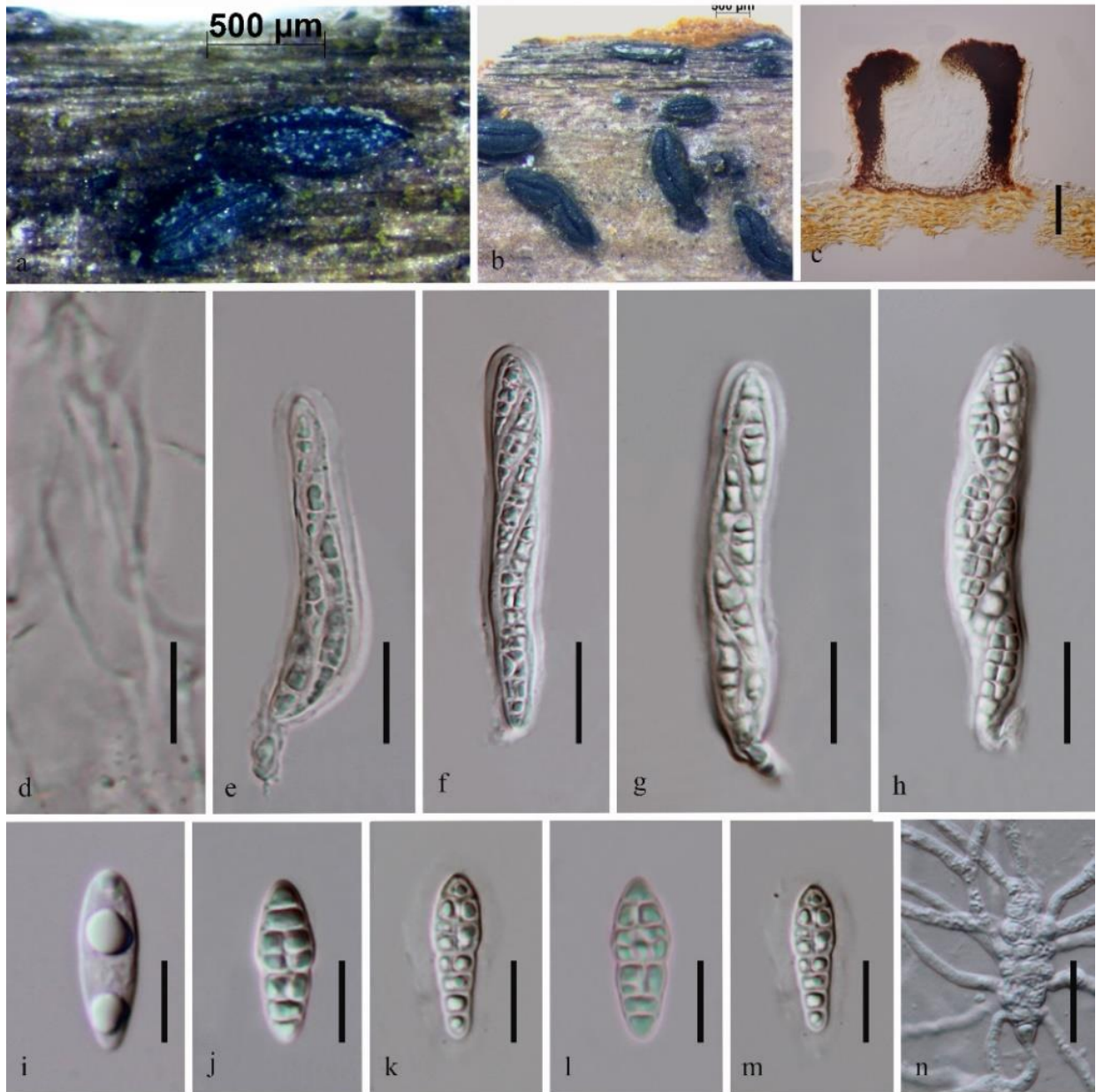
oblong, linear or cylindrical, base consisting of epidermis or periderm cells, longitudinally striate, navicular with tapering ends. *Peridium* 30–60  $\mu\text{m}$  wide ( $\bar{x}$  = 47 $\mu\text{m}$ ), carbonaceous and brittle when dry, narrower at base within the substrate, widest at the mid-point. *Hamathecium* 0.5–1  $\mu\text{m}$  wide, cellular, septate, persistent, hyaline, apically thickened, branched and forming an epithecium in a gelatinous matrix above the ascial layer. *Asci* 70–83  $\times$  12–15  $\mu\text{m}$  ( $\bar{x}$  = 78  $\times$  13  $\mu\text{m}$ , n = 20), 8-spored, bitunicate, cylindrical to clavate, short-stipitate. *Ascospores* 18–22  $\times$  5–8  $\mu\text{m}$  ( $\bar{x}$  = 20  $\times$  6  $\mu\text{m}$ , n = 20), uniseriate to biseriata, hyaline, dictyosporous, asymmetric, with acuminate ends, with 6–7 vertical and 2–4 longitudinal septa, constricted at central septum, gelatinous sheath appears when mature. Asexual morph: *Conidiomata* as irregular locules, brown to pale brown, solitary, *Conidiogenous cells* 5–8  $\times$  1.5–2  $\mu\text{m}$ , enteroblastic, phialidic, globose to flask-shaped, hyaline, thin-walled. *Conidia* 2.5–4  $\times$  1–2  $\mu\text{m}$ , fusiform with slightly curved apex and refractive base.



**Figure 9** – *Hysterobrevium hakeae* (holotype). a Host fruits. b, c Hysterothecia on exocarp of seed. d Section through hysterothecia. e Section through the slit. f Hamathecium. f–h Immature and mature asci. i–l Ascospores. Scale bars: d = 100  $\mu\text{m}$ , e = 50  $\mu\text{m}$ , f = 10  $\mu\text{m}$ , g–i = 30 $\mu\text{m}$ , i–l = 10 $\mu\text{m}$ .

Culture characteristics – Colonies on MEA attaining 20–30 mm diam. after 7 d at 25 °C, with irregular pale brown edge, with dense aerial mycelium on the surface with brown, reverse similar in colour.

Material examined – ITALY, Forlì-Cesena Province [FC]), near Pieve Salutare – Castrocaro Terme, on a dead aerial branch of *Rosa canina* (Rosaceae), 15 June 2014, Erio Camporesi, IT 86-B (MFLU 16–2989, holotype; HKAS96318, isotype); ex-type living cultures MFUCC 14–0551(type), 14–0552, BCC.

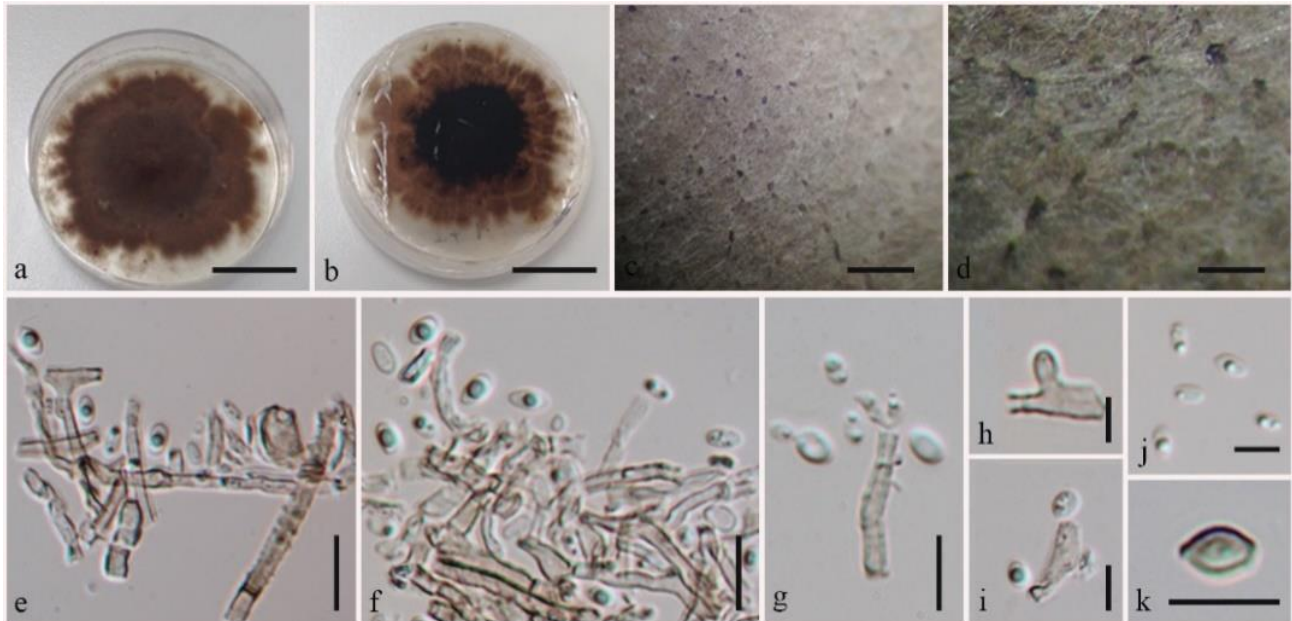


**Figure 10** – *Hysterobrevium rosae* (holotype). a–b Hysterothecia on host. c Vertical section through hysterothecium. d Pseudoparaphyses. e–h Asci with 8-spores. i–m Ascospores. n Germinated ascospore. Scale bars: c=50 µm, d, f, g, i–n = 20 µm, e = 10 µm.

Notes – *Hysterobrevium rosae* fits the generic concept of *Hysterobrevium* in having navicular, erumpent and partially embedded hysterothecia, longitudinally striate on the surface of ascomata and a prominent longitudinal slit, cylindrical to clavate asci, ovoid to obovoid, pigmented or hyaline dictyospores surrounded by a gelatinous sheath, with either obtuse or acuminate ends, with 3–4(–6) transverse septa, and 1–2 longitudinal septa. *Hysterobrevium rosae* groups in a sister



clade to *Hy. mori*, although there are morphological differences with *Hy. rosae* having relatively smaller hysterothecia (0.5–1.5 mm, 150–200  $\mu\text{m}$ , 180–240  $\mu\text{m}$  vs. 1–2(–3.5) mm, 220–275(–440)  $\mu\text{m}$ , 190–330  $\mu\text{m}$ ), shorter asci (70–83  $\times$  12–15  $\mu\text{m}$  vs. 80–110  $\times$  10–18  $\mu\text{m}$ ) and hyaline ascospores. Therefore, in this study we introduce *Hysterobrevium rosae* as a new species from a dead branch of *Rosa canina*. Wanasinghe et al. (2018) have introduced a high diversity of microfungi from the genus *Rosa* and this is another species found on this host genus.



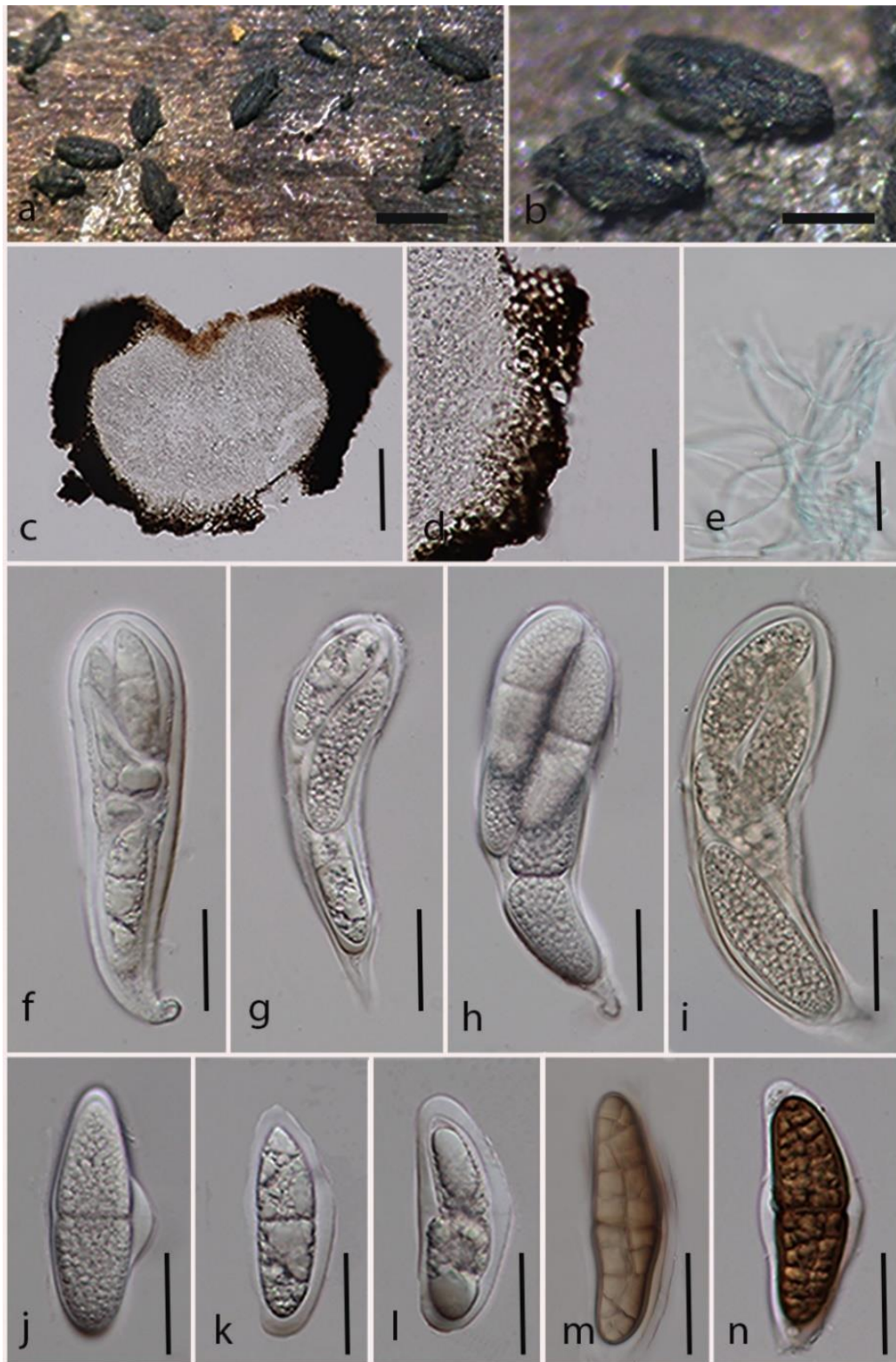
**Figure 11** – *Hysterobrevium rosae* asexual morph in culture. a, b Culture reverse and forward view c, d Asexual structures in culture. e–i Conidia with conidiophores. j, k Conidia. Scale bars: a, b = 2 cm, c = 500  $\mu\text{m}$ , d = 200  $\mu\text{m}$ , e–g = 10  $\mu\text{m}$ , h–k = 5  $\mu\text{m}$ .

*Psiloglonium macrosporum* Thambugala, Senan. & K.D. Hyde, in Fungal Diversity 78: 26 (2016) Fig. 12

*Saprobic* on decaying wood. Sexual morph: *Hysterothecia* 400–495  $\mu\text{m}$  high, 450–480  $\mu\text{m}$  wide, 570–1300  $\mu\text{m}$  long ( $\bar{x}$  = 470  $\times$  460  $\times$  921  $\mu\text{m}$ , n = 10), elongate, depressed conchate, scattered, superficial, base immersed in substrate, surface black, shiny, longitudinally striate, apex compressed, opening by a longitudinal slit. *Periphyses* along the slit, v-shaped, with brown cells. *Peridium* 50–80  $\mu\text{m}$  ( $\bar{x}$  = 68, n = 15) carbonaceous, brittle, of heavily pigmented, small, prosenchymatous cells. *Hamathecium* comprising 0.5–1  $\mu\text{m}$  wide, trabeculate, hyaline, aseptate, branched, pseudoparaphyses, borne in a gel matrix. *Asci* 110–145  $\times$  28–35  $\mu\text{m}$  ( $\bar{x}$  = 130  $\times$  32  $\mu\text{m}$ , n = 15), 4-spored, bitunicate, oblong to clavate, with a very short pedicel or apedicellate, apically thickened, with a distinct ocular chamber. *Ascospores* 50–100  $\times$  17–24  $\mu\text{m}$  ( $\bar{x}$  = 78  $\times$  22  $\mu\text{m}$ , n = 25), crowded to biseriate, fusiform when young, oblong at maturity, hyaline when young and becoming brown at maturity, when young with 1 transverse septum, having 7 transverse and 6–7 longitudinal septa to multiseptate at maturity, deeply constricted at the central septum, smooth-walled, ornamented, surrounded by a mucilaginous sheath. Asexual morph: Undetermined.

Material examined – THAILAND, Chiang Mai Province, Mushroom Research Centre, on dead branch, July 2015, Subashini C. Jayasiri, C 083 (MFLU 16-0955; HKAS96312)

Notes – *Psiloglonium macrosporum* was introduced by Li et al. (2016) on a dead twig, from Thailand. Our collection from the same locality fits with the original description of *P. macrosporum* (Li et al. 2016), but we observed 4-spored asci in both the original collection and in this study. Therefore, the species description is emended to include 4-spored asci. The multigene phylogenetic analysis shows 100% similarity between the original isolate and our isolate.



**Figure 12** – *Psiloglonium macrosporum*. a, b View of hysterothecia on host surface. c Section through the hysterothecium. d Peridium e Pseudoparaphyses. f–i Asci. j–n Ascospores. Scale bars: c, d, f–i = 50  $\mu$ m, e = 10  $\mu$ m, j–n = 30  $\mu$ m.

*Hysteroglyphium fraxi* (Pers.) De Not. 1847

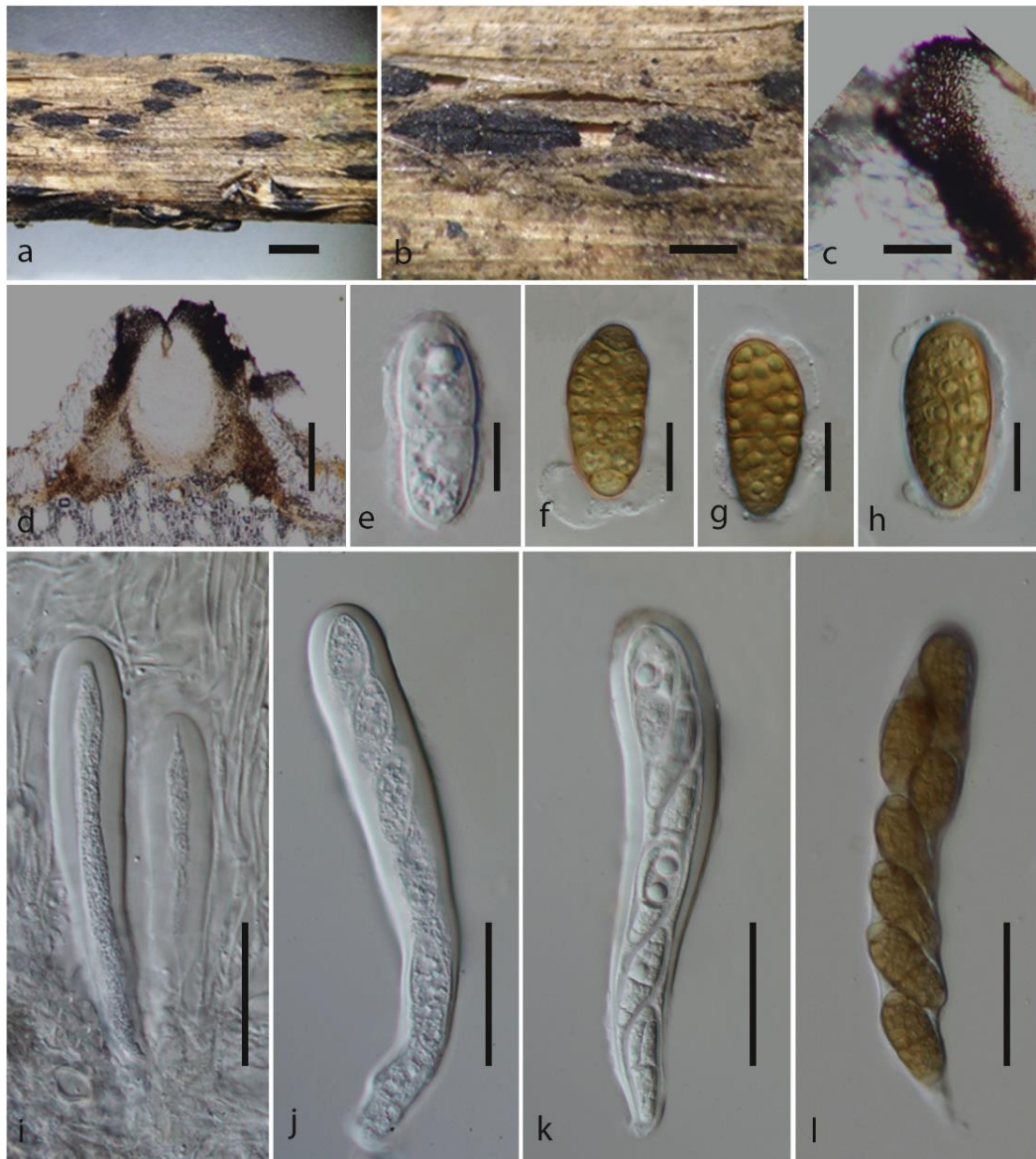
Fig. 13

Facesoffungi number: FoF04583

*Saprobic* on dead branch. Sexual morph: *Hysterothecia* 430–500  $\mu$ m high, 390–490  $\mu$ m diam., 700–1200  $\mu$ m long ( $\bar{x}$  = 480  $\times$  450  $\times$  900  $\mu$ m, n=10), navicular, flexuous, erumpent from



host tissue, scattered, with a prominent longitudinal slit. *Peridium* 80–110  $\mu\text{m}$  wide ( $\bar{x}$  = 90  $\mu\text{m}$ ), carbonaceous near the slit, narrower at base within the substrate, thickening not equal, base brown,



**Figure 13** – *Hysterographium fraxi*. a, b Hysterothecia on host surface. c Peridium. d Hand section of hysterothecia. e–h Ascospores i Immature asci with pseudoparaphyses. j–l Asci with ascospores. Scale bars: a = 1 mm, b = 500  $\mu\text{m}$ , c = 100  $\mu\text{m}$ , d = 300  $\mu\text{m}$ , e = 10  $\mu\text{m}$ , f–h = 20  $\mu\text{m}$ , i–j = 50  $\mu\text{m}$ .

composed with cells of *textura angularis*. *Hamathecium* 1–1.5  $\mu\text{m}$  wide, persistent, septate, massed, branched above the asci. *Asci* 120–130  $\times$  18–22  $\mu\text{m}$ , ( $\bar{x}$  = 125  $\times$  20  $\mu\text{m}$ , n = 30), 8-spored, bitunicate, cylindrical to clavate, with short, narrow pedicel. *Ascospores* 30–38  $\times$  12–15  $\mu\text{m}$  ( $\bar{x}$  = 35  $\times$  14  $\mu\text{m}$ , n = 30), uni-seriate to biseriate, asymmetric, hyaline to pale brown, muriform, septation highly variable, one prominent constricted longitudinal septa in the middle, guttulate, mucilaginous sheath present in both mature and immature spores. Asexual morph: Undetermined.

Material examined – RUSSIA, Rostov region, Rostov-on-Don City, Botanical Garden of Southern Federal University, secondary forest (47.2315173 N; 39.6600866 E), on dead branch of *Fraxinus excelsior* (Oleaceae), 15 April 2015, TS Bulgakov, T-198 (MFLU 15–1902; HKAS96321); Krasnodar region, Sochi City, Central city district, Sochi Dendrarium, collection of

plants (43.5707N; 39.7438), 8 October 2014, dying leaves and twigs of *Catalpa bignonioides* (Bignoniaceae) TS Bulgakov, T-893 (MFLU 15–3035; HKAS96322); Rostov region, Krasnosulinsky District, Donskoye forestry, Kabanya Balka (Boar gully), ravine forest (47° 85' 99" N; 40° 25' 24" E), 27 October 2015, dying and dead twigs of *Fraxinus excelsior* (Oleaceae), TS Bulgakov, T-1019 (MFLU 15–3681; HKAS96323)

Known distribution – Switzerland (Zogg, 1943) and from Canada (Lohman 1934).

Notes – *Hysterographium* is characterized by ovoid to ellipsoid-fusoid, relatively broad, pigmented dictyospores, with one to several longitudinal septa, usually constricted at the first-formed septum (Boehm et al. 2009a). Our isolate fits with the morphological description of *Hy. fraxi*. In multigene phylogenetic analyses our strains (MFLU 15-1902, MFLU 15-3035 and MFLU 15-3681) clade to *Hy. fraxi* (CBS 109.43 and CBS 242.34) with high statistical support (Fig. 1: 99% MLBS, 1.00 BPP). *Hysterographium* was belonged to Pleosporomycetidae genera *incertae sedis* (Goh et al. 1998, Boehm et al. 2009a), however in this study also we placed it as previous because this genus still have a species and less support in the multigene phylogeny.

**Mytilinidiales** E.W.A. Boehm, C.L. Schoch & Spatafora, Mycol. Res. 113 (4): 468 (2009)

Notes – The genera *Mytilinidion*, *Lophium* and *Quasiconcha* formed a monophyletic clade, representing the order Mytilinidiales (Boehm et al. 2009b). The conchate nature of the *hysterothecia* and the thin-walled peridium are characteristic features of this group. (Boehm et al. 2009a, b, Hyde et al. 2013). Boonmee et al. (2012) introduced a new genus *Halokirschsteiniothelia* based on multigene phylogenetic analysis. Although characters of *Halokirschsteiniothelia* are unusual for this group and placement was tentative (Boonmee et al. 2012). In our multigene phylogenetic analysis also confirmed the placement of monotypic order Mytilinidiales within the class Dothideomycetes.

***Mytilinidion didymospora*** Jayasiri, Camporesi & K.D. Hyde, sp. nov.

Fig. 14

Index Fungorum number: IF554457; Facesoffungi number: FoF04584

Etymology: The epithet “*didymospora*” refers to the ascospores having two cells.

Holotype: MFLU 15–3252

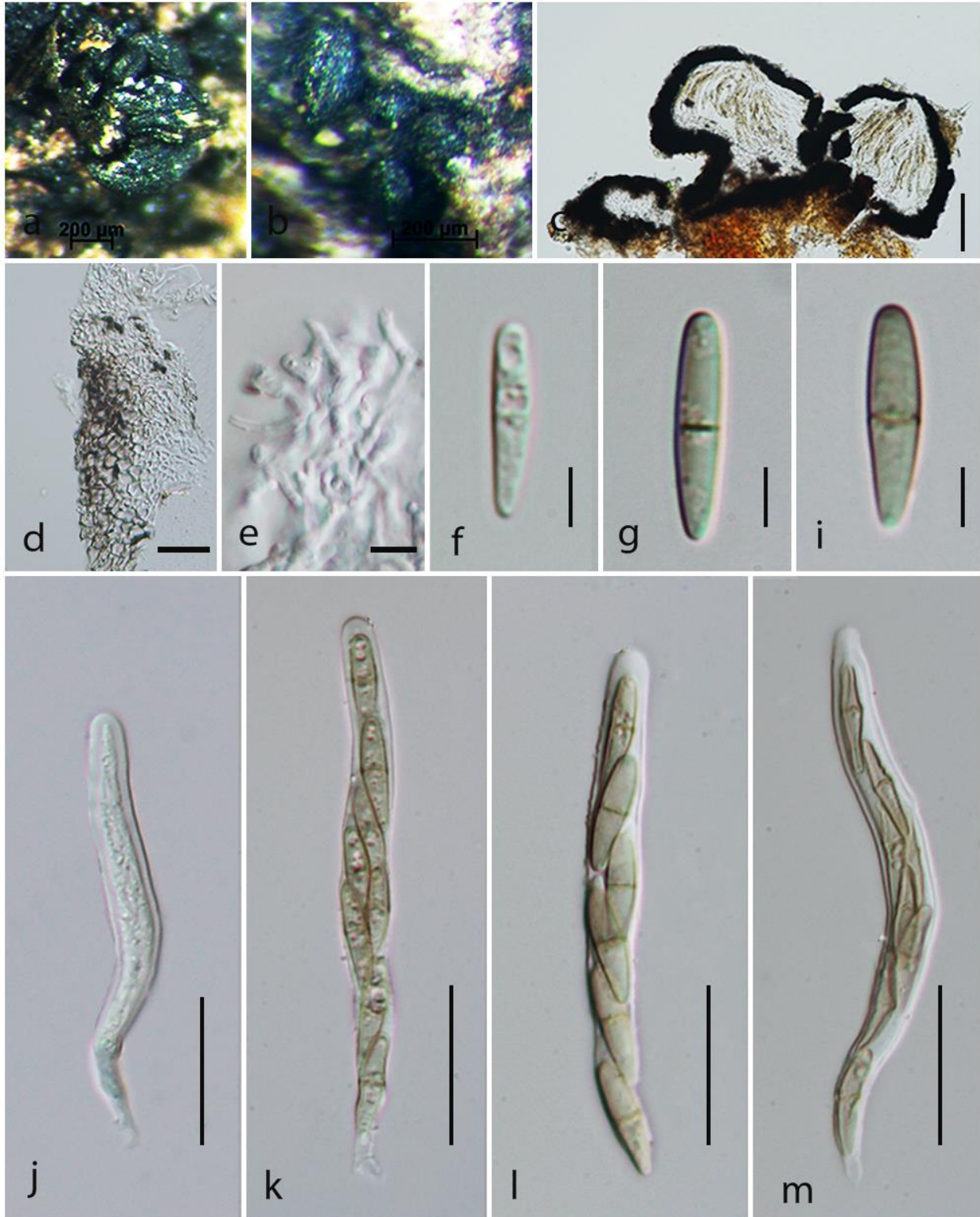
*Saprobic* on dead cones of *Cupressus glabra* (Cupressaceae). Sexual morph: *Hysterothecia* 500–800 µm long × 101–135 µm wide × 110–149 µm high ( $\bar{x}$  = 700 × 122 × 129 µm, n = 10), navicular, flexuous, superficial on host tissue, scattered or appear as a group, with a longitudinal slit, surface black and shiny. *Peridium* 12–19 µm wide ( $\bar{x}$  = 14 µm), carbonaceous, narrow, thickening equally, composed of cells of *textura angularis*. *Hamathecium* 1–1.5 µm wide, persistent, septate, hyaline, branched, shorter than the asci. *Asci* 71–94 × 4–6 µm ( $\bar{x}$  = 84 × 5 µm, n = 20), 8-spored, bitunicate, cylindrical to clavate, with short, narrow pedicel. *Ascospores* 14–18 × 2–4 µm ( $\bar{x}$  = 15 × 3 µm, n = 20), uni-seriate to biseriate, asymmetric, cylindrical, one end tapering and another end rounded, hyaline to pale brown, 1-septate, not constricted at the septa, guttules present, mucilaginous sheath absent, smooth-walled. Asexual morph: Undetermined.

Culture characteristics – Colonies on MEA attaining 12–15 mm diam. after 7 days at 25 °C, with irregular pale brown edge, brown, with dense aerial mycelium on the surface with brown, reverse similar.

Material examined – ITALY, Forlì-Cesena [FC] Province, Montebello – Modigliana, on dead land cones of *Cupressus glabra* (Cupressaceae), 6 October 2015, Erio Camporesi, IT 2629 (MFLU 15–3252, holotype; HKAS96319, isotype), ex-type living cultures MFUCC16-0619, BCC.

Notes – *Mytilinidion didymospora* is similar to other *Mytilinidion* species in having fragile yet persistent carbonaceous, bivalve shell-shaped ascomata, thin-walled, scleroparenchymatous peridium enclosing a hamathecium of narrow trabeculate pseudoparaphyses, borne in a gel matrix and transversely septate phragmospores. *Mytilinidion didymospora* groups with *M. mytilinellum* (EB 386) with 98% MLBS/1.00 BPP statistical support. *Mytilinidion mytilinellum* has (2–)3(–5)-septate, yellow ascospores, while *My. didymospora* has 1-septate, pale brown ascospores. In addition, *My. mytilinellum* is characterized by a longitudinal cristate-like apex and base edge

attached with the substrate, whereas *My. didymospora* has a slightly connivent apical portion and base spread on the substrate. Therefore, *My. didymospora* is distinct from *M. mytilinellum* based on morphology and phylogeny. All recorded *Mytilinidion* species are from Pinaceae, Cupressaceae, and Taxodiaceae plant families (Lohman 1932, Zogg 1962, Speer 1986, Barr 1990a) and interestingly our isolate is also from the family Cupressaceae.



**Figure 14** – *Mytilinidion didymospora* (holotype). a, b View of hysterothecia on host surface. c Section through hysterothecium. d Peridium. e Pseudoparaphyses. f–i Ascospores. j–m Asci. Scale bars: c = 50  $\mu\text{m}$ , d = 20  $\mu\text{m}$ , e = 10  $\mu\text{m}$ , f–i = 5  $\mu\text{m}$ , j–m = 30  $\mu\text{m}$ .



## Discussion

In this study on hysteriform Dothideomycetes, we introduce six new species based on morphological and phylogenetic data. *Hysterobrevium hakeae*, *Hysterobrevium rosae*, *Hysterium doirmaeensis*, *Hysterium thailandica*, *Mytilinidion didymospora* and *Purpurepithecium* are illustrated and discussed. In addition, we propose *Hysterium curtisii* (Basionym) as the current name for *Ostreichnion curtisii*. The genus *Ostreichnion* comprised *O. curtisii* (CBS 198.34) and *O. sassafras* (CBS 322.34) introduced by Lohman (1934). *Ostreichnion nova-caesariense* is quite similar to *O. sassafras*, but no molecular data are available for comparison. However, the phylogenetic analysis shows that *O. curtisii* is distinct from the generic type, *O. sassafras*. These three species are morphologically similar, having mytilinidioid ascomata within *Hysteriaceae*, but differ with *O. sassafras* having ascospores with up to 27 septa, and four spored asci. Therefore, the family *Hysteriaceae* must also encompass some mytilinidioid forms (Boehm et al. 2009b) as observed in the genera *Hysterium* and *Ostreichnion*. In addition, new records of *Hysterium angustatum*, *Gloniopsis subrugosa* and *Hysteroglyphium fraxini* are described and illustrated. *Hysterium angustatum* has been recorded from New Zealand, South Africa, North America (Boehm et al. 2009a) and Thailand (Hyde et al. 2016) but is reported here for the first time from Italy. *Gloniopsis subrugosa* has been reported from Argentina (Messuti & Lorenzo 2003), Europe (Zogg 1962), North America (Barr 1990b), South Africa (van der Linde 1992) and from Thailand in this study.

The new family Acrogenosporaceae is introduced and placed in the order Minutisphaerales based on phylogenetic analyses and based on morphological differences with Minutisphaeraceae. *Minutisphaera* is characterized by a slit-like opening in the immature ascomata, which become apothecioid when mature (Raja et al. 2013, 2015), providing morphological support for the close relationship within the order. Acrogenosporaceae is typified by the genus *Acrogenospora*, which is the asexual morph of *Farlowiella* (hysterothecial sexual morph). We used this name, because Rossman et al. (2015) proposed the protection of *Acrogenospora* (1971) over *Farlowiella* (1891). Furthermore, this study supports the synonymy of *Acrogenospora* with *Farlowiella*.

We conducted a phylogenetic analysis of protein data (i.e. amino acid sequences) for whole hysteriform Dothideomycetes. Interestingly, the *RPB2* amino acid sequences resolved the relationships for this group, but additional sequences would be desirable for a more complete understanding. Among the 301 strains included in the nucleic acid phylogeny, *RPB2* gene sequence data were only available for 95 strains. Representing functionally important proteins and being unambiguously alignable across phylogenetically distinct taxa, amino acid sequence data are promising for resolving phylogenetic relationships at higher taxonomic levels.

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**Appendix 1** GenBank accession numbers used in this study. GenBank accessions marked in bold represent new sequences generated in the current study.

| <b>Species name</b>                  | <b>Strain</b>  | <b>LSU</b> | <b>SSU</b> | <b>TEF</b> | <b>RPB2</b> |
|--------------------------------------|----------------|------------|------------|------------|-------------|
| <i>Acanthostigma perpusillum</i>     | UAMH 7237      | AY856892   | AY856937   |            |             |
| <i>Acrocordia subglobosa</i>         | HTL940         | JN887392   | JN887373   |            |             |
| <i>Acrogenospora sphaerocephala</i>  | CBS 164 76     | GU301791   | GU296129   | GU349059   | GU371748    |
| <i>Acrogenospora sphaerocephala</i>  | CBS 206.36     | AY541492   | AY541482   | DQ677931   | DQ677989    |
| <i>Acrogenospora sphaerocephala</i>  | CBS 179 73     |            | GU296148   |            |             |
| <i>Acrogenospora sphaerocephala</i>  | JX-43          | KF836062.1 | KF836061   |            |             |
| <i>Acrogenospora sphaerocephala</i>  | FMR11021       | HF677191.1 |            |            |             |
| <i>Acrogenospora sphaerocephala</i>  | MFLUCC:16-0179 | MH606222   |            |            | MH626448    |
| <i>Acrogenospora thailandica</i>     | MFLUCC 17-2396 | MH606223   | MH606221   |            | MH626449    |
| <i>Acrospermum adeanum</i>           | M133           | EU940104   | EU940256   |            | EU940320    |
| <i>Acrospermum compressum</i>        | M151           | EU940084   | EU940012   |            | EU940301    |
| <i>Acrospermum gramineum</i>         | M152           | EU940085   | EU940013   |            | EU940302    |
| <i>Aglaospora profusa</i>            | CBS 123109     | GU301792   | GU296130   | GU349062   |             |
| <i>Aigialus grandis</i>              | 2Q             | GU301794   | GU296132   | GU349063   |             |
| <i>Aliquandostipite khaoyaiensis</i> | CBS 118232     | GU301796   | NG 016494  |            |             |
| <i>Alternaria alternata</i>          | AFTOL ID 1610  | DQ678082   | DQ678031   | DQ677927   | DQ677980    |
| <i>Amniculicola parva</i>            | CBS 123092     | FJ795497   | GU296134   | GU349065   |             |
| <i>Anisomeridium ubianum</i>         | MPN94          | GU327709   | GU327682   |            |             |
| <i>Anteaglonium abbreviatum</i>      | ANM925a/GKM129 | GQ221877   |            | GQ221915   |             |
| <i>Anteaglonium globosum</i>         | SMH5283        | GQ221911   |            | GQ221919   |             |
| <i>Anteaglonium parvulum</i>         | SMH5210        | GQ221907   |            | GQ221917   |             |
| <i>Arthopyrenia cinchonae</i>        | Lu29583        | JN872351   |            |            |             |
| <i>Arthopyrenia cinchonae</i>        | MPN417         | KM453759   |            |            |             |
| <i>Arthopyrenia salicis</i>          | CBS 368 94     | AY538339   | AY538333   | KF443404   | KF443397    |
| <i>Arthrographis longispora</i>      | UTHSC 05 3220  | HG004540   |            |            |             |
| <i>Asterina phenacis</i>             | TH 589         | GU586217   | GU586211   |            |             |
| <i>Asterina weinmanniae</i>          | TH 592         | GU586218   | GU586212   |            |             |
| <i>Asterodiscus tamaricis</i>        | L114           |            |            | KU234133   | KU234116    |
| <i>Asterotexis cucurbitacearum</i>   | PMA M 0141224  | HQ610510   |            |            |             |
| <i>Asterotexis cucurbitacearum</i>   | VIC 42814      | KP143734   |            |            |             |
| <i>Astrosphaeriella bakeriana</i>    | CBS 115556     | GU301801   |            | GU349015   |             |
| <i>Astrothelium variolosum</i>       | MPN43          | KM453768   |            |            |             |
| <i>Aureobasidium pullulans</i>       | CBS 584 75     | DQ470956   | DQ471004   | DQ471075   | DQ470906    |



**Appendix 1** Continued.

| <b>Species name</b>                            | <b>Strain</b>  | <b>LSU</b> | <b>SSU</b> | <b>TEF</b> | <b>RPB2</b> |
|--|----------------|------------|------------|------------|-------------|
| <i>Bambusaria bambusae</i>                     | MFLUCC 12-0851 | KP687812   |            | KP687982   | KP687890    |
| <i>Bambusaria bambusae</i>                     | CBS 139763     | KP687813   |            | KP687983   | KP687891    |
| <i>Bathelium feei</i>                          | MPN397         | KM453773   |            |            |             |
| <i>Beverwykella pulmonaria</i>                 | CBS 283 53     | GU301804   | KY190005   |            | GU371768    |
| <i>Bimuria novae zelandiae</i>                 | AFTOL-ID 931   | AY016356   | AY016338   | DQ471087   | DQ470917    |
| <i>Boeremia exigua</i> var.<br><i>exigua</i>   | CBS 431 74     | EU754183   | NG 016533  | KY484687   | KT389569    |
| <i>Botryosphaeria dothidea</i>                 | AFTOL ID 946   | DQ678051   |            | DQ767637   | DQ677944    |
| <i>Capnobotryella renispora</i>                | CBS 214 90     | GU214398   | EF137360   |            |             |
| <i>Capnodium coffeae</i>                       | CBS 147 52     | DQ247800   | DQ247808   | DQ471089   | DQ247788    |
| <i>Catenulostroma abietis</i>                  | CBS 459 93     | DQ678092   | DQ678040   | DQ677933   |             |
| <i>Cenococcum geophilum</i>                    | HUNT A1        |            | L76616     |            |             |
| <i>Cenococcum geophilum</i>                    | CGMONT         |            | L76617     |            |             |
| <i>Cenococcum geophilum</i>                    | CG54           |            | JX093574   |            |             |
| <i>Cercospora beticola</i>                     | CBS 116456     | DQ678091   | DQ678039   |            |             |
| <i>Chaetothyriothecium elegans</i>             | CPC 21375      | KF268420   | GU371734   |            |             |
| <i>Cladosporium cladosporioides</i>            | CBS 170 54     | DQ678057   | DQ678004   | DQ677898   | DQ677952    |
| <i>Clavatispora thailandica</i>                | MFLUCC100107   | KF770458   | KF770457   | KF770459   |             |
| <i>Coleroa robertiani</i>                      | CBS 458 64     | JQ036231   |            |            |             |
| <i>Collemopsidium</i> cf.<br><i>foveolatum</i> | RO27           | KU556973   | KU556967   | KU556866   |             |
| <i>Collemopsidium</i> cf.<br><i>ostrearum</i>  | s1473          | KU556976   | KU556971   |            |             |
| <i>Collemopsidium pelvetiae</i>                | RO25           | KU556868   | KU556965   |            | KU556861    |
| <i>Collemopsidium</i> sp.                      | RO28           | KU556974   | KU556968   |            | KU556863    |
| <i>Corynespora cassiicola</i>                  | CBS 100822     | GU301808   | NG 016518  | GU349052   | GU371742    |
| <i>Corynespora smithii</i>                     | CABI 5649b     | GU323201   |            | GU349018   | GU371783    |
| <i>Delitschia didyma</i>                       | UME 31411      | DQ384090   | AF242264   |            |             |
| <i>Delitschia winteri</i>                      | AFTOL ID 1599  | DQ678077   | DQ678026   | DQ677922   | DQ677975    |
| <i>Didymella exigua</i>                        | CBS 183 55     | EU754155   | GU296147   | KR184187   | GU371764    |
| <i>Dissoconium aciculare</i>                   | CBS 204 89     | GU214419   | GU214523   |            |             |
| <i>Dothidea hippophaeos</i>                    | CBS 188.58     | DQ678048   | U42475     | DQ677887   | DQ677942    |
| <i>Dothidea insculpta</i>                      | CBS 189 58     | DQ247802   | DQ247810   | DQ471081   | AF107800    |
| <i>Dothiorella sarmentorum</i>                 | CBS 115038     | DQ377860   | KF766248   |            |             |
| <i>Dyfrlomyces tiomanensis</i>                 | NTOU3636       | KC692156   | KC692155   | KC692157   |             |
| <i>Elsinoe centrolobi</i>                      | CBS 222 50     | DQ678094   | DQ678041   | DQ677934   |             |
| <i>Elsinoe phaseoli</i>                        | CBS 165 31     | DQ678095   | DQ678042   | DQ677935   |             |
| <i>Elsinoe veneta</i>                          | CBS 150.27     | DQ767658   | DQ767651   | DQ767641   |             |
| <i>Entodesmium rude</i>                        | CBS 650 86     | GU301812   |            | GU349012   |             |
| <i>Eremodothis angulata</i>                    | CBS 610 74     | DQ384105   | DQ384067   | GU371821   |             |
| <i>Eremomyces bilateralis</i>                  | CBS 781 70     | HG004545   |            |            |             |
| <i>Extremus antarcticus</i>                    | CCFEE 5312     | KF310020   |            |            | KF310086    |
| <i>Falciformispora lignatilis</i>              | BCC 21118      | GU371827   | GU371835   | GU371820   |             |

Appendix 1 Continued.

| Species name                        | Strain                | LSU             | SSU             | TEF             | RPB2            |
|-------------------------------------|-----------------------|-----------------|-----------------|-----------------|-----------------|
| <i>Flavobathelium epiphyllum</i>    | MPN67                 | GU327717        | JN887382        | JN887423        |                 |
| <i>Floricola striata</i>            | JK 5678I              | GU301813        | GU296149        | GU479852        | GU371758        |
| <i>Fusicladium africanum</i>        | CPC 12828             | EU035423        |                 |                 |                 |
| <i>Gibbera conferta</i>             | CBS 191 53            | GU301814        | GU296150        | GU349041        |                 |
| <i>Gloniopsis arciformis</i>        | GKM L166A             | GU323211        | GU323180        |                 |                 |
| <i>Gloniopsis kenyensis</i>         | GKM1010               | GQ221891        |                 |                 |                 |
| <i>Gloniopsis praelonga</i>         | CBS 112415            | FJ161173        | FJ161134        | FJ161090        | FJ161113        |
| <i>Gloniopsis praelonga</i>         | CMW 19983             | FJ161193        | FJ161152        |                 |                 |
| <i>Gloniopsis praelonga</i>         | CBS 123337            | FJ161195        |                 |                 |                 |
| <i>Gloniopsis praelonga</i>         | CMW 18053             | FJ161191        | FJ161150        |                 |                 |
| <i>Gloniopsis praelonga</i>         | SMH5280               | GQ221912        |                 | GQ221914        |                 |
| <i>Gloniopsis</i> sp.               | MFLUCC14 0581         |                 |                 |                 |                 |
| <i>Gloniopsis subrugosa</i>         | CBS 123346            | FJ161210        |                 |                 |                 |
| <b><i>Gloniopsis subrugosa</i></b>  | <b>MFLUCC 14 1179</b> | <b>MH535892</b> | <b>MH535884</b> |                 | <b>MH535874</b> |
| <i>Gloniopsis subrugosa</i>         | SMH557                | GQ221896        |                 |                 |                 |
| <i>Glonium circumserpens</i>        | CBS 123342/EB 0332    | FJ161208        | FJ161160        |                 |                 |
| <i>Glonium circumserpens</i>        | CBS 123343/EB 0331    | FJ161200        | FJ161168        | FJ161108        | FJ161126        |
| <i>Glonium stellatum</i>            | CBS 207 34            | FJ161179        |                 |                 |                 |
| <i>Glonium stellatum</i>            | ANM32                 | GQ221887        |                 | GQ221926        |                 |
| <i>Gonatophragmium triuniae</i>     | CBS 138901            | KP004479        |                 |                 |                 |
| <i>Graphyllum caracolinensis</i>    | HUEFS 42838           | KF914914        |                 |                 |                 |
| <i>Heleiosa barbatula</i>           | JK 5548I              | GU479787        | GU479753        |                 |                 |
| <i>Helicomyces roseus</i>           | AFTOL ID 1613         | DQ678083        | DQ678032        | DQ677928        | DQ677981        |
| <i>Hysterium angustatum</i>         | GKM5211               | GQ221906        |                 |                 |                 |
| <i>Hysterium angustatum</i>         | CMW 20409             | FJ161194        | FJ161153        |                 |                 |
| <i>Hysterium angustatum</i>         | SMH5216               | GQ221908        |                 | GQ221933        |                 |
| <i>Hysterium angustatum</i>         | GKM243a               | GQ221899        |                 | GQ221928        |                 |
| <i>Hysterium angustatum</i>         | CBS 123334            | FJ161207        |                 |                 |                 |
| <i>Hysterium angustatum</i>         | CBS 236 34            | FJ161180        | GU397359        | FJ161096        | FJ161117        |
| <b><i>Hysterium angustatum</i></b>  | <b>MFLUCC 16 0623</b> | <b>MH535893</b> | <b>MH535885</b> | <b>MH535878</b> | <b>MH535875</b> |
| <i>Hysterium barrianum</i>          | ANM1495               | GQ221885        |                 | GQ221931        |                 |
| <i>Hysterium barrianum</i>          | ANM1442               | GQ221884        |                 |                 |                 |
| <b><i>Hysterium doimaensis</i></b>  | <b>MFLUCC 16 0338</b> | <b>MH535894</b> | <b>MH535886</b> |                 |                 |
| <i>Hysterium hyalinum</i>           | CBS 237 34            | FJ161181        | FJ161141        |                 |                 |
| <i>Hysterium pulicare</i>           | ANM85                 | GQ221898        |                 | GQ221934        |                 |
| <i>Hysterium pulicare</i>           | ANM1455               | GQ221904        |                 | GQ221932        |                 |
| <b><i>Hysterium thailandica</i></b> | <b>MFLUCC 16-0338</b> | <b>MH535895</b> |                 |                 | <b>MH535876</b> |
| <i>Hysterium vermiforme</i>         | GKM1234               | GQ221897        |                 | GQ221929        |                 |
| <i>Hysterobrevium constrictum</i>   | SMH5211 1             | GQ221905        |                 | GQ221923        |                 |

Appendix 1 Continued.

| Species name                           | Strain               | LSU             | SSU             | TEF             | RPB2     |
|--|----------------------|-----------------|-----------------|-----------------|----------|
| <i>Hysterobrevium constrictum</i>      | GKM426N              | GQ221901        |                 | GQ221913        |          |
| <b><i>Hysterobrevium hakeae</i></b>    | <b>MFLU 16 2987</b>  | <b>MH535896</b> |                 |                 |          |
| <i>Hysterobrevium mori</i>             | SMH 5273             | GU301820        |                 |                 |          |
| <i>Hysterobrevium mori</i>             | GKM1214              | GQ221895        |                 |                 |          |
| <i>Hysterobrevium mori</i>             | SMH 5286             | GU397345        |                 |                 |          |
| <i>Hysterobrevium mori</i>             | SMH5273              | GQ221910        |                 | GQ221936        |          |
| <i>Hysterobrevium mori</i>             | CBS 123564           | FJ161198        |                 |                 |          |
| <i>Hysterobrevium mori</i>             | CBS 123336           | FJ161204        | NG 016534       |                 |          |
| <i>Hysterobrevium mori</i>             | CBS 123563           | FJ161196        |                 |                 |          |
| <i>Hysterobrevium mori</i>             | CBS 123335           | FJ161202        |                 |                 |          |
| <i>Hysterobrevium mori</i>             | GKM 1013             | GU397344        |                 | GU397338        |          |
| <b><i>Hysterobrevium rosae</i></b>     | <b>MFUCC 14-0551</b> | <b>MH535897</b> |                 | <b>MH535879</b> |          |
| <b><i>Hysterobrevium rosae</i></b>     | <b>MFUCC 14-0552</b> | <b>MH535898</b> | <b>MH535887</b> | <b>MH535880</b> |          |
| <i>Hysterobrevium smilacis</i>         | CBS 200 34           | FJ161177        | FJ161138        |                 |          |
| <i>Hysterobrevium smilacis</i>         | CBS 114601           | FJ161174        | FJ161135        | FJ161091        | FJ161114 |
| <i>Hysterodifractum partisporum</i>    | HUEFS 42865          | KF914916        |                 |                 |          |
| <i>Hysterographium flexuosum</i>       | GKM1262c             | GQ221886        |                 | GQ221935        |          |
| <i>Hysterographium fraxini</i>         | CBS 242 34           | FJ161189        |                 |                 |          |
| <i>Hysterographium fraxini</i>         | CBS 109 43           | FJ161171        | FJ161132        | FJ161088        |          |
| <b><i>Hysterographium fraxini</i></b>  | <b>MFLU 15–1902</b>  | <b>MH535899</b> | <b>MH535888</b> | <b>MH535881</b> |          |
| <b><i>Hysterographium fraxini</i></b>  | <b>MFLU 15–3035</b>  | <b>MH535900</b> | <b>MH535889</b> | <b>MH535882</b> |          |
| <b><i>Hysterographium fraxini</i></b>  | <b>MFLU 15–3681</b>  | <b>MH535901</b> | <b>MH535890</b> | <b>MH535883</b> |          |
| <i>Hysteropatella clavispora</i>       | AFTOL-ID 1305        | AY541493        | DQ678006        | DQ677901        | DQ677955 |
| <i>Hysteropatella elliptica</i>        | CBS 935.97           | DQ767657        | EF495114        | DQ767640        | DQ767647 |
| <i>Jahnula aquatica</i>                | R68 1                | EF175655        | EF175633        |                 |          |
| <i>Jahnula bipileata</i>               | F49 1                | EF175657        | EF175635        |                 |          |
| <i>Julella avicenniae</i>              | BCC 18422            | GU371823        | GU371831        | GU371816        | GU371787 |
| <i>Julella avicenniae</i>              | BCC 20173            | GU371822        | GU371830        | GU371815        | GU371786 |
| <i>Keissleriella cladophila</i>        | CBS 104 55           | JX681090        | GU296155        | GU349043        | GU371735 |
| <i>Kirschsteiniothelia elaterascus</i> | HKUCC7769            | AY787934        |                 |                 |          |
| <i>Laurera megasperma</i>              | AFTOL ID 2094        | FJ267702        |                 |                 |          |
| <i>Lentithecium fluviatile</i>         | CBS 122367           | GU301825        | GU296158        | GU349074        |          |
| <i>Leptosphaeria biglobosa</i>         | CBS 303 51           | GU301826        |                 | GU349010        |          |
| <i>Leptosphaeria doliolum</i>          | CBS 505 75           | GQ387576        | GQ387515        | GU349069        | KY064035 |
| <i>Leptoxyphium fumago</i>             | CBS 123 26           | GU301831        | GU214535        | GU349051        | GU371741 |
| <i>Lichenothelia calcarea</i>          | L1324                | KC015062        | KC015082        |                 |          |
| <i>Lichenothelia convexa</i>           | L1607                | KC015069        | KC015084        |                 |          |
| <i>Lindgomyces breviappendiculatus</i> | KT 1215              | AB521748        | AB521733        |                 |          |
| <i>Lindgomyces ingoldianus</i>         | ATCC 200398          | AB521736        | NG 016531       |                 |          |
| <i>Lophiostoma crenatum</i>            | AFTOL ID 1581        |                 |                 | DQ677912        | DQ677965 |

**Appendix 1** Continued.

| <b>Species name</b>                    | <b>Strain</b>       | <b>LSU</b>      | <b>SSU</b>      | <b>TEF</b> | <b>RPB2</b>     |
|--|---------------------|-----------------|-----------------|------------|-----------------|
| <i>Lophiostoma fuckelii</i>            | GKM 1063            | GU385192        |                 | GU327759   |                 |
| <i>Lophiotrema neoarundinaria</i>      | KT 856              | AB524596        | AB524455        | AB539109   | AB539096        |
| <i>Lophiotrema nucula</i>              | CBS 627 86          | FJ795446        | FJ795489        | LC194410   | LC194465        |
| <i>Lophium elegans</i>                 | EB 0366             | GU323210        | GU323184        |            |                 |
| <i>Lophium mytilinum</i>               | CBS 114111          |                 | EF596818        |            |                 |
| <i>Lophium mytilinum</i>               | AFTOL ID 1609       | DQ678081        | DQ678030        | DQ677926   | DQ677979        |
| <i>Lophium mytilinum</i>               | CBS 123344          | FJ161203        |                 |            |                 |
| <i>Lophium mytilinum</i>               | CBS 269 34          | DQ678081        | DQ678030        | DQ677926   | DQ677979        |
| <i>Manglicola guatemalensis</i>        | BCC20079            | FJ743449        | FJ743443        |            |                 |
| <i>Manglicola guatemalensis</i>        | BCC20156            | FJ743448        | FJ743442        |            |                 |
| <i>Massaria anomia</i>                 | CBS 591 78          | GU301839        | GU296169        |            | GU371769        |
| <i>Massarina eburnea</i>               | CBS 473 64          | FJ201983        | GU296170        | GU349040   | GU371732        |
| <i>Massarina igniaria</i>              | CBS 845 96          | GU301841        | GU29617         |            | GU371793        |
| <i>Massariosphaeria grandispora</i>    | CBS 613 86          | GU301842        | GU296172        | GU349036   | GU371725        |
| <i>Massariosphaeria phaeospora</i>     | CBS 611 86          | GU301843        | GU296173        |            | GU371794        |
| <i>Megalotremis verrucosa</i>          | MPN104              | GU327718        | GU327694        |            |                 |
| <i>Melanomma rhododendri</i>           | ANM 73              | GU385198        |                 |            |                 |
| <i>Microthyrium microscopicum</i>      | CBS 115976          | GU301846        | GU296175        |            | GU371734        |
| <i>Minutisphaera aspera</i>            | G427 1a             | KP309993        | KP309999        |            |                 |
| <i>Minutisphaera aspera</i>            | G427-1a             | KP309993        | KP309999        |            |                 |
| <i>Minutisphaera fimbriatispora</i>    | L A242 8A           | HM196367        | HM196374        |            |                 |
| <i>Minutisphaera japonica</i>          | JCM 18560           | AB733440        | AB733434        |            |                 |
| <i>Montagnula opulenta</i>             | AFTOL ID 1734       | DQ678086        |                 |            | DQ677984        |
| <i>Morosphaeria ramunculicola</i>      | KH 220              | AB807554        | AB797264        | AB808530   |                 |
| <i>Munkovalsaria rubra</i>             | IFRD 2017           | FJ795507        | GU456308        |            |                 |
| <i>Mycocomrothelia miculiformis</i>    | 101B                | GU327720        | GU327696        |            |                 |
| <i>Myriangium duriaei</i>              | CBS 260 36          | DQ678059        | AY016347        | DQ677900   | DQ677954        |
| <i>Myriangium hispanicum</i>           | CBS 247 33          | GU301854        | GU296180        | GU349055   | GU371744        |
| <i>Myrmaecium rubricosum</i>           | CBS 139067          | KP687881        | KP687977        | KP688049   | KP687955        |
| <i>Mytilinidion acicola</i>            | EB 0349             | GU323209        | GU323185        |            | GU371757        |
| <i>Mytilinidion acicola</i>            | EB 0379             | GU397346        | GU397362        |            | GU397355        |
| <i>Mytilinidion andinense</i>          | CBS 123562          | FJ161199        |                 |            |                 |
| <i>Mytilinidion andinense</i>          | EB 0330             | FJ161199        | FJ161159        | FJ161107   | FJ161125        |
| <i>Mytilinidion australe</i>           | CBS 301 34          | FJ161183        |                 |            |                 |
| <i>Mytilinidion californicum</i>       | EB 0385             | GU323208        | GU323186        |            |                 |
| <b><i>Mytilinidion didymospora</i></b> | <b>MFUCC16-0619</b> | <b>MH535902</b> | <b>MH535891</b> |            | <b>MH535877</b> |



**Appendix 1** Continued.

| <b>Species name</b>                    | <b>Strain</b>              | <b>LSU</b> | <b>SSU</b> | <b>TEF</b> | <b>RPB2</b> |
|--|----------------------------|------------|------------|------------|-------------|
| <i>Mytilinidium mytilinellum</i>       | CBS 303 34                 | FJ161184   | FJ161144   | FJ161100   | FJ161119    |
| <i>Mytilinidium mytilinellum</i>       | EB 0386                    | GU397347   | GU397363   |            | GU397356    |
| <i>Mytilinidium resinicola</i>         | CBS 304 34                 | FJ161185   | NG 016511  | FJ161101   | FJ161120    |
| <i>Mytilinidium rhenanum</i>           | EB 0341                    | GU323207   | GU323187   |            |             |
| <i>Mytilinidium rhenanum</i>           | CBS 135 45                 | FJ161175   |            |            |             |
| <i>Mytilinidium scolecosporum</i>      | CBS 305 34                 | FJ161186   | NG 016510  | FJ161102   | FJ161121    |
| <i>Mytilinidium thujarum</i>           | EB 0268                    | GU323206   | GU323188   |            |             |
| <i>Mytilinidium tortile</i>            | CBS 306.34                 | FJ161187   | FJ161147   |            |             |
| <i>Natipusilla limonensis</i>          | L AF286                    | HM196370   | HM196377   |            |             |
| <i>Natipusilla naponensis</i>          | L AF217                    | HM196372   | HM196378   |            |             |
| <i>Neodevriesia hilliana</i>           | CBS 123187                 | GU214414   |            |            |             |
| <i>Neomicrothyrium siamense</i>        | IFRDCC 2194                | JQ036228   | JQ036223   |            |             |
| <i>Oedohysterium insidens</i>          | ANM1443                    | GQ221882   |            |            |             |
| <i>Oedohysterium insidens</i>          | CBS 238 34                 | FJ161182   | NG 016512  | FJ161097   | FJ161118    |
| <i>Oedohysterium sinense</i>           | CBS 123345                 | FJ161209   | NG016513   |            |             |
| <i>Oedohysterium sinense</i>           | EB 0339                    | GU397348   | GU397364   | GU397339   | GU397357    |
| <i>Ostreichnion centramurum</i>        | isolate chuni 70           | KM272256   | KM272257   | KM277819   |             |
| <i>Ostreichnion curtisii</i>           | CBS 198 34                 | FJ161176   | FJ161137   | FJ161093   |             |
| <i>Ostreichnion sassafras</i>          | CBS 322 34                 | FJ161188   | FJ161148   |            | FJ161122    |
| <i>Othia spiraeae</i>                  | CBS 114124                 | EF204498   | EF204515   |            | EF204485    |
| <i>Patellaria atrata</i>               | CBS 958 97                 | GU301855   | GU296181   | GU349038   | GU371726    |
| <i>Petrophila incerta</i>              | CBS 118608                 | GU323961   | GU323991   |            |             |
| <i>Phaeosphaeria avenaria</i>          | AFTOL ID 280               | AY544684   | AY544725.  | DQ677885   | DQ677941    |
| <i>Phaeothecoidiella illinoisensis</i> | CBS125223                  | GU117901   |            |            |             |
| <i>Phaeotrichum benjaminii</i>         | AFTOL ID 1184              | AY004340   | AY016348   | DQ677892   | DQ677946    |
| <i>Phyllobathelium anomalum</i>        | 242                        | GU327722   | JN887386   |            |             |
| <i>Piedraia hortae</i>                 | CBS 480 64                 | KF901943   | AY016349   |            | KF902289    |
| <i>Piedraia quintanilhae</i>           | CBS 327 63                 | GU214468   |            |            |             |
| <i>Pleospora herbarum</i>              | CBS 191<br>86/AFTOL-ID 940 | GU238232   | DQ247812   | DQ471090   | DQ247794    |
| <i>Pleosporales</i> sp.                | CLS 2009a                  | GQ289828   |            |            | GU371759    |
| <i>Pleurotrema thamplaensis</i>        | MFLUCC 15 0635             | KX925435   | KX925436   |            |             |
| <i>Polyplosphaeria fusca</i>           | KT 1616                    | AB524604   | AB524463   | AB524820   |             |
| <i>Preussia terricola</i>              | AFTOL ID 282               | AY544686   | AY544726   | DQ471063   | DQ470895    |
| <i>Pseudorobillarda eucalypti</i>      | MFLUCC 12-0422             | KF827457   | KF827463   |            | KF827496    |
| <i>Pseudorobillarda phragmitis</i>     | CBS 398 61                 | EU754203   | EU754104   |            |             |
| <i>Pseudorobillarda siamensis</i>      | NTCL082-3                  | KF827454   | KF827460   | KF827481   | KF827493    |

**Appendix 1** Continued.

| <b>Species name</b>                    | <b>Strain</b>       | <b>LSU</b>      | <b>SSU</b> | <b>TEF</b> | <b>RPB2</b> |
|--|---------------------|-----------------|------------|------------|-------------|
| <i>Pseudorobillarda</i> sp.            | MFLUCC12 0316       | KF827453        | KF827459   | KF827480   | KF827492    |
| <i>Pseudorobillarda</i> sp.            | MFLUCC12 0422       | KF827457        | KF827463   | KF827484   | KF827496    |
| <i>Pseudorobillarda texana</i>         | BCC12535            | FJ825377        | FJ825367   |            |             |
| <i>Pseudovirgaria grisea</i>           | CPC 19134           | JF957614        |            |            |             |
| <i>Pseudovirgaria hyperparasitica</i>  | CPC 10753           | EU041824        |            |            |             |
| <i>Psiloglonium araucanum</i>          | CMW 18760           | FJ161192        | FJ161151   |            |             |
| <i>Psiloglonium araucanum</i>          | CBS 112412          | FJ161172        | FJ161133   | FJ161089   | FJ161112    |
| <i>Psiloglonium araucanum</i>          | CMW 17941           | J161190         | FJ161149   |            |             |
| <i>Psiloglonium clavisporum</i>        | CBS 123340          | FJ161205        |            |            |             |
| <i>Psiloglonium clavisporum</i>        | CBS 123341          | FJ161206        |            |            |             |
| <i>Psiloglonium clavisporum</i>        | CBS 123338          | FJ161197k       |            |            |             |
| <i>Psiloglonium clavisporum</i>        | GKM L172A           | GU323204        | GU323192   |            |             |
| <i>Psiloglonium clavisporum</i>        | GKM344A             | GQ221889        |            |            |             |
| <i>Psiloglonium colihuae</i>           | MFLUCC 11 0178      | KP744511        |            |            |             |
| <i>Psiloglonium macrosporum</i>        | MFLUCC 13 0448      | KU243049        |            |            |             |
| <b><i>Psiloglonium macrosporum</i></b> | <b>MFLU 16-0955</b> | <b>MH535903</b> |            |            |             |
| <i>Psiloglonium multiseptatum</i>      | MFLUCC 11 C0164     | KP744512        |            |            |             |
| <i>Psiloglonium sasicola</i>           | MFLUCC 10 0565      | KP744513        |            |            |             |
| <i>Psiloglonium simulans</i>           | CBS 206 34          | FJ161178        | FJ161139   | FJ161094   | FJ161116    |
| <i>Psiloglonium simulans</i>           | ANM1557             | GQ221873        |            |            |             |
| <i>Quadricrura septentrionalis</i>     | HC 4983             | AB524615        | AB524474   | AB524830   |             |
| <i>Quasiconcha reticulata</i>          | EB QR               | GU397349        |            |            |             |
| <i>Rhexothecium globosum</i>           | CBS 955 73          | HG004544        |            |            |             |
| <i>Rhytidhysterion hysterinum</i>      | EB 0351             | GU397350        |            | GU397340   |             |
| <i>Rhytidhysterion neorufulum</i>      | MFLUCC 13 0221      | KU377567        | KU377572   |            |             |
| <i>Rhytidhysterion neorufulum</i>      | MFLUCC 13 0216      | KU377566        | KU377571   | KU510400   |             |
| <i>Rhytidhysterion opuntiae</i>        | GKM1190             | GQ221892        |            |            |             |
| <i>Rhytidhysterion rufulum</i>         | 361A                | GU301867        | GU296192   |            |             |
| <i>Rhytidhysterion rufulum</i>         | GKM361A             | GQ221893        |            |            |             |
| <i>Rhytidhysterion rufulum</i>         | MFLUCC 12 0529      | KJ526124        | KJ546127   |            |             |
| <i>Rhytidhysterion rufulum</i>         | HUEFS 192194        | KF914915        |            |            |             |
| <i>Rhytidhysterion rufulum</i>         | MFLUCC 12 0528      | KJ418117        | KJ418119   |            |             |
| <i>Rhytidhysterion rufulum</i>         | AFTOL ID 2109       | FJ469672        |            |            |             |
| <i>Rhytidhysterion rufulum</i>         | MFLUCC 12 0011      | KJ418109        | KJ418110   |            |             |
| <i>Rhytidhysterion rufulum</i>         | MFLUCC 12 0567      | KJ526126        | KJ546129   |            |             |

**Appendix 1** Continued.

| <b>Species name</b>                    | <b>Strain</b>  | <b>LSU</b> | <b>SSU</b> | <b>TEF</b> | <b>RPB2</b> |
|--|----------------|------------|------------|------------|-------------|
| <i>Rhytidhysteron rufulum</i>          | EB 0381        | GU397351   | GU397366   |            |             |
| <i>Rhytidhysteron rufulum</i>          | MFLUCC 14 0577 | KU377565   | KU377570   | KU510399   |             |
| <i>Rhytidhysteron rufulum</i>          | EB 0384        | GU397354   | GU397368   |            |             |
| <i>Rhytidhysteron rufulum</i>          | EB 0382        | GU397352   |            |            |             |
| <i>Rhytidhysteron rufulum</i>          | EB 0383        | GU397353   | GU397367   |            |             |
| <i>Rhytidhysteron rufulum</i>          | MFLUCC 12 0013 | KJ418111   | KJ418113   |            |             |
| <i>Rhytidhysteron rufulum</i>          | MFLUCC 12 0530 | KJ526125   | KJ546128   |            |             |
| <i>Rhytidhysteron thailandicum</i>     | MFLUCC 14 0503 | KU377564   | KU377569   | KU497490   |             |
| <i>Rousoella hysterioides</i>          | KT 1651        | AB524621   | AB524480   | AB539114   | AB539101    |
| <i>Saccardoella rhizophorae</i>        | JK 5456A       | GU479799   | GU479766   | GU479860   |             |
| <i>Schismatomma decolorans</i>         | AFTOL-ID 307   | AY548815   | AY548809   | DQ883725   | DQ883715    |
| <i>Schizothyrium pomi</i>              | CBS 406 61     | EF134949   |            |            |             |
| <i>Setomelanomma holmii</i>            | CBS 110217     | GQ387633   | GQ387572   | GU349028   | GU371800    |
| <i>Stigmatodiscus enigmaticus</i>      | L83            |            | KU234131   |            | KU234126    |
| <i>Stigmatodiscus pruni</i>            | L167           | KX611110   | KX611110   | KX611111   | KX611109    |
| <i>Strigula jamesii</i>                | MPN548         | JN887404   | JN887388   | JN887432   |             |
| <i>Strigula nemathora</i>              | MPN72          | JN887405   | JN887389   | JN887433   |             |
| <i>Sympoventuria capensis</i>          | CPC 12840      | KF937238   |            |            | KF937272    |
| <i>Teratosphaeria jonkershoekensis</i> | CBS 112224     | KF901827   | GU301874   | KF903090   | KF902183    |
| <i>Tetraplospheeria sasicola</i>       | KT 563         | AB524631   | AB524490   | AB524838   |             |
| <i>Thyridaria rubronotata</i>          | CBS 419 85     | GU301875.  |            | GU349002   | GU371728    |
| <i>Trematosphaeria pertusa</i>         | CBS 122371     | GU301876   | FJ201993   | KF015702   | GU371801    |
| <i>Trichodelitschia bisporula</i>      | CBS 262 69     | GU348996   | GU349000   | GU349020   | GU371802    |
| <i>Trichodelitschia munkii</i>         | Kruys 201      | DQ384096   | DQ384070   |            |             |
| <i>Tripospermum myrti</i>              | CBS 437 68     | GU323216   | GU566744   |            | GU561854    |
| <i>Trypethelium tropicum</i>           | MPN130         | KM453819   |            |            |             |
| <i>Tubeufia paludosa</i>               | CBS 120503     | GU301877   | GU296203   | GU349024   | GU371731    |
| <i>Tyrannosorus pinicola</i>           | CBS 124.88     | DQ470974   | DQ471025   | DQ471098   | DQ470928    |
| <i>Ulospora bilgramii</i>              | AFTOL ID 1598  | DQ678076   | DQ678025   | DQ677921   | DQ677974    |
| <i>Valsaria insitiva</i>               | CBS 127882     | KP687886   |            | KP688054   | KP687959    |
| <i>Valsaria lopadostomoides</i>        | CBS 139062     | KP687868   | KP687972   | KP688037   | KP687943    |
| <i>Valsaria neotropica</i>             | CBS 139064     | KP687874   | KP687974   | KP688042   | KP687948    |
| <i>Venturia inaequalis</i>             | CBS 815 69     | GU301878   | GU296204   | GU349023   |             |
| <i>Verruculina enalia</i>              | AFTOL ID 1601  | DQ678079   | DQ678028   | DQ677924   | DQ677977    |
| <i>Zeloasperisporium cliviae</i>       | CPC 25145      | KR476781   |            |            |             |
| <i>Zeloasperisporium ficusicola</i>    | MFLUCC 15 0222 | KT387735   | KT387736   |            |             |
| <i>Zeloasperisporium wrightiae</i>     | MFLUCC 15 0210 | KT387739   | KT387743   |            |             |