Revision of the Massarineae (Pleosporales, Dothideomycetes)

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Abstract: We here taxonomically revise the suborder Massarineae (Pleosporales, Dothideomycetes, Ascomycota). Sequences of SSU and LSU rDNA and the translation elongation factor 1-alpha gene (tef1) are newly obtained from 106 Massarineae taxa that are phylogenetically analysed along with published sequences of 131 taxa in this suborder retrieved from GenBank. We recognise 12 families and five unknown lineages in the Massarineae. Among the nine families previously known, the monophyletic status of the Dictyosporaceae, Didymosphaeriaceae, Latoruaceae, Macrodiplodiopsidaceae, Massarineae, Monosporaceae, and Trematosphaeriaceae was strongly supported with bootstrap support values above 96%, while the clades of the Bambusicolaceae and the Lentitheciaceae are moderately supported. Two new families, Parabambusicolaceae and Sulcatisporaceae, are proposed. The Parabambusicolaceae is erected to accommodate Aquastroma and Parabambuscola genera nova, as well as two unnamed Monodictys species. The Parabambusicolaceae is characterised by depressed globose to hemispherical ascoma with or without surrounding stromatic tissue, and multi-septate, clavate to fusiform, hyaline ascospores. The Sulcatisporaceae is established for Magnicamarosporium and Sulcatispora genera nova and Neobambusicola. The Sulcatisporaceae is characterised by subglobule ascoma with a short ostioral neck, trabeculate pseudoparaphyses, clavate asci, broadly fusiform ascospores, and ellipsoid to subglobose conidia with or without striate ornamentation. The genus Periconia and its relatives are segregated from the Massarineae and placed in a resurrected family, the Periconiaceae. We have summarised the morphological and ecological features, and clarified the accepted members of each family. Ten new genera, 22 new species, and seven new combinations are described and illustrated. The complete ITS sequences of rDNA are also provided for all new taxa for use as barcode markers.

Key words: Coelomycetes, Freshwater ascomycetes, Helminthosporium, Holomorph, Hyp hocymetes, Massarina, Periconia, Spegazzinia.

Taxonomic novelties: New families: Parabambusicolaceae Kaz. Tanaka & K. Hiray. New genera: Aquastroma Kaz. Tanaka & K. Hiray, Clypeolocus Kaz. Tanaka & K. Hiray, Fuscostagonospora Kaz. Tanaka & K. Hiray, Gregartheicum Kaz. Tanaka & K. Hiray, Magnicamarosporium Kaz. Tanaka & K. Hiray, Neophosphaeria Kaz. Tanaka & K. Hiray, Parabambuscola Kaz. Tanaka & K. Hiray, Pseudocoleophoma Kaz. Tanaka & K. Hiray, Pseudoxylomyces Kaz. Tanaka & K. Hiray, Sulcatispora Kaz. Tanaka & K. Hiray. New species: Aquastroma magnistiotata Kaz. Tanaka & K. Hiray, Aqulomyces rebuenensis Kaz. Tanaka & K. Hiray, Clypeolocus akiensis Kaz. Tanaka & K. Hiray, Clypeolocus hirosaiensis Kaz. Tanaka & K. Hiray, Clypeolocus microsporus Kaz. Tanaka & K. Hiray, Clypeolocus towaasidea Kaz. Tanaka & K. Hiray, Dityosporum pseudosorbace Kaz. Tanaka, G. Sato & K. Hiray, Fuscostagonospora asase Kaz. Tanaka & K. Hiray, Gregartheicum curvisporum Kaz. Tanaka & K. Hiray, Helminthosporium massarinum Kaz. Tanaka, K. Hiray, Shirouzu, Keisslerella brevisaca Kaz. Tanaka & K. Hiray, Keislerella quadriseptata Kaz. Tanaka & K. Hiray, Keislerella yonaguniensis Kaz. Tanaka & K. Hiray, Lentitheciaceae pseudoluminum Kaz. Tanaka & K. Hiray, Magnicamarosporium irontemese Kaz. Tanaka & K. Hiray, Periconia pseudodigitata Kaz. Tanaka & K. Hiray, Pseudocoleophoma calamagrostidis Kaz. Tanaka & K. Hiray, Pseudocoleophoma polygonicola Kaz. Tanaka & K. Hiray, Stagonospora pseudoperegrina Kaz. Tanaka & K. Hiray, Sulcatispora acerina Kaz. Tanaka & K. Hiray, Sulcatispora berchimia Kaz. Tanaka & K. Hiray, New combinations: Lentitheciaceae clonarium Kaz. Tanaka, Sat. Hatak. & Y. Harada Kaz. Tanaka & K. Hiray, Neophosphaeria sasicola (Nagas. & Y. Otani) Kaz. Tanaka & K. Hiray, Parabambuscola bambusina (Teng) Kaz. Tanaka & K. Hiray, Pseudoxylomyces elegans (Goh, W.H. Ho, K.D. Hyde & K.M. Tsui) Kaz. Tanaka & K. Hiray, Setocephoria arundinacea (Sowerby) Kaz. Tanaka & K. Hiray, Setocephoria magniarundinacea (Kaz. Tanaka & Y. Harada) Kaz. Tanaka & K. Hiray, Stagonospora bicolor (D. Hawksw., W.J. Kaiser & Ndimande) Kaz. Tanaka & K. Hiray, Epthypifications (basionyms): Phaeosphaeria arundinacea var. brevispora Nagas. & Y. Otani, Phaeosphaeria sasicola Nagas. & Y. Otani.

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INTRODUCTION

The Pleosporales is the largest order in the Dothideomycetes. Two suborders have been recognised, viz. the Pleosporineae and the Massarineae, containing more than 19 families that presently still lack subordinal assignment (Hyde et al. 2013). One suborder, the Pleosporineae, includes many economically important plant pathogens, Alternaria, Bipolaris, Didymella, Leptosphaeria, Parastagonospora, and Pyrenophora, for example, containing huge species diversity (Manamgoda et al. 2011, Zhang et al. 2012, Woudenberg et al. 2013). In this suborder, the phylogenetic relationships within each family, the morphological circumscriptions including those of asexual morphs, their evolutionary trend as plant pathogens, biogeography, and speciation are well established and documented (Rouxel & Balesdent 2005, Peever 2007, Zhang et al. 2009b, Ohm et al. 2012, Grandaubert et al. 2014). In contrast, for the other suborder, the Massarineae, much fundamental information including the taxonomic framework, phylogenetic relationships, biology, and species diversity are poorly understood. The Massarineae was originally established by Barr (1979) to accommodate the Massarineae and the Arthopyreniaceae, but this suborder has long been disregarded in the classification of bitunicate ascomycetes (Hawksworth et al. 1983, 1995, Barr 1987, Eriksson & Winka 1998, Kirk et al. 2008, Lumbsch & Huhndorf 2010).
The family Massarinaceae was established by Munk (1956) to encompass four genera, Massarina, Metasphaeria, Pseudotrichia, and Trichometasphaeria. The thin basal peridium and dark tissue (= clypeus) around the ostiole found in the ascomata of these genera were emphasised as familial characters. Although this proposal was accepted by many researchers (Eriksson 1981, Boise 1985), the characters emphasised by Munk (1956) for the family also exist in several other groups of bitunicate ascomycetes, such as Didymosphaerid (Didymosphaeraceae), Salsuginea (Salsugineaceae) and Rossoellaceae (Rousseoellaceae). The Massarinaceae, therefore, has been treated as a synonym of the Pleosporaceae (Bose 1961, Luttrell 1973, Von Arx & Müller 1975) or Lophiotomataceae (Barr 1987, 1992). Similarly, taxonomic circumscription of the genus Massarina has also been repeatedly revised (see Notes in Massarina, 2007, Schoch et al. 2011). Consequently, several new genera belonging to the Massarineae have been assigned to the Massarinae as circumscribed by Eriksson & Hawksworth (2003), and the concept of the family has been revised (Hyde et al. 2013). In a recent molecular study on the Pleosporales (Zhang et al. 2012), the suborder Massarineae was resurrected as a sister to the Pleosporineae, and was emended to include five families, the Lenitheciaeae (Zhang et al. 2009b), Massarinaeae (Munk 1956), Montagnulaceae (Barr 2001; later synonymised under Didymosphaeraceae, Aryawansa et al. 2014), Morosphaeraceae (Suetrong et al. 2009), and Trematosphaeraceae (Suetrong et al. 2011b). More recently, the Bambusicolaceae (Hyde et al. 2013), Dictyosporaceae (nom. prov., see Liu et al. 2015), Latoruaceae and Macrodiodipteraceae (Crous et al. 2015a) have been added to the suborder. Most of these families have been recognised from the results of recent molecular studies. Only a few members of each family are currently known, and thus the morphological characteristics and phylogenetic relationships within each family are not fully understood. Consequently, several new genera belonging to the Massarinae, such as Ascorhombispor (Cai & Hyde 2007b), Inflatispora (Zhang et al. 2011), and Noosia (Crous et al. 2011a), have been published but their phylogenetic placements at familial level remain obscure (Zhang et al. 2012, Hyde et al. 2013).

Our aims were to reveal the species diversity within the Massarinae and to establish a taxonomic framework within this suborder for understanding the relationships among the Massarinae. To this end we examined 106 specimens/isolates belonging to this suborder, and analysed their morphology and partial DNA sequences of the small and large subunit nuclear ribosomal DNA (SSU and LSU nrDNA) and the translation elongation factor 1-alpha gene (tef1).

MATERIALS AND METHODS

Morphological studies

Leaf and twig specimens were collected from various plants in Japan, and deposited in the herbarium of Hiroaki University (HHUF). Measurements of all structures except for ascomata/ conidiomata were taken from material mounted in distilled water. India ink or Black-Blue ink in distilled water was added to water mounts to detect gelatinous sheaths or appendages around spores. To observe the internal structure of strongly melanised spores, 5 % sodium hypochlorite solution (NaClO) was used for the bleaching of spores as described in Eriksson (1989). The position of the primary septum of spores was noted using the decimal system (Shoemaker 1984), and the numbers of spore septa were recorded as “septa of upper hemisphere + the primary septum + septa of lower hemisphere”. To observe spore-carp structure, ascomata/conidiomata were boiled in water for a few minutes, sectioned using a freezing microtome (HM 400R; MICROM, Germany), and mounted in diluted lactophenol cotton blue. Morphology was observed using differential interference and phase contrast microscopy (Olympus BX53, Japan).

Single spore cultures were obtained following the methods of Tubaki (1978). Ninety-nine cultures on 2 % potato-dextrose agar (PDA) or potato-carrot agar (PCA) were prepared from the collections and were deposited in the Japan Collection of Micro-organisms (JCM), the National Institute of Agrobiological Sciences, Japan (MAFF), and the CBS-KNAW Fungal Biodiversity Centre (Centraalbureau voor Schimmelcultures; CBS). An additional seven strains were obtained from the CBS culture collection (Table 1). Growth rate and colony characteristics were recorded from cultures grown on PDA within 2 or 4 wk at 20 °C in the dark. Colours were designated according to Rayner (1970). Induction of sexual/sexual sporulation was attempted by culturing isolates on rice straw agar (RSA; Tanaka & Harada 2003a) and/or incubating small pieces of colony in sterilised water (Scheuer 1991). Nomenclatural novelties were deposited in MycoBank (Crous et al. 2004).

Molecular phylogenetic analysis

A total of 106 isolates were used for DNA extraction (Table 1). DNA from mycelia was extracted using the ISOLPLANT Kit (Nippon Gene, Tokyo, Japan) following the manufacturer’s instructions. Partial SSU and LSU nrDNA, and tef1 were sequenced to elucidate phylogenetic relationships of the isolates for considering familial and generic classifications. The complete internally transcribed spacer (ITS) regions of nrDNA were also obtained for use as DNA barcode markers (Schoch et al. 2012), although the sequences were not used for phylogenetic reconstruction (Table 1). Four primer sets, NS1–NS4 (White et al. 1990), LR0R–LR7 (Rehner & Samuels 1994), EF1-983F–EF1-2218R (Rehner & Buckley 2005), and ITS1–ITS4 (White et al. 1990) were used for the amplification of SSU, LSU, tef1, and ITS, respectively. DNA fragments were amplified and sequenced following the methods described by Tanaka et al. (2009). Newly obtained sequences have been deposited in GenBank (Table 1). These sequences together with those retrieved from GenBank (Table 2) were aligned by MUSCLE included in the program Molecular Evolutionary Genetic Analysis (MEGA) v. 6 (Tamura et al. 2013) and manually adjusted to optimise the alignment. Hysterobrevium mori and Hysterium pulicare, both belonging to the Hysteriales, were designated as outgroup taxa. The alignments used were deposited in TreeBASE (http://www.treebase.org). Phylogenetic analyses were conducted based on maximum likelihood (ML) method. The optimum substitution models for each dataset were estimated by Kakusan4 (Tanabe 2011), based on the Akaike information criterion (AIC; Akaike 1974) for ML analyses. The ML analyses were performed with TreeFinder Mar 2011 (Jobb 2011) based on

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Table 1. Cultures and GenBank accession numbers of *Massarineae* obtained in this study.

| Taxon Family | Original no. | Culture no. | Specimen no. | GenBank accession no. |
|--------------|--------------|-------------|--------------|-----------------------|
| *Aquastroma magniostiolata* | Par KT 2485 | CBS 139680 = JCM 19429 = MAFF 243824 | HHUF 301122T | AB797220 AB807510 AB808486 LC014540 A |
| *Aquilityces rebunensis* | Mor KT 732-2 | CBS 139684 = JCM 19427 = MAFF 243862 | HHUF 27556T | AB797252 AB807542 AB808518 AB809630 A |
| *Bactrodesmium cubense* | IS – | CBS 680.96 = JCM 14126 | – | AB797218 AB807508 AB808484 LC014541 C |
| *Clupeofocus akiataensis* | Mor KT 788 | CBS 139681 = JCM 19424 = MAFF 239467 | HHUF 27557T | AB797253 AB807543 AB808519 AB809631 A |
| *C. hirosakensis* | Mor KT 1283 | CBS 139682 = JCM 19426 = MAFF 243864 | HHUF 301144T | AB797260 AB807550 AB808526 AB809638 A |
| *C. microsporus* | Mor KT 1131 | CBS 139683 = JCM 19425 = MAFF 243863 | HHUF 301143T | AB797245 AB807535 AB808510 AB811451 A |
| *C. towadensis* | Mor KT 1340 | CBS 139685 = JCM 19428 = MAFF 243865 | HHUF 301145T | AB797259 AB807549 AB808525 AB809637 A |
| *Dictyosporium aff. bulbosum* | Dic KH 375 | JCM 19410 = MAFF 243830 | HHUF 301126 | AB797224 AB807514 AB808490 LC014542 C |
| *D. aff. heptasporum* | Dic KH 332 | JCM 19406 = MAFF 243828 | HHUF 301126 | AB797223 AB807513 AB808489 LC014543 C |
| *D. bulbosum* | Dic KH 401 | JCM 19404 = MAFF 243830 | HHUF 301128 | AB797225 AB807515 AB808491 LC014545 C |
| *D. digitatum* | Dic KT 2660 | JCM 19405 = MAFF 243833 | HHUF 301131 | AB797228 AB807518 AB808494 LC014546 C |
| *D. digitatum* | Dic KT 2682 | JCM 19406 = MAFF 243832 | HHUF 301130 | AB797222 AB807512 AB808488 LC014547 C |
| *D. hughesii* | Dic KT 1847 | JCM 19407 = MAFF 243832 | HHUF 301132 | AB797227 AB807517 AB808493 LC014548 C |
| *D. pseudomusae* | Dic KH 412 | JCM 19408 = MAFF 243833 | HHUF 301126T | AB797226 AB807516 AB808492 LC014549 C |
| *D. pseudomusae* | Dic yone 234 | CBS 139686 = JCM 19409 = MAFF 243836 | HHUF 301133T | AB797230 AB807520 AB808496 LC014550 C |
| *D. tetrasporum* | Dic KT 2865 | JCM 19410 = MAFF 243834 | HHUF 301132 | AB797229 AB807519 AB808495 LC014551 C |
| *Fuscostagonospora sasae* | IS KT 1467 | CBS 139687 = JCM 13104 = MAFF 239614 | HHUF 29106T | AB797258 AB807548 AB808524 AB809636 A |
| *Gregantheicum curvisporum* | Dic KT 922 | CBS 139688 = JCM 19411 = MAFF 243838 | HHUF 301134T | AB797257 AB807547 AB808523 AB809644 A |
| *Helicascus aquaticus* | Mor KT 1544 | JCM 19423 = MAFF 243866 | HHUF 301146 | AB797242 AB807532 AB808507 AB809627 A |
| *H. elaterascus* | Mor KT 2673 | MAFF 243867 | HHUF 301147 | AB797243 AB807533 AB808508 AB809626 A |
| *H. elaterascus* | Mor KT 2682 | CBS 139689 | HHUF 30451 | LC014603 LC014608 LC014613 LC014552 A |
| *H. thalassioideus* | Mor – | CBS 110441 = JCM 14147 | – | AB797267 AB807557 AB808533 LC014553 A |
| *H. thalassioideus* | Mor KH 242 | JCM 17526 = NBRC 107811 | HHUF 30069 | AB797268 AB807558 AB808534 LC014554 A |
| *Helminthosporium dalbergiae* | Mas H 4628 (= TS 36) | MAFF 243853 | HHUF 27971 | AB797231 AB807521 AB808497 LC014555 C |
| *H. magnisporum* | Mas H 4627 (= TS 33) | MAFF 239628 | HHUF 27968T | AB797232 AB807522 AB808498 AB811452 C |
| *H. massarinum* | Mas KT 838 | JCM 13094 = MAFF 239604 | HHUF 27573T | AB797233 AB807523 AB808499 AB809628 A |
| *H. massarinum* | Mas KT 1564 | CBS 139690 = JCM 13095 = MAFF 239605 | HHUF 29089T | AB797234 AB807524 AB808500 AB809629 A |
| *Helminthosporium sp.* | Mas H 4743 (= TS 68) | MAFF 243856 | HHUF 28248 | AB797236 AB807526 – – C |
| *Helminthosporium sp.* | Mas yone 38 | MAFF 243857 | HHUF 29740 | AB797237 AB807527 AB808502 – C |
| *Helminthosporium sp.* | Mas yone 63 | MAFF 243858 | HHUF 29741 | AB797238 AB807528 AB808503 – C |

(continued on next page)
| Taxon                          | Family | Original no. | Culture no. | Specimen no. | GenBank accession no. | Notes  | SSU | LSU | tef1 | ITS |
|-------------------------------|--------|--------------|-------------|--------------|-----------------------|--------|-----|-----|------|-----|
| *H. velutinum*                | Mas    | H 4626 (= TS 28) | MAFF 243854 | HHUF 27966   | AB797240 AB807530 AB808505 LC014556 C |         |     |     |     |     |
| *H. velutinum*                | Mas    | H 4739 (= TS 58) | MAFF 243855 | HHUF 28243   | AB797235 AB807525 AB808501 LC014557 C |         |     |     |     |     |
| *H. velutinum*                | Mas    | 96            | MAFF 243859 | HHUF 30140   | AB797239 AB807529 AB808504 LC014558 C |         |     |     |     |     |
| *Karstenula rhodostoma*       | Did    | –             | CBS 691.94  | UPS (F-141152) 425947 | AB797241 AB807531 AB808506 LC014559 A |         |     |     |     |     |
| *K. brevisaca*                | Len    | KT 1517a      | JCM 13131 = MAFF 239641 | HHUF 28661°  | AB524454 AB524595 AB539108° LC014560 A |         |     |     |     |     |
| *K. brevisaca*                | Len    | KT 540        | JCM 19413 = MAFF 239476 | HHUF 27715°  | AB797296 AB807586 AB808565 AB811453 C |         |     |     |     |     |
| *K. culmifera*                | Len    | KT 2642       | JCM 19417 = MAFF 243849 | HHUF 30136   | AB797302 AB807592 AB808571 LC014562 A |         |     |     |     |     |
| *K. gloeospora*                | Len    | KT 829        | MAFF 239474 | HHUF 27704   | AB797299 AB807589 AB808568 LC014563 A |         |     |     |     |     |
| *K. quadriseptata*            | Len    | KT 2292       | CBS 139692 = JCM 19418 = MAFF 243850 | HHUF 30137°  | AB797303 AB807593 AB808572 AB811456 A |         |     |     |     |     |
| *Keissleriella breviscava*     | Len    | KT 895        | JCM 19420 = MAFF 243845 | HHUF 27705   | AB797300 AB807590 AB808569 – A |         |     |     |     |     |
| *K. cultifera*                | Len    | KT 571        | MAFF 243846 | HHUF 27707   | AB797305 AB807595 AB808574 LC014564 A |         |     |     |     |     |
| *K. culmifera*                | Len    | KT 594        | MAFF 236874 | HHUF 27709   | AB797306 AB807596 – – A |         |     |     |     |     |
| *K. culmifera*                | Len    | KT 678        | MAFF 236475 | HHUF 27711   | AB797307 AB807597 AB808575 LC014565 A |         |     |     |     |     |
| *K. yonaguniensis*            | Len    | KT 2604       | CBS 139693 = JCM 19419 = MAFF 243851 | HHUF 30138°  | AB797304 AB807594 AB808573 AB811457 A |         |     |     |     |     |
| *Lentintheicum clioninum*     | Len    | KT 1119       | JCM 19421 = MAFF 243840 | HHUF 29053°  | AB797254 AB807544 AB808520 AB809632 A |         |     |     |     |     |
| *L. clioninum*                | Len    | KT 1111       | JCM 19421 = MAFF 243840 | HHUF 29053°  | AB797254 AB807544 AB808520 AB809632 A |         |     |     |     |     |
| *L. pseudoclioninum*          | Sul    | KT 2822       | CBS 139696 = JCM 19422 = MAFF 243841 | HHUF 30125°  | AB797219 AB807509 AB808485 AB809640 C |         |     |     |     |     |
| *Massarina cisti*             | Mas    | –             | CBS 266.62 = JCM 14140 | ZT (Hütter & Loefler)°° | AB797249 AB807539 AB808514 LC014568 A |         |     |     |     |     |
| *M. eburnea*                  | Mas    | 3953          | CBS 139697 = JCM 14422 | HHUF 26621   | AB521718° AB521735° AB808517 LC014569 A |         |     |     |     |     |
| *Monodictys capensis*         | IS     | HR 1          | CBS 134928 = VKM F-4506 | HHUF 29712   | AB797261 AB807551 AB808527 LC014570 C |         |     |     |     |     |
| *Monodictys sp.*              | Par    | JO 10         | MAFF 243825 | HHUF 30123   | AB797262 AB807552 AB808528 – C |         |     |     |     |     |
| *Monodictys sp.*              | Par    | KH 331        | MAFF 243826 | HHUF 30124   | AB797263 AB807553 AB808529 – C |         |     |     |     |     |
| *Morosphaeria ramunculicola*  | Mor    | KH 220        | NBRC 107813 | HHUF 30070   | AB797264 AB807554 AB808530 – A |         |     |     |     |     |
| *M. velatispora*              | Mor    | KH 218        | JCM 17529 = NBRC 107814 | HHUF 30072   | AB797265 AB807555 AB808531 LC014571 A |         |     |     |     |     |
| *M. velatispora*              | Mor    | KH 221        | JCM 17530 = NBRC 107812 | HHUF 30073   | AB797266 AB807556 AB808532 LC014572 A |         |     |     |     |     |
| *Neokalmusia brevispora*      | Did    | KT 1466       | CBS 120248 = JCM 13543 = MAFF 239276 | HHUF 28229   | AB524459 AB524600 AB539112° LC014573 A |         |     |     |     |     |
| *N. brevispora*               | Did    | KT 2313       | NBRC 106240 | HHUF 30016°  | AB524460 AB524601 AB539113° LC014574 A |         |     |     |     |     |
| *N. scabrispora*              | Did    | KT 1023       | CBS 120246 = JCM 12851 = MAFF 239517 | HHUF 28608   | AB524452° AB524593 AB539106° LC014575 A |         |     |     |     |     |
| Taxon                        | Family     | Original no. | Culture no.   | Specimen no. | GenBank accession no. | Notes |
|-----------------------------|------------|--------------|---------------|--------------|-----------------------|-------|
| N. scabrispora              | Did        | KT 2202     | NBRC 106237   | HHUF 30013   | AB5244531, AB5245941, AB5391072 | LC014576 |
| Necrophosphaerea sasicola   | Len        | KT 1706     | CBS 120247 = JCM 13134 = MAFF 239644 | HHUF 29443ET | AB5244581, AB5245991, AB5391112 | LC014577 |
| Parabambusicola bambusina  | Par        | H 4321      | MAFF 239462   | HHUF 26590   | AB797246, AB807536, AB808511 | LC014578 |
| P. bambusina               | Par        | KH 139      | MAFF 243823   | HHUF 30121   | AB797247, AB807537, AB808512 | LC014579 |
| P. bambusina               | Par        | KT 2637     | MAFF 243822   | HHUF 30120   | AB797248, AB807538, AB808513 | LC014580 |
| Paraphaeosphaeria michotii | Did        | KT 2222     | MAFF 243861   | HHUF 30142   | AB797269, AB807559, AB808535 | AB809639 |
| Periconia byssoides        | Per        | H 4600 (= TS 29) | MAFF 243872 | HHUF 28238   | AB797280, AB807570, AB808546 | LC014581 |
| P. byssoides               | Per        | H 4432      | MAFF 243869   | –           | AB797279, AB807569, AB808545 | LC014582 |
| P. byssoides               | Per        | H 4853 (= TS 60) | MAFF 243873 | –           | AB797281, AB807571, AB808547 | LC014583 |
| P. digitata                | Per        | –           | CBS 510.77    | –           | AB797271, AB807561, AB808537 | LC014584 |
| P. homothallica            | Per        | KT 916      | CBS 139698 = JCM 13100 = MAFF 239610 | HHUF 29105IT | AB797275, AB807565, AB808541 | AB809645 |
| P. igniaria                | Per        | –           | CBS 379.86    | –           | AB797276, AB807566, AB808542 | LC014585 |
| P. igniaria                | Per        | –           | CBS 845.96 = JCM 14142 | –           | AB797277, AB807567, AB808543 | LC014586 |
| P. pseudobyssoides         | Per        | H 4151      | MAFF 243868   | –           | AB797278, AB807568, AB808544 | LC014587 |
| P. pseudobyssoides         | Per        | H 4790 (= TS 102) | MAFF 243874 | HHUF 28257   | AB797270, AB807560, AB808536 | LC014588 |
| P. pseudodigitata          | Per        | KT 644      | JCM 13164 = MAFF 239674 | HHUF 27566ET | AB797272, AB807562, AB808538 | LC014589 |
| P. pseudodigitata          | Per        | KT 1195A    | JCM 13165 = MAFF 239675 | HHUF 29368ET | AB797273, AB807563, AB808539 | LC014590 |
| P. pseudodigitata          | Per        | KT 1395     | CBS 139699 = JCM 13166 = MAFF 239676 | HHUF 29370ET | AB797274, AB807564, AB808540 | LC014591 |
| Periconia sp.              | Per        | KT 1820A    | MAFF 243870   | HHUF 30148   | AB797282, AB807572, AB808548 | – |
| Periconia sp.              | Per        | KT 1825     | MAFF 243871   | HHUF 30149   | AB797283, AB807573, AB808549 | – |
| Pseudocoleophoma calamagrostidis | Dic | KT 3284     | CBS 139700   | HHUF 30450IT | LC014604, LC014609, LC014614 | LC014592 |
| P. polygonicola            | Dic        | KT 731      | CBS 139701 = JCM 19412 = MAFF 239468 | HHUF 27558IT | AB797256, AB807546, AB808522 | AB809634 |
| Setoseptoria arundinacea   | Len        | KT 552      | MAFF 239460   | HHUF 27543   | AB797284, AB807574, AB808550 | LC014594 |
| S. arundinacea             | Len        | KT 600      | MAFF 243842   | HHUF 27544   | AB797285, AB807575, AB808551 | LC014595 |
| S. magniarundinacea        | Len        | KT 1174     | CBS 139702 = MAFF 239294 | HHUF 28292IT | AB797286, AB807576, AB808552 | LC014596 |
| Spegazzinia deightonii     | Did        | yone 66     | MAFF 243876   | HHUF 30150   | AB797291, AB807581, AB808557 | – |
| S. deightonii              | Did        | yone 212    | MAFF 243877   | HHUF 30151   | AB797292, AB807582, AB808558 | – |
| Spegazzinia sp.            | Did        | yone 279    | MAFF 243878   | HHUF 30152   | AB797293, AB807583, AB808559 | – |
| S. tessarthra              | Did        | SH 287      | MAFF 243875   | HHUF 27691   | AB797294, AB807584, AB808560 | – |
| Stagonospora perfecta      | Mas        | KT 1726A    | JCM 13099 = MAFF 239609 | HHUF 29095   | AB797289, AB807579, AB808555 | AB809642 |
| S. pseudoperfecta          | Mas        | KT 889      | CBS 120236 = JCM 13097 = MAFF 239607 | HHUF 29087IT | AB797287, AB807577, AB808553 | AB809641 |
| Stagonospora sp.           | Mas        | KT 903      | CBS 120237 = JCM 13098 = MAFF 239608 | HHUF 29088   | AB797288, AB807578, AB808554 | – |

(continued on next page)
RESULTS

Molecular phylogenetic analysis

Approximately 940–1750 bp of SSU, 870–1330 bp of LSU nrDNA, 830–940 bp of tef1, and 500–900 bp of ITS sequences were determined for 106 isolates of fungi within the Massarineae. Analyses of different gene datasets were performed individually, but no topological conflict was observed at familial level with the exception of Lentitheciaceae, which was polyphyletic in the tef1 tree (data not shown). A combined dataset of SSU, LSU, and tef1 sequences was generated after excluding insertions of several species which corresponded to positions 493–1,005 of Monodictys capensis (GenBank AB797261) and positions 1,286–1,651 of Magnicamarosporium inomotense (GenBank AB797219) in the SSU, and positions 836–892 of Montagula spartii (GenBank GU205225) and positions 871–924 of Hypostrum pulicare (GenBank FJ161201) in the LSU sequences. The combined dataset consisted of 243 taxa and 3,386 characters, of which 28 % were missing and gap characters. The alignment had 82 % representation for SSU, 100 % for LSU and 60 % for tef1. BP support of each familial clade in the LSU tree was generally improved by adding the SSU and tef1 dataset with missing data, e.g., from 82 % to 100 % in the Massarineae, and from 90 % to 100 % in the Trematosphaeriaceae.

The ML tree of Massarineae based on the SSU and LSU nrDNA and tef1 regions with the highest log likelihood (~36965.0525) is shown in Fig. 1. A total of 237 taxa of the Massarineae formed a clade (with 98 % BP support) and were scattered in 12 familial clades and five unknown clades. Seven families previously recognised, namely the Dictyosporaceae (nom. prov., 100 % BP), Didymosphaeriaceae (99 % BP), Latoruaceae (99 % BP), Macrodiplodiopsidaceae (96 % BP), Massarineae (100 % BP), Morosphaeriaceae (98 % BP), and Trematosphaeriaceae (100 % BP) were highly supported as independent monophyletic groups. The Bambusicolaceae and Lentitheciaceae received moderate BP support, 87 % and 71 %, respectively. We erected two new families, the Para-bambusicolaceae (81 % BP) and Sulcatisporaceae (97 % BP), to accommodate several genera, which cannot be placed in any of the existing families in the Massarineae. Although species in the genus Periconia have been treated as members of the Massarineae (Zhang et al. 2012, Hyde et al. 2013), we have placed them in a distinct family, the Periconiaceae (100 % BP), which was established by Nannizzi (1934).

Taxonomy

As a result of morphological comparisons and phylogenetic analyses of 106 strains, along with sequences from 131 taxa obtained from GenBank, at least 12 families including two new families (the Para-bambusicolaceae and Sulcatisporaceae) are recognised. Ten new genera, 22 new species, and seven new combinations are proposed. Taxa are arranged in alphabetical
### Table 2. Cultures and GenBank accession numbers of Massarineae used for phylogenetic analysis.

| Taxon                        | Family | Culture no. | GenBank accession no. |
|------------------------------|--------|-------------|-----------------------|
| *Aflatoxinithrium aptrootii* | Did    | CBS 980.95<sup>IT</sup> | NS JX496234 NS         |
| *Aqualicheirospora lignicola* | Dic    | RK-2006<sup>IT</sup> | AY736377 AY736378 NS   |
| *Aquillomyces patris*        | Mor    | CBS 135661<sup>IT</sup> | KP184077 KP184041 NS   |
| *Asteromassaria pulchra*     | IS     | CBS 124082 | GU296137 GU301800 GU349066 |
| *Bambusicola bambusae*       | Bam    | MFLUCC 11-0614<sup>IT</sup> | JX442039 JX442035 NS   |
| *B. irregulispora*           | Bam    | MFLUCC 11-0437<sup>IT</sup> | JX442040 JX442036 NS   |
| *B. loculata*                | Bam    | MFLUCC 13-0856<sup>IT</sup> | KP761735 KP761729 KP761724 |
| *B. massarinia*              | Bam    | MFLUCC 11-0389<sup>IT</sup> | JX442041 JX442037 NS   |
| *B. splendida*               | Bam    | MFLUCC 11-0439<sup>IT</sup> | JX442042 JX442038 NS   |
| *Bambusistroma didymosporum* | Per    | MFLUCC 13-0862<sup>IT</sup> | KP761730 KP761727      |
| *Bimunia novae-zelandiae*    | Did    | CBS 107.79<sup>IT</sup> | AYO16338 AYO16356 DQ471087 |
| *Byssothecium circinans*     | Mas    | CBS 675.92 | GU205235 AYO16357 GU349061 |
| *Camarographium koreanum*    | Mac    | CBS 117159<sup>IT</sup> | NS JQ044451 NS         |
| *Corynespora leucadendri*    | Mas    | CBS 135133 | NS KF251654 NS         |
| *C. olivacea*                | Mas    | CBS 114450 | GU301809 GU349014      |
| *Cucurbidothis pityophila*   | Did    | CBS 149.32 | U42480 DQ384102 NS     |
| *Darksidea alpha*            | Len    | CBS 135659<sup>IT</sup> | KP184049 KP184019 KP184166 |
| *D. beta*                    | Len    | CBS 135636<sup>IT</sup> | KP184074 KP184023 KP184189 |
| *D. gamma*                   | Len    | CBS 135634<sup>IT</sup> | KP184073 KP184028 KP184188 |
| *D. delta*                   | Len    | CBS 135638<sup>IT</sup> | KP184069 KP184024 KP184184 |
| *D. epsilon*                 | Len    | CBS 135658<sup>IT</sup> | KP184070 KP184029 KP184186 |
| *D. zeta*                    | Len    | CBS 135640<sup>IT</sup> | KP184071 KP184031 KP184191 |
| *Dendryphiella vinosa*       | Dic    | –           | EU848589 EU848590 NS   |
| *Deniqueulata barringtoniae* | Did    | CBS 110422<sup>IT</sup> | JX254656 JX254655 NS   |
| *Dictyosporium alatum*       | Dic    | ATCC 34953<sup>IT</sup> | DQ018080 DQ018101 NS   |
| *D. elegans*                 | Dic    | NBRC 32502 | DQ018079 DQ018100 NS   |
| *D. infatum*                 | Dic    | NTOU 3855  | JQ267361 JQ267363 NS   |
| *D. meiosporum*              | Dic    | MFLUCC 10-0131<sup>IT</sup> | KP710946 KP710945 NS   |
| *D. stellatum*               | Dic    | CCFC 241241<sup>IT</sup> | NS JF951177 NS         |
| *D. streltzii*               | Dic    | CBS 123359<sup>IT</sup> | NS FJ839653 NS         |
| *D. thailandicum*            | Dic    | MFLUCC 13-0773<sup>IT</sup> | KP716707 NS          |
| *D. toruloides*              | Dic    | CBS 209.65 | DQ018081 DQ018104 NS   |
| *Didymocrea sadasivanii*     | Did    | CBS 438.65<sup>IT</sup> | DQ384066 DQ384103 NS   |
| *Didymosphaeria rubi-ulmifolii* | Did | MFLUCC 14-0023<sup>IT</sup> | KJ436588 KJ436586 NS   |
| *D. spirii*                  | Mas    | CBS 183.58 | GU205250 GU205225 NS   |
| *Digitosdium bambusicola*    | Dic    | CBS 110279<sup>IT</sup> | NS DQ018103 NS         |
| *Diplococcium asperum*       | Dic    | CBS 139.95 | EF204511 EF204493 NS   |
| *Falcoformispora lignifilis* | Tre    | BCC 21117  | GU371834 GU371826 GU371819 |
| *F. senegalensis*            | Tre    | CBS 196.79<sup>IT</sup> | KF015636 KF015631 KF015687 |
| *F. tompkinsii*              | Tre    | CBS 200.79<sup>IT</sup> | KF015639 KF015625 KF015685 |
| *Flavomycetes fulophazii*    | Per    | CBS 135761<sup>IT</sup> | KP184082 KP184040 NS   |
| *Halomassarina thalassiae*   | Tre    | BCC 17054  | GQ025842 GQ025849 NS   |
| *H. thalassiae*              | Tre    | JK 5262D  | NS GU301816 GU349011  |
| *Helicascus aegyptiacus*     | Mor    | FWCC 99<sup>IT</sup> | KCS94852 KCS94853 NS   |
| *H. aquaticus*               | Mor    | MFLUCC 10-0918<sup>IT</sup> | KCS86638 KCS86640 NS   |
| *H. elaterascus*             | Mor    | A22-SA = HKUCC 7769 | AFO53727 AY787934 NS   |
| *H. nypae*                   | Mor    | BCC 36751  | GU479754 GU479788 GU479854 |
| *H. nypae*                   | Mor    | BCC 36752  | GU479755 GU479789 GU479855 |
| *H. thallassiodicus*         | Mor    | MFLUCC10-0911 | KCS86637 KCS86636 NS   |

(continued on next page)
| Taxon                          | Family ¹ | Culture no. ² | GenBank accession no. ³ | SSU | LSU | tef1 |
|-------------------------------|----------|---------------|-------------------------|-----|-----|-----|
| H. unilocularis               | Mor      | MUF14020¹T    |                         | NS  |     |     |
| Hysterium pulicare            | OG       | CBS 12337     | FJ161161                |     | FJ161201 | FJ161109 |
| Hysterobrevium mori           | OG       | CBS 12356     | FJ161155                |     | FJ161196 | FJ161104 |
| Inflatispora pseudostromatica | IS       | CBS 123110¹T  | JN231132                |     | JN231131 |     |
| *Kalmusia* (Montagnula) anthostomoides | Did | CBS 615.86    | GU205246                |     |     |     |
| K. ebuli                      | Did      | CBS 123120¹T  | JN851818                |     |     |     |
| K. italicA                    | Did      | MFLUCC 13–0066¹T | KP325442                 |     |     |     |
| K. spartii                    | Did      | MFLUCC 14–0560¹T | KP753953                 |     |     |     |
| K. varispora                  | Did      | CBS 121517¹T  | NS                      |     |     |     |
| K. sparticola                 | Len      | MFLUCC 14–0196¹T | KP369571                 |     |     |     |
| K. trichophoricola            | Len      | CBS 136770¹T  | NS                      |     |     |     |
| Latorua caligans              | Lat      | CBS 576.65¹T  | NS                      |     |     |     |
| L. grootfonteiensis           | Lat      | CBS 369.72¹T  | NS                      |     |     |     |
| Lenthecidium aquaticum        | Len      | CBS 123099¹T  | GU296156                |     |     |     |
| L. fluviale                   | Len      | CBS 122367    | GU296158                |     |     |     |
| Leptosphaeria doliolum        | Lep      | CBS 505.75    | GU296159                |     |     |     |
| Letendraea eurotioides        | Did      | CBS 212.31    | NS                      |     |     |     |
| L. helminthicola              | Len      | CBS 884.85    | AY016345                |     |     |     |
| L. padouk                     | Did      | CBS 485.70    | GU296162                |     |     |     |
| Lophiostruma arundinis        | Lop      | JCM 13550     | AB618679                |     |     |     |
| L. macrostomorum              | Lop      | JCM 13544     | AB618691                |     |     |     |
| Macrodiplodiopsis desmazieri  | Mac      | CBS 140062¹T  | NS                      |     |     |     |
| M. desmazieri                 | Mac      | CBS 221.37    | DO678013                |     |     |     |
| Massarina eburnea             | Mas      | CBS 473.64    | GU296170                |     |     |     |
| Montagnula aices              | Did      | CBS 132531¹T  | NS                      |     |     |     |
| M. graminicola                | Did      | MFLUCC 13–0352¹T | KM658316                |     |     |     |
| M. opulenta                   | Did      | CBS 168.34    | AF684370                |     |     |     |
| Morosphaeria ramunculicola    | Mor      | BCC 18404     | GQ925838                |     |     |     |
| M. velatispora                | Mor      | BCC 17059     | GQ925841                |     |     |     |
| Multiseptospora thailandica   | Par      | MFLUCC 11–0183¹T | KP753955                 |     |     |     |
| Monkvalssaria appendiculata   | Did      | CBS 109027¹T  | NS                      |     |     |     |
| Munlenthecidium clementioidis | Len      | MFLUCC 14–0561¹T | KM408761                 |     |     |     |
| Neobambusicola streitiae      | Sul      | CBS 138869¹T  | NS                      |     |     |     |
| Neosia banksiae               | Per      | CBS 129526¹T  | NF951167                |     |     |     |
| Palmiascoma greganiascomum    | Barn     | MFLUCC 11–0175¹T | KP753958                 |     |     |     |
| Paracamarosporium leucandetri | Did      | CBS 123027¹T  | EU552106                |     |     |     |
| P. psoralae                   | Did      | CBS 136628¹T  | NS                      |     |     |     |
| Paraconiothyrium estuarinum   | Did      | CBS 109850¹T  | NS                      |     |     |     |
| "P." flavescens              | Did      | CBS 178.93    | GU238216                |     |     |     |
| "P." fuckeli                  | Did      | CBS 797.95    | GU238204                |     |     |     |
| P. maculicuvis                | Did      | CBS 101461¹T  | EU754101                |     |     |     |
| P. thysanolaenae              | Did      | MFLUCC 10–0550¹T | KP753959                 |     |     |     |
| "P." tiliae                   | Did      | CBS 265.94¹T  | EU754040                |     |     |     |
| Paraphaeosphaeria michotii    | Did      | CBS 652.86    | GQ387520                |     |     |     |
order by family, genus, and species. For the known species a brief description and/or taxonomic notes are provided.

**Dictyosporiaceae** nom. prov. (see Liu et al. 2015)

**Type genus:** Dictyosporium Corda.

| Taxon                          | Family1                        | Culture no.2 | GenBank accession no.3 |
|-------------------------------|--------------------------------|--------------|------------------------|
| "P." sparti                 | Did                            | MFLUCC 13–03982TT | KP711367                |
| *Periconia macropinosa*       | Per                            | CBS 135663    | KP184080               |
| *Phaeodothis winteri*         | Did                            | CBS 182.58    | GU296183               |
| *Phragmocamarosporium hederae*| Len                            | MFLUCC 13–05522TT | KP842918               |
| *P. platani*                 | Len                            | MFLUCC 14–11911TT | KP842919               |
| "Pithomyces" valparadiicus   | Mor                            | CBS 113339    | NS E552152              |
| *Pleospora herbarum*          | Ple                            | CBS 191.86    | DQ247812               |
| *Pleurophoma pleurospora*     | Len                            | CBS 130326 L7 | NS JF740327            |
| *Poaceascoma helicoides*      | Len                            | MFLUCC 11–01361TT | KP998463               |
| *P. tilicola*                 | Did                            | MFLUCC 13-05502TT | KJ819950               |
| *Pseudocamarosporium brabei*  | Did                            | CBS 1192192TT | NS E552104              |
| *P. cotinae*                 | Did                            | MFLUCC 14–06241TT | KP753964               |
| *P. propinquum*               | Did                            | MFLUCC 13–05442TT | KJ819949               |
| *P. lariformis*               | Lat                            | CBS 463.88    | NS EF204503             |
| *P. tertiola*                 | Lat                            | CBS 301.652TT | EF204519               |
| *Pseudocamarosporium brabei*  | Did                            | CBS 1192192TT | NS E552104              |
| *P. cotinae*                 | Did                            | MFLUCC 14–06241TT | KP753964               |
| *P. propinquum*               | Did                            | MFLUCC 13–05442TT | KJ819949               |
| *P. tilicola*                 | Did                            | MFLUCC 13-05502TT | KJ819950               |
| *Pseudochaetosphaerena larense*| Mac                            | CBS 640.732TT | KF015652               |
| *Pseudodictyosporium elegans* | Len                            | CBS 688.932TT | DQ018084               |
| *P. wauenese*                | Dic                            | CBS 30078     | DQ018083               |
| *Setospora arundinacea*       | Len                            | CBS 619.86    | GU296157               |
| *S. arundinacea*              | Len                            | CBS 123131    | GU456298               |
| *S. phragmitis*               | Len                            | CBS 1148022TT | NS KF251752            |
| *S. phragmitis*               | Len                            | CBS 1149662TT | NS KF251753            |
| *Sporidesmiella fusiformis*   | Did                            | HKUCC 10831   | NS DQ048577            |
| "Sporidesmium" kangi*         | Per                            | HKUCC 10837   | NS DQ048559            |
| *S. macrocyndenia*            | Len                            | CBS 114202    | GU296198               |
| *S. paludosa*                 | Mas                            | CBS 1350932TT | NS KF251758            |
| *S. (Neottiospora) paspali*   | Mas                            | CBS 331.37    | EU754073               |
| *S. perfecta*                 | Mas                            | CBS 1350992TT | NS KF251761            |
| *S. pseudocaricis*            | Mas                            | CBS 1351322TT | NS KF251763            |
| *S. pseudolaudosa*            | Mas                            | CBS 1364242TT | NS KFF77239             |
| *S. pseudovitensis*           | Mas                            | CBS 6022TT    | NS KF251765            |
| *S. trichophoricola*          | Mas                            | CBS 1367642TT | NS KJ869168            |
| *S. uniseptata*               | Mas                            | CBS 1350902TT | NS KF251767            |
| *Suttonomyces grisea*          | Mas                            | MFLUCC 14–02402TT | KP842920               |
| *Trematosphaeria grisea*       | Tre                            | CBS 332.502TT | KF015641               |
| *T. grisea*                   | Tre                            | CBS 135984    | KF015632               |
| *T. pertusa*                  | Tre                            | CBS 1223682TT | FJ020991               |

1 Abbreviation of family names: Acr (*Acrocalymmataceae*), Bam (*Bambusicolaceae*), Dic (*Dictyosporaceae*), Did (*Didymosphaeriaceae*), IS (*insertae sedis*), Lat (*Latoriuaceae*), Len (*Lentitheciaceae*), Lep (*Leptosphaeriaceae*), Lop (*Lophiostomataceae*), Mac (*Macrodiplodiopsidaceae*), Mas (*Massarinaceae*), Mor (*Morosphaeriaceae*), OG (outgroup), Par (*Parabambusicolaceae*), Per (*Periconiaceae*), Ple (*Pleosporaceae*), Sul (*Sulciatistiporaceae*), and Tre (*Trematosphaeriaceae*).

2 Isolate ex ET (epitype), HT (holotype), IT (isotype), LT (lectotype), NT (neotype), and PT (paratype).

3 NS: No sequence available in GenBank.

**Dictyosporium** Corda, Weitenweber’s Beitr. Nat.: 87. 1836.

**Type species:** *Dictyosporium elegans* Corda.

**Notes:** *Dictyosporium* species have been reported worldwide from dead wood and decaying leaves in terrestrial and
Massarineae

Didymosphaeriaceae

Massarinae based on the SSU and LSU nrDNA and tef1 regions. ML bootstrap proportion (BP) greater than 50 % is presented at the nodes. An original isolate designation (or culture collection number) is noted after the species name. Sequences derived from holotype, isotype, neotype, paratype and epitype.

Fig. 1. Maximum-likelihood tree of Massarineae based on the SSU and LSU nrDNA and tef1 regions. ML bootstrap proportion (BP) greater than 50 % is presented at the nodes. An original isolate designation (or culture collection number) is noted after the species name. Sequences derived from holotype, isotype, neotype, paratype and epitype.
Fig. 1. (Continued).

materials are indicated as HT, IT, NT, PT and ET, respectively. Species used for morphological observation in this study are formatted in bold. New names are marked by five-pointed stars. Families, where known, are indicated with coloured blocks. The tree was rooted to Hysterobrevium mori in the Hysteriales. The scale bar represents the number of nucleotide substitutions per site.
freshwater environments. The genus is characterised by pigmented, cheloid conidia formed on sporodochial colonies. It has been considered that the genus is closely related to the Massarineae in the Pleosporales based on phylogenetic analysis using SSU and LSU nrDNA sequences (Tsui et al. 2006). After taxonomic revision of the genus (Goh et al. 1999, Cai et al. 2003), 33 species were accepted as Dictyosporium (Crous et al. 2009a). In addition, 16 species have been further recorded in this genus (Manoharachary et al. 2007, Zhang et al. 2009a, Wongsawas et al. 2009, Hu et al. 2010, McKenzie 2010, Crous et al. 2011a, Whilton et al. 2012, Kirschner et al. 2013, Liu et al. 2015, Prasher & Venema 2015).

**Dictyosporium bulbosum**

Tzean & J.L. Chen, Mycol. Res. 92: 500. 1989. Fig. 2A–C.

Specimens examined: Japan, Okinawa, Isl. Irinomote, near Maryu-falls, on dead twigs of woody plant, 27 Sep. 2007, H. Yonezawa & K. Tanaka, yone 221 = HHUF 29990, culture MAFF 138869.
Dictyosporium aff. bulbosum Fig. 2D–F.

Specimen examined: Japan, Okinawa, Isl. Iriomote, Uehara, near Tropical Biosphere Research Center (Ryukyu Univ.), small stream, on submerged twigs of woody plant, 13 Jul. 2011, K. Hirayama & K. Tanaka, KH 375 = HHUF 30127, culture JCM 19403 = MAFF 243829.

Notes: The above isolate produced an asexual morph in culture, which is similar to that on the natural specimen. Conidia in culture were 36–50 × 26–33 μm (av. 45.7 × 29.1 μm, n = 33), l/w 1.3–1.8 (av. 1.6, n = 33), consisting of 29–47 cells arranged in 5–6 rows, with apical appendages. These features almost agree with the description in the protologue of D. bulbosum (Tzean & Chen 1989), but the ITS sequences of our material (KH 375; GenBank LC014542) differed from those of D. bulbosum (GenBank LC014544 and DQ018086) in ca. 8 % (40/515) positions.

Dictyosporium digitatum J.L. Chen et al., Mycol. Res. 95: 1145. 1991. Fig. 2G–I.

Specimens examined: Japan, Okinawa, Isl. Ishigaki, trail of Mt. Omoto, on dead stems of herbaceous plant, 16 Jul. 2011, K. Hirayama & K. Tanaka, KH 401 = HHUF 30128, culture JCM 19404 = MAFF 243830; Okinawa, Isl. Iriomote, Komi, on dead wood of Castanopsis sieboldii, 15 Sep. 2009, Y. Kurihara, KT 2660 = HHUF 30131, culture JCM 19405 = MAFF 243833; Okinawa, Isl. Iriomote, Kanpire-falls, on dead twigs of woody plant, 21 Nov. 2008, K. Tanaka & K. Hirayama, yone 280 = HHUF 30093, culture MAFF 243837.

Notes: The morphological characters of our specimens are consistent with those of D. digitatum (Chen et al. 1991), as reported by Hirayama et al. (2012). The ITS sequences of this species from our three isolates were highly similar (99.1–99.8 %) but their similarities with a deposited sequence of D. digitatum in GenBank (GenBank DQ018089) were rather low (90.1–90.4 %).

Dictyosporium aff. heptasporum Fig. 2J–L.

Specimen examined: Japan, Okinawa, Isl. Ishigaki, Mt. Banna, near small stream, on dead twigs of woody plant, 14 Jul. 2011, K. Hirayama & K. Tanaka, KH 332 = HHUF 30126, culture JCM 19406 = MAFF 243828.

Notes: The morphological features of the above specimen were as follows; conidia 70–90 × 21–31 μm (av. 79.7 × 23.3 μm,
n = 43), cylindrical, l/w 3.1–3.9 (av. 3.4, n = 43), with (5–)7 rows, 16–18-septate, without appendages. This agrees with the details in the description of *D. heptasporum* (Goh et al. 1999), but the conidia in our material are somewhat larger (vs. 50–80 × 20–30 μm; Goh et al. 1999). A BLAST search using ITS sequences from our culture showed *D. heptasporum* (GenBank DQ018090) as the closest species, but the similarity was relatively low (493/518 = 95.2 %).

**Dictyosporium hughesi**i McKenzie, Mycotaxon 111: 156. 2010. Fig. 2M–O.

*Specimen examined:* *Japan*, Kagoshima, Isl. Yakushima, Shirataniunusuiko, on dead twigs of *Stewartia monadelpha*, 18 Oct. 2005; K. Tanaka & T. Hosoya, KT 1847 = HHUF 30130 = TNS-F-12407, culture JCM 19407 = MAFF 243832.

**Note:** This collection was identified as *D. hughesi* (McKenzie 2010) based on the conidial morphology; conidia 43–51 × 18–28 μm (av. 46.8 × 24.8 μm, n = 30), l/w 1.6–2.3(–2.6) (av. 1.9, n = 30), consisting of 50–71 cells arranged in 6–7 rows, with or without apical appendages.

**Dictyosporium pseudomusae** Kaz. Tanaka, G. Sato & K. Hiray., sp. nov. MycoBank MB811297. Fig. 2P–V.

**Etymology:** After its morphological similarity to *Dictyosporium musae*.

*Sporodochia* on natural substrate scattered, punctiform, dark brown to black. *Mycelium* immersed, 170–490 μm diam. *Conidiophores* micronematous, not differentiated from vegetative hyphae. *Conidiogenous cells* holoblastic, cylindrical, 5.5–8 μm wide. *Conidia* solitary, brown, ellipsoid to cylindrical, cheiroid, not complanate, (58–)61–78(–81) × 19–29(–33) μm (av. 69.9 × 22.9 μm, n = 60), l/w (2.2–)2.5–3.8(–4.0) (av. 3.1, n = 60), consisting of 78–100 cells arranged in (6–)7 rows and basal connecting cell (6–)8 × 5.5–8 μm); each row cylindrical, with 13–15 cells. *Appendages* globose to subglobose, hyaline, 6–11.5 μm diam, bearing from apical cells or side of outer rows. Sexual morph unknown.

Colonies on PDA (after 4 wk) attaining a diam of 3.9–4.4 cm, white to rosy buff; reverse buff to cinnamon; rosy vinaceous pigment produced. In culture asexual morph formed.

**Specimens examined:** *Japan*, Okinawa, Isl. Ishigaki, Mt. Banna, near small stream, on dead twigs of woody plant, 16 Jul. 2011, K. Tanaka & K. Hirayama, KT 2865 = HHUF 30132, culture JCM 19410 = MAFF 243834.

**Notes:** The collection matches the original description of *D. tetrasporum* (Cai & Hyde 2007a). The characters of our specimen are as follows; conidia 22–37 × 15–21 μm (av. 27.5 × 17.5 μm, n = 30), l/w 1.2–2.2 (av. 1.6, n = 30), consisting of 11–28 cells arranged in (3–)4 rows, without apical appendages. In culture, conidia were produced that were identical to those on the natural specimen (24–38 × 16–24 μm; av. 30.3 × 20.1 μm, n = 32).

**Gregarithecium** Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811298.

**Type species:** *Gregarithecium curvisporum* Kaz. Tanaka & K. Hiray.

**Etymology:** Referring to the gregarious ascomata.

Ascomata grouped, immersed to erumpent, depressed globose to hemispherical with flattened base in section. *Ostioral neck* short terete, central, with periphyses, covered by black clypeus. *Ascomatal wall* composed of thin-walled cells, surrounded by vertically-orientated stromatic tissue. *Pseudoparaphyses* septate, branched and anastomosed. *Asci* fissitunicate, cylindrical, short-stalked, with 8 biseriate ascospores. Ascospores broadly fusiform, with a median septum, hyaline, smooth, surrounded by an entire sheath. Asexual morph unknown.

**Type species:** *Gregarithecium curvisporum* Kaz. Tanaka & K. Hiray.

**Notes:** In its depressed globose ascomata with clYPEATE ostiole, *Gregarithecium* is reminiscent of species in *Massarina* s. *lat.* (Aptroot 1998, Tanaka & Harada 2003b), but *Gregarithecium* can be separated from the latter by the presence of stromatic tissue surrounding the ascomata. *Massarina* s. *lat.* is regarded as being polyphyletic and thus has recently been segregated into several new genera. These are scattered in the *Lentitheciaceae* (Tingoldiago; Hirayama et al. 2010), *Morosphaeriaceae* (Morosphaeria; Suetrong et al. 2009), *Trematosphaeriaceae* (Halomassarina; Suetrong et al. 2009), *Tetraplosphaeriaceae* (Triplosphaeria; Tanaka et al. 2009), and *Lindgomycetaceae* (Lindgomycetes; Hirayama et al. 2010), but are not so far reported in the *Dictyosporiaceae*.

**Gregarithecium curvisporum** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811299. Fig. 3.

**Etymology:** From the Latin *curvi-*, in reference to the curved ascospores.

Ascomata grouped in numbers of 3–6, immersed to erumpent, depressed globose to hemispherical with flattened base in section, 140–180 μm high, 290–430 μm diam. *Ostioral neck* short terete, central, with an ostiole (25–50 μm diam) and short periphyses, covered by a black clypeus composed of small cells (2.5–7.5 × 1–3 μm). *Ascomatal wall* in longitudinal section 8–12 μm thick at the sides, composed of thin-walled, flattened, pale brown cells, surrounded by vertically-orientated stromatic...
tissue composed of rectangular to polygonal cells (5–25 × 5–16 μm) or by compact brown hyphae. *Pseudoparaphyses* septate, branched and anastomosed, 2–3.5(-5) μm wide. *Asci* fissitunicate, cylindrical, 73.5–102 × 11–15.5 μm (av. 87.4 × 13.6 μm, n = 50), rounded at the apex, with a shallow ocular chamber (0.5–1 μm high), short-stalked (5–15 μm long; av. 9.6 μm, n = 32), with 8 biseriate ascospores. *Ascospores* broadly fusiform, mostly curved, 19–31 × 4.5–6.5 μm (av. 24.2 × 5.8 μm, n = 50), l/w (3.3–)3.6–4.9(-5.2) (av. 4.2, n = 50), with a median (0.50) septum and constricted, hyaline, smooth, with an entire sheath; sheath sharply delimited and 1–2 μm wide at first, diffuse and 4–8 μm wide at a later. Senescent ascospores 3-septate, thick-walled, dark brown.

Colonies on PDA (after 4 wk) attaining a diam of 6.2–6.8 cm, buff to smoke grey; reverse pale luteous to sienna; no pigment produced. In culture ascomatal and spermatial morphs observed. *Asci* 82.5–101.5 × 14.5–17.5 μm. *Ascospores* 21–31 × 6–8 μm (av. 24.5 × 7.0 μm, n = 31), l/w 3.1–4.2 (av. 3.5, n = 31). *Spermatia* 2.2–3.5 × 1.4–2.1 μm (av. 3.0 × 1.8 μm, n = 20), subglobose, hyaline.

*Specimen examined:* Japan, Aomori, Hirosaki, Kozawa, on dead culms of *Sasa* sp., 25 Oct. 2002, T. Handa (holotype KT 922 = HHUF 30134, culture ex-type CBS 139688 = JCM 19411 = MAFF 243838).

**Pseudocoleophoma** Kaz. Tanaka & K. Hiray., gen. nov.

MycoBank MB811300.

**Etymology:** Referring to the similarity of the asexual morph with that of *Coleophoma*.

**Ascomata** scattered to grouped, immersed to erumpent, globose to subglobose in section. *Ostiolar neck* central, composed of subglobose dark brown cells. *Ascomatal wall* composed of polygonal to rectangular cells. *Pseudoparaphyses* numerous. *Asci* fissitunicate, cylindrical to clavate, short-stalked, with 8 ascospores. *Ascospores* fusiform, 1-septate, smooth, with a conspicuous sheath. *Conidiomata* coleophoma-like, pycnidial, subglobose. *Conidiophores* absent. *Conidiogenous cells* phialidic, doliform to lageniform. *Conidia* cylindrical, hyaline, smooth.

**Type species:** *Pseudocoleophoma calamagrostidis* Kaz. Tanaka & K. Hiray.

**Notes:** The pycnidial asexual morph of *Pseudocoleophoma* bears a slight resemblance to that of *Coleophoma*. The type species of *Coleophoma* (*C. crateriformis*), however, has pycnidia possessing paraphyses that are not found in *Pseudocoleophoma*, and is a member of the *Dothideales*, rather than the *Pleosporales* (De Gruyter et al. 2009).

**Pseudocoleophoma calamagrostidis** Kaz. Tanaka & K. Hiray., sp. nov. MB811301. Fig. 4.

**Etymology:** Referring to the host plant.

*Ascomata* scattered, immersed, erumpent at the top, globose to depressed globose, 140–200 μm high, 160–220 μm diam; ostiolate. *Ostiolar neck* central. *Ascomatal wall* in longitudinal section 5–10 μm thick at sides, composed of 2–3 layers of thin-walled, polygonal, flattened, 5–12 × 2–5 μm, brown cells; of polygonal to subglobose, 2–5 × 1.5–2.5 μm cells around ostiole. *Pseudoparaphyses* septic, branched and anastomosed, 2.5–5 μm wide. *Asci* fissitunicate, cylindrical, 62.5–80 × 7.5–10 μm (av. 69.0 × 8.4 μm, n = 50), rounded at the apex, with a shallow ocular chamber, short-stalked (5–12 μm long), with 8 biseriate ascospores. *Ascospores* narrowly fusiform,
Colonies on PDA (after 4 wk) attaining a diam of 2.3–3.2 cm, buff to honey; reverse similar; no pigment produced. In culture coelomycetous asexual morph formed. **Conidiomata** pycnidial, 220–300 μm high, (150–)250–500 μm diam, immersed to erumpent, depressed globose. **Ostiolar neck** well-developed, 75–100 μm long, 85–100 μm wide, cylindrical, central. **Conidiomatal wall** in longitudinal section uniformly 7.5–15 μm thick, composed of 3–4 layers of slightly thick-walled, polygonal to rectangular, 2–6 × 1.5–2.5 μm cells around ostiole. **Conidiophores** absent. **Conidiogenous cells** phialidic, 5–9 × 2–4 μm, doliiform to subglobose. **Conidia** cylindrical, aseptate, hyaline, smooth, 6–10 × 2–2.5 μm (av. 8.6 × 2.2 μm, n = 50), l/w 2.9–4.7 (av. 3.9, n = 50).

Specimen examined: Japan, Aomori, Hirosaki, Mt. Iwaki, on dead leaves of *Calamagrostis matsumurae*, 27 Jul. 2013, K. Tanaka (holotype KT 3284 = HHUF 30450, culture ex-type CBS 139700).

Note: This species is phylogenetically close to *P. polygonicola*, but the ITS sequence similarity between these two species is relatively low (490/521 = 94.0%).

**Pseudocoleophoma polygonicola** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811302. Fig. 5.

*Etymology:* Referring to the host plant.

**Ascomata** scattered to 2–4 grouped, immersed to erumpent, 230–310 μm high, 280–350 μm diam. **Ostiole** central, 50–75 μm long, 70–100 μm wide. **Ascomatal wall** in longitudinal section 7–13 μm thick at sides. **Pseudoparaphyses** 2–2.5 μm wide. **Asci** cylindrical to clavate, (67–)74–90(–100) × 9–12.5 μm (av. 81.3 × 10.7 μm, n = 48). **Ascospores** fusiform, (17.5–)19–23(–25) × 4–6 μm (av. 20.6 × 4.8 μm, n = 50), l/w 3.6–4.8 (av. 4.2, n = 45), with a septum supramedian (0.46–0.50; av. 0.48, n = 40), surrounded by a sheath; sheath 1–2 μm wide at sides, 2–5 μm long at both ends, staining with Black-Blue ink when in fresh condition.

Colonies on PDA (after 4 wk) attaining a diam of 3.4–4.8 cm, white; reverse white to straw; no pigment produced. In culture coelomycetous asexual morph formed. **Conidiomata** pycnidial,
170–250 μm diam. Conidiomatal wall in longitudinal section 12–15 μm wide at sides. Conidiophores absent. Conidiogenous cells phialidic, 7–17 × 3.5–5 μm, doliform to lageniform, formed all around the locular cavity. Conidia cylindrical, aseptate, hyaline, smooth, (9–)11.5–18(–21.5) × 3–4.5 μm (av. 14.4 × 3.4 μm, n = 31).

Specimen examined: Japan, Hokkaido, Isl. Rebun, Kafuka, Nairo-river, on dead stems of polygonaceous plant, 30 Aug. 2001, K. Tanaka (holotype KT 731 = HHUF 27558, culture ex-type CBS 139701 = JCM 19412 = MAFF 239468).

Notes: Additional details of this species were reported by Tanaka & Harada (2003b), who misidentified this fungus as Massarina rubi based mostly on the morphology of the sexual morph. However, *Pseudocoleophoma* is phylogenetically different from *M. rubi*, which belongs to the Lophiotremataceae (Zhang et al. 2009b, Hirayama & Tanaka 2011b). This species resembles *P. calamagrostidis* but has larger ascospores (20.6 × 4.8 μm vs. 17.4 × 3.8 μm) and conidia (14.4 × 3.4 μm vs. 8.6 × 2.2 μm).

**Didymosphaeriaceae** Munk, Dansk Bot. Ark. 15 (2): 128. 1953. = Montagnulaceae M.E. Barr, Mycotaxon 77: 194. 2001.

Type genus: *Didymosphaeria* Fuckel.

**Karstenula** Speg., Decades Mycologicae Italicae 7–12: no. 94. 1879.

Type species: *Karstenula rhodostoma* (Alb. & Schwein.) Speg.

Notes: This genus is phylogenetically close to *Paraphaeosphaeria*, but can be distinguished from the latter by the ascomata surrounded by well-developed subiculum and cylindrical asci with uniseriate ascospores.

**Karstenula rhodostoma** (Alb. & Schwein.) Speg., Decades Mycologicae Italicae 7–12: no. 94. 1879. Fig. 6.

Basionym: *Sphaeria rhodostoma* Alb. & Schwein., Consp. Fung. (Leipzig): 43. 1805.
Ascospores (Ariyawansa et al. 2014). Two bambusicolous species, *N. brevispora* on Sasa and *N. scabrispora* on *Phyllostachys* are known in this genus. Although they share many morphological features, monophyly of *Neokalmusia* was not supported in this study (Fig. 1). Additional taxa and sequence data of this genus are needed to evaluate validity of *Neokalmusia*.

**Neokalmusia brevispora** (Nagas. & Y. Otani) Kaz. Tanaka et al., Fungal Divers. 68: 92. 2014. **Fig. 7.**

Basionym: *Phaeosphaeria arundinacea* var. *brevispora* Nagas. & Y. Otani, Rep. Tottori Mycol. Inst. 15: 38. 1977.

*Neokalmusia brevispora* (Nagas. & Y. Otani) Kaz. Tanaka et al., Fungal Divers. 68: 92. 2014. **Fig. 7.**

Basionym: *Phaeosphaeria arundinacea* var. *brevispora* Nagas. & Y. Otani, Rep. Tottori Mycol. Inst. 15: 38. 1977.

Specimens examined: Japan, Hokkaido, Otofuke, Sapporo, Moiwa-yama, on culms of Sasa sp., 13 Jun. 1972, E. Nagasawa (holotype of *Phaeosphaeria arundinacea* var. *brevispora* TMI 3175); Fukushima, Minamiaizu, Ose pond, on dead twigs of Sasa sp., 30 Aug. 2003, N. Asama, KT 1466 = HHUF 28229, culture CBS 120248 = JCM 13543 = MAFF 239276; Hokkaido, Isl. Rishiri, Aitonomorani-river, on dead twigs of Sasa kurilensis, 29 Jul. 2007, K. Tanaka & G. Sato (epitype designated here KT 2313 = HHUF 30016, MBT202863, culture ex-epitype NBRC 106240).

**Neokalmusia Kaz.** Tanaka et al., Fungal Divers. 68: 92. 2014.

Type species: *Neokalmusia brevispora* (Nagas. & Y. Otani) Kaz. Tanaka et al.

Notes: For further description of this species including its asexual morph (*Microdiplodia frangulae*), see Constantinescu (1931) and Zhang et al. (2012). More than 360 species are recorded as *Microdiplodia* (MycoBank, http://www.mycobank.org), but the validity of this genus is unknown due to lack of phylogenetic information regarding the lectotype species, *M. conigena* (Clements & Shear 1931).

**Neokalmusia** Kaz. Tanaka et al., Fungal Divers. 68: 92. 2014.

Notes: For other descriptions of this species, see Nagasawa & Otani (1977), Shoemaker & Babcock (1989), Tanaka & Harada (2004), and Ariyawansa et al. (2014). Although this species was transferred to *Kalmusia* (Zhang et al. 2009b), subsequent molecular studies (Hyde et al. 2013, Zhang et al. 2014a) did not support this placement, and thus *Neokalmusia* was established to accommodate *N. brevispora* as the type species of this genus (Ariyawansa et al. 2014). We here designate an epitype specimen for this species.

Specimen examined: Sweden, "Odlingen" field, ca. 250 m S of Jerusalem, on twigs of *Frangula alnus*, Jan. 1995, K. Holm & L. Holm, UPS (F-141152) 425947, culture CBS 691.94.

Notes: For further description of this species, see Nagasawa & Otani (1977), Shoemaker & Babcock (1989), Tanaka & Harada (2004), and Ariyawansa et al. (2014). Although this species was transferred to *Kalmusia* (Zhang et al. 2009b), subsequent molecular studies (Hyde et al. 2013, Zhang et al. 2014a) did not support this placement, and thus *Neokalmusia* was established to accommodate *N. brevispora* as the type species of this genus (Ariyawansa et al. 2014). We here designate an epitype specimen for this species.
Paraphaeosphaeria date, about 35 taxa have been described as species within this genus. The type species is Paraphaeosphaeria O.E. Erikss., Ark. Bot. 6: 405. 1967.

Specimens examined: Japan, Tochigi, Kanuma, near Ooashi-river, on dead twigs of Phyllostachys bambusoides, 6 Mar. 2003, N. Asama, KT 1023 = HHUF 28608, culture CBS 120246 = JCM 12851 = MAFF 239517; Kagoshima, Kumagegun, Isl. Yokushima, Miyakoura-river, riverbank, on dead twigs of Phyllostachys bambusoides, 17 Mar. 2007, K. Tanaka & H. Yonezawa, KT 2202 = HHUF 30013, culture NBRC 106237.

Notes: For a description of this species, see Tanaka et al. (2005a). This fungus was originally described as a Leptosphaeria (Teng 1934), and later transferred to Massariosphaeria (Shoemaker & Babcock 1989) or Kalmusia (Tanaka et al. 2005a). Molecular studies, however, did not support these placements (Tanaka et al. 2009, Zhang et al. 2014a). This species is currently treated as Neokalmusia (Ariyawansa et al. 2014), but we were not able to confirm the congenericity of N. scabrispora with N. brevispora (type species of Neokalmusia) (Fig. 1).

Paraphaeosphaeria O.E. Erikss., Ark. Bot. 6: 405. 1967.

Type species: Paraphaeosphaeria michotii (Westend.) O.E. Erikss.

Notes: The genus Paraphaeosphaeria was established by Eriksson (1967) as a generic segregate from Leptosphaeria. To date, about 35 taxa have been described as species within Paraphaeosphaeria (http://www.indexfungorum.org, Aug. 2015), of which nine species have been transferred to Neokalmusia (Coniothyriaceae or Leptosphaeriaceae) or Phaeosphaeriopsis (Phaeosphaeriaceae) based on ascospore and conidial morphology, as well as sequence data from SSU and ITS nrDNA (Câmara et al. 2001, 2003), and 10 asexual species with conidiothyrium-like morphology have been added to this genus based on molecular evidence (Trakunyingcharoen et al. 2014, Verkley et al. 2014, Liu et al. 2015).

Paraphaeosphaeria michotii (Westend.) O.E. Erikss., Arkiv Bot. 6: 405. 1967. Fig. 9.

Basionym: Sphaeria michotii Westend., Bull. Acad. R. Sci. Belg., Cl. Sci., sér. 2, 7: 87. 1859.

In culture, both sexual and asexual morphs were observed. Asci 77–90 × 13–14.5 μm. Ascospores ellipsoid, 18–24 × 5–7 μm (av. 21.3 × 6.2 μm, n = 30), l/w 2.8–3.8 (av. 3.5, n = 30), with a submedian primary septum (0.56–0.67; av. 0.61, n = 30), 2-septate (1+1+0). Conidia broadly fusiform to ellipsoid, 8–14.5 × 4–7 μm (av. 10.8 × 5.3 μm, n = 50), l/w 1.6–2.9 (av. 2.0, n = 50), echinulate.

Specimen examined: Japan, Tochigi, Utsunomiya, Ootani-kannon, on dead leaves of Typha latifolia, 29 Mar. 2007, K. Tanaka & Y. Harada, KT 2222 = HHUF 30142, culture MAFF 243861.

Notes: Morphological features of the sexual morph in our material agree well with the description of P. michotii reported by several authors (Eriksson 1967, Shoemaker & Eriksson 1967, Shoemaker & Babcock 1985, Ariyawansa et al. 2014). The conidia we observed are somewhat larger than those reported by Webster (1955; 6–10 × 3–5 μm) and Câmara et al. (2001; 4–8 × 2.4–4.4 μm), but match those reported by Sivanesan (1984; 5–13.5 × 3–5 μm). A BLAST search using ITS sequences showed 99.8 % similarity to sequences from the ex-epitype of P. michotii (GenBank KJ939279; 519/520) deposited in GenBank by Ariyawansa et al. (2014).

Spegazzinia Sacc., Michelia 2 (6): 37. 1880.

Type species: Spegazzinia ornata Sacc.

Notes: Based on the morphological features of basauxic conidiogenesis, Hyde et al. (1998) considered Spegazzinia to be a possible member of the Apiosporaceae (Sordariomycetes), although this was not fully resolved by molecular evidence (Hyde et al. 2011, Crous & Groenewald 2013). We have assigned this genus to the Didymosphaeriaceae (Fig. 1).

Spegazzinia deightonii (S. Hughes) Subram., J. Indian Bot. Soc. 35: 78. 1956. Fig. 10.

Basionym: Spegazzinia tessarttha var. deightonii S. Hughes, Mycol. Pap. 50: 65. 1953.

Specimens examined: Japan, Kagoshima, Isl. Yukushima, Kurio, on dead leaves of Arundo donax, 14 Mar. 2007, K. Tanaka & H. Yonezawa, yone 66 = HHUF
Fig. 10. Spegazzinia deightonii. A, B. Sporodochia on the natural host surface; C, D. Conidiophores and conidiogenous cells (arrowheads indicate basauxic conidiogenesis); E. Conidia (arrowheads indicate a type conidia, arrows indicate b type conidia). A from yone 66; B–E from culture yone 66. Scale bars: A, B = 500 μm; C–E = 10 μm.

Fig. 11. Spegazzinia tessarthra. A. Sporodochia on the natural host surface; B, C. Conidiophores and conidiogenous cells (arrowheads indicate basauxic conidiogenesis); D. Conidia (arrowheads indicate a type conidia, arrows indicate b type conidia). All from SH 287. Scale bars: A = 500 μm; B–D = 10 μm.

30150, culture MAFF 243876; Okinawa, Isl. Iriomote, Inamori path, on dead stems of herbaceous plant, 25 Sep. 2007, H. Yonezawa & K. Tanaka, yone 212 = HHUF 30151, culture MAFF 243877.

Note: The above collections match the original description and illustration of S. tessarthra var. deightonii provided by Hughes (1953b).

Spegazzinia tessarthra (Berk. & M.A. Curtis) Sacc., Syll. Fung. 4: 758. 1886. Fig. 11.
Basionym: Sporidesmium tessarthrum Berk. & M.A. Curtis, J. Linn. Soc., Bot. 10: 355. 1868 (1869).

Specimen examined: Japan, Aomori, Towada, Santongi, Yagami, on balsa wood, 9 Nov. 2002, S. Hatakeyama, SH 287 = HHUF 27691, culture MAFF 243875.

Notes: The features of the collection match the description of S. tessarthra (Ellis 1971). The ITS sequences from the above isolate were identical to those of S. tessarthra in GenBank (GenBank JQ673429).

Lentitheciaceae Y. Zhang ter et al., Stud. Mycol. 64: 93. 2009.
Type genus: Lentithecium K.D. Hyde et al.

Katumota Kaz. Tanaka & Y. Harada, Mycoscience 46: 313. 2005.
Type species: Katumotoa bambusicola Kaz. Tanaka & Y. Harada.

Notes: Two bambusicolous genera, Katumotoa (Tanaka & Harada 2005) and Neophiosphaerella, formed a clade as reported in previous molecular studies (Schoch et al. 2009, Tanaka et al. 2009, Zhang et al. 2012), but these have ascospores with distinct features, i.e., apioporous in Katumotoa and multi-septate sclecosporous in Neophiosphaerella. Furthermore, sequence similarity between the type species of both genera was 82.7 % (417/504) in their ITS regions, suggesting that they are not congeneric. Although a correlation between phylogenetic relationships and host preferences has been noted in these bambusicolous fungi (Zhang et al. 2012), discovery of additional species in both monotypic genera will be needed to confirm this.

Katumotoa bambusicola Kaz. Tanaka & Y. Harada, Mycoscience 46: 313. 2005. Fig. 12.
Specimen examined: Japan, Iwate, Nishine, Hirakasa, near Yakebashiri, Mt. Iwate, on Sasa kurilensis, 19 Oct. 2003, K. Tanaka (paratype KT 1517a = HHUF 28661, culture ex-paratype JCM 1517a = MAFF 239641).

Keissleriella Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1128: 582. 1919.
Type species: Keissleriella aesculi (Höhn.) Höhn.

Notes: Keissleriella is characterised by an ostiolar neck covered by short dark setae. Munk (1953) introduced Trichometasphaeria, which can be separated from Keissleriella by their host preferences and the morphological features of hamathecium and ascospores. Trichometasphaeria occurs on herbaceous plants and has cellular pseudoparaphyses and septate ascospores, while Keissleriella occurs on woody plants and has trabecular pseudoparaphyses and 1-septate ascospores (Munk 1957, Barr 1990a, 1992). However, Bose (1961) treated Trichometasphaeria as a synonym of Keissleriella, and this opinion was accepted by several authors (e.g., Eriksson 1967, Dennis 1978, Sivanesan 1984). We also regard these two genera as
congeneric as species with the features of *Trichometasphaeria* (e.g., *K. gloeospora*, the type species of *Trichometasphaeria*) and *Keissleriella* (e.g., *K. cladophila*; Corbaz 1956, Bose 1961) form a clade (Fig. 1), although the type of the latter genus (*K. sambucina*) is not included in our analysis.

**Keissleriella breviasca** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811304. Fig. 13.

**Etymology**: From the Latin *brevi-* meaning short, in reference to the ascus length.

Ascomata scattered, erumpent, 95–115 μm high, 130–165 μm diam. Ostiolar neck papillate, 18–23(–50) μm long, covered with 1-celled, thick-walled, dark brown to almost black setae. Ascomatal wall 7.5–11.5 μm thick at sides, composed of 3–4 layers of polygonal to subglobose cells of 2.5–10 × 2.5–5 μm. Pseudoparaphyses cellular, septate, branched and anastomosed, 2–3.5 μm wide. Asci fusitunicate, clavate to cylindrical, 51–66 × 7–11 μm (av. 59.0 × 8.7 μm, n = 39), rounded at the apex and with a shallow ocular chamber, short-stalked (5–12 μm long), with 4 biseriate ascospores. Ascospores narrowly fusiform, 17.5–24.5 × 3.5–5 μm (av. 21.1 × 4.3 μm, n = 64), l/w (3.7–) 4.0–5.7(–6.3) (av. 4.9, n = 64), with a nearly median primary septum (0.44–0.53; av. 0.49, n = 48), 3-septate (1+1+1), slightly constricted at the septa, hyaline, smooth, with an entire sheath; sheath gelatinous and 8–11 μm wide when fresh, delimited and 1–2 μm wide when dry.

Colonies on PDA (after 4 wk) attaining a diam of 1.0–1.3 cm, coral with white margin; reverse red to flesh; sienna pigment produced. In culture coelomycetous asexual morph formed. *Conidiomata* pycnidial, 70–90 μm high, 120–200 μm diam, subglobose to hemispherical in section. *Conidiomatal wall* 7–15 μm thick at sides, composed of thin-walled, flattened cells. *Conidigenous cells* cylindrical to doliform, 8–13 × 2.5–3.5 μm, holoblastic. *Conidia* cylindrical to bone-shaped, 0–3-septate, hyaline, smooth, 11–20 × 3–4 μm (av. 15.2 × 3.7 μm, n = 20), l/w 3.7–5.0 (av. 4.1, n = 20), without sheath. Sometimes, sexual morph formed. *Ascospores* 19–23 × 3.5–4.5 μm.
to that of *K. gallica* 120

Ascomata

Basionym 188. 1961. Fig. 14. *Keissleriella culmi* K. breviasca Ridley 1988), which is most probably conspecific with *Ascochyta* sp. has sometimes been reported (Dennis 1978, 19415 = MAFF 243844).

Specimens examined: *Japan*, Aomori, Hirosaki, Campus of Hirosaki Univ., on dead culms of *Dactylis glomerata*, 13 Jun, 2001. K. Tanaka, KT 540 = HHUF 27715; culture JCM 19413 = MAFF 239476; *ibid.*, 20 Jul, 2001, KT 581 = HHUF 27717; culture JCM 19414 = MAFF 243843; Aomori, Hirakawa, Hirakawa-river, riverbank, on dead culms of *Dactylis glomerata*, 5 Aug, 2001. K. Tanaka (holotype KT 649 = HHUF 27718, culture *ex-type* CBS 138691 = JCM 19415 = MAFF 243844).

Notes: To date, 50 species have been described as *Keissleriella* (or *Trichometasphaeria*; MycoBank, http://www.mycobank.org, April, 2015), but *K. breviasca* can be distinguished from all known species by its short asci with consistently four ascospores (Fig. 13G). The asexual morph of *K. culmi* is similar to that of *K. gallica* reported as “Ascochyta sp.” (Sivanesan 1984), but the conidia of *K. breviasca* have 0–3 septa (vs. 0–1 septa in *K. gallica*). A collection of *K. culmifida* with 4-spored asci has sometimes been reported (Dennis 1978, Ridley 1988), which is most probably conspecific with *K. breviasca*.

**Keissleriella culmifida** (P. Karst.) S.K. Bose, Phytopath. Z. 41: 190. 1961. Fig. 14. *Basionym: Leptosphaeria culmifida* P. Karst., Bidr. Känn. Finl. Nat. Folk. 23: 103. 1873.

Ascomata 120–145 μm high, 120–150 μm diam, with dark brown setae of 30–58 × 3–5 μm around the ostiolar. *Asci* 8-spored, 70.5–84 × 10.5–13 μm. Ascospores fusiform, 17.5–22 × 4–5.5 μm (av. 19.4 × 4.9 μm, n = 36), l/w 3.5–5.0 (av. 3.9, n = 36), with nearly median primary septum (0.47–0.53; av. 0.51, n = 35), 3-septate (1+1+1), surrounded by an entire gelatinous sheath, 3–9 μm wide.

In culture sexual morph formed. *Asci* 90–127.5 × 10.5–15 μm (av. 102.9 × 13.0 μm, n = 40). Ascospores fusiform, 19–26 × 5–7 μm (av. 22.5 × 5.9 μm, n = 60), l/w 3.3–4.5 (av. 3.8, n = 60), with a nearly median primary septum (0.46–0.55; av. 0.50, n = 60). Asexual morph not observed.

Specimens examined: *Japan*, Hokkaido, Isl. Rishiri, Forest park, on dead stems of *Agrostis flaccida*, 29 Jul. 2007. K. Tanaka & G. Sato, KT 2308 = HHUF 30135, culture JCM 19416 = MAFF 243848; Iwate, Hachimantai, Top of Aspite line, on dead leaves of *Festuca* sp. 25 Jul. 2009. K. Tanaka & Y. Harada, KT 2642 = HHUF 30136, culture JCM 19417 = MAFF 243849.

Notes: We identified these specimens as *K. culmifida*, based on the description (Karsten 1873, Holm 1957, Bose 1961) and illustration (Berlese 1894, Eriksson 1967) of this species. However, ITS sequences from the above materials completely matched with those from the ex-type of *K. poagena* (GenBank KJ869112), a species recently published by Crous et al. (2014a). *Keissleriella poagena* is morphologically close to *K. culmifida*, and thus taxonomic reassessment of these two species will be needed.

**Keissleriella gloeospora** (Berk. & Curr.) S.K. Bose, Phytopath. Z. 41: 190. 1961. Fig. 15. *Basionym: Sphaeria gloeospora* Berk. & Curr., Ann. Mag. Nat. Hist., Ser. 3 7: 454. 1861.

Ascomata 130–230 μm high, 350–480 μm diam, with dark brown setae (up to 60 μm long) around the ostiole. Asc clavate, 80–118 × 14–19 μm (av. 97.2 × 16.8 μm, n = 20), short-stalked (10–25 μm long). Ascospores fusiform to clavate, 21.5–33 × 6–9 μm (av. 28.0 × 7.3 μm, n = 50), l/w 3.3–4.9 (av. 3.8, n = 50), with a supramedian primary septum (0.39–0.48; av. 0.43, n = 50), 4–6-septate (1+1+2, 1+1+3, 2+1+2, 2+1+3), sometimes with a vertical septum in central cells, surrounded by an entire sheath (6–10 μm wide when fresh, 2–3 μm wide when dry).

In culture spermatial morph formed. Spermatia 3.3–4.9 × 1.2–1.8 μm (av. 4.1 × 1.5 μm, n = 20), hyaline, cylindrical.

Specimen examined: *Japan*, Aomori, Hirosaki, Campus of Hirosaki Univ., on dead culms of *Setaria faberii*, 4 Nov. 2001. K. Tanaka, KT 829 = HHUF 27704, culture MAFF 239474.

Note: The above material matches well the descriptions of *K. gloeospora* provided by Bose (1961) and Shearer et al. (1993).

**Keissleriella quadriseptata** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811305. Fig. 16.
Etymology: Referring to the 4-septate ascospores.

Ascomata scattered to 2–4 grouped, immersed to erumpent, globose in section, 210–320 μm high, 170–310 μm diam. Ostiolar neck central, papillate, 35–50 μm long, 55–62 μm diam, with setae; setae bluntly pointed, aseptate, slightly waved, dark brown to black, 37–93 μm long, 2.5–4 μm wide at the base. Ascomatal wall in longitudinal section uniformly 15–20 μm thick, composed of 5–6 layers of polygonal, slightly thick-walled, 4.5–16.5 × 3–7.5 μm, brown cells. Pseudoparaphyses cellular, septate, branched and anastomosed, 2–2.5 μm wide. Asci fissitunicate, clavate, 78.5–107.5 × 12–14.5 μm (av. 92.8 × 13.1 μm, n = 30), rounded at the apex and with a shallow ocular chamber, short-stalked (5–24 μm long; av. 13.1 μm, n = 26), with 8 biseriate ascospores. Ascospores clavate, 19–24.5 × 5–7 μm (av. 21.5 × 5.8 μm, n = 50), l/w 3.3–4.4 (av. 3.7, n = 50), with a supramedian primary septum (0.38–0.45; av. 0.42, n = 50), 4-septate (1+1+2), slightly constricted at the
primary septum, hyaline, smooth, with an entire gelatinous sheath of 4–6 μm wide.

Colonies on PDA (after 2 wk) attaining a diam of 1.7–2.2 cm, pale luteous; reverse rust; no pigment produced. In culture asexual morph formed. Conidiomata pycnidial, 200–380 μm high, 160–310 μm diam, globose in section. Ostiolar neck papillate, 60–90 μm long, 50–75 μm wide. Conidiomatal wall 13–25 μm thick, composed of 4–6 layers of polygonal cells (5–17 × 2.5–6.5 μm). Conidiophores absent. Conidiogenous cells lageniform, holoblastic. Conidia cylindrical, rounded at the apex, slightly truncate at the base, straight, asperate, hyaline, smooth, 25–32 × 6–8.5 μm (av. 28.4 × 7.2 μm, n = 30), l/w 3.3–4.8 (av. 3.9, n = 30), without sheath; senescent spores brown, 0–1-septate.

Specimen examined: Japan, Hokkaido, Isl. Rishiri, Beach near Ryzinnoiwa, on dead culms of Dactylis glomerata, 26 Jul. 2007, K. Tanaka & G. Sato (holotype KT 2292 = HHUF 30137, culture ex-type CBS 139692 = JCM 19418 = MAFF 243850).

Notes: This species is characterised by its consistently 4-septate ascospores (1+1+2). Phylogenetically, it is closest to K. gloeospora (97.8 %; 904/924 in tef1), but the latter has larger ascospores (21.5–33 × 6–9 μm) with 4–6 septa (1+1+2, 1+1+3, 2+1+2, 2+1+3). In culture, K. quadriseptata produced an asexual morph with cylindrical, asperate, hyaline conidia, but only a spermatidial morph was found in K. gloeospora.

Keissleriella taminensis (H. Wegelin) S.K. Bose, Phytopath. Z. 41: 190. 1961. Fig. 17.

Basionym: Leptosphaeria taminensis H. Wegelin, Mitt. Thürgau. Naturf. Ges. 12: 173. 1896.

Ascomata 190–280 μm high, 180–300 μm diam. Asci clavate, 70–106 × 11.5–16 μm (av. 84.3 × 13.3 μm, n = 53), short-stalked (8–25 μm long; av. 15.5 μm, n = 27). Ascospores fusiform, 19–25 × 4–7 μm (av. 21.9 × 5.9 μm, n = 103), l/w 3.0–4.5 (av. 3.7, n = 103), with a supramedian primary septum (0.43–0.51; av. 0.47, n = 100), 4–5-septate (1+1+2, 2+1+2), surrounded by an entire sheath (3–10 μm wide when fresh, 1–2 μm wide when dry).

In culture spermatidial morph formed. Spermatia cylindrical, hyaline, 3.5–8.8 × 1.3–2.3 μm (av. 5.5 × 1.8 μm, n = 60). Sometimes sexual morph observed.

Specimens examined: Japan, Aomori, Hirosaki, Sanpinai, on dead stems of herbaceous plant, 17 Jul. 2001, K. Tanaka, KT 571 = HHUF 27707, culture MAFF 243846; Aomori, Hirosaki, Kadoke, Oowasawa-river, riverbank, on dead stems of herbaceous plant, 29 Jul. 2001, K. Tanaka, KT 594 = HHUF 27709, culture MAFF 243847; ibid., 14 Aug. 2001, K. Tanaka, KT 678 = HHUF 27711, culture MAFF 239475.

Note: These materials agree well with the description of K. taminensis except for the slightly wider ascospores in our collections (4–7 μm vs. 4.5–5 μm; Bose 1961).

Keissleriella yonaguniensis Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811307. Fig. 18.

Etymology: Referring to the collection site.

Ascomata scattered, immersed to erumpent, globose in section, 100–170 μm high, 100–180 μm diam. Ostiolar neck central, papillate to terete, 37–45 μm long, 32–35 μm diam, with setae; setae bluntly pointed, asperate, straight, dark brown to black, 20–30 μm long, 3–4.5 μm wide at the base. Ascomatal wall in longitudinal section uniformly 7.5–10 μm thick, composed of 3–5 layers of polygonal, thin-walled, flattened, 3.5–7.5 × 1.5–2.5 μm, brown cells. Pseudoparaphyses cellular, septate, branched and anastomosed, 1.5–2.5 μm wide (3–4.5 μm wide at below). Asci fissitunicate, cylindrical, 65–99.5 (–112.5) × 10.5–14.5 μm (av. 80.1 × 12.1 μm, n = 35), rounded at apex and with a shallow ocular chamber, with a short stipe of 5–13 μm long, 8-spored. Ascospores cylindrical with rounded ends, 15–20 × 4.5–6.5 μm (av. 18.1 × 5.3 μm, n = 50), l/w 3.0–3.9 (av. 3.5, n = 50), with a nearly median primary septum (0.47–0.53; av. 0.50, n = 50), 5-septate (2+1+2), yellow, smooth, with an entire gelatinous sheath of 3–5 μm wide (later diffuse up to 10 μm wide).

Colonies on PDA (after 4 wk) attaining a diam of 5.2–5.7 cm, white to pale luteous; reverse similar; no pigment produced. In culture sexual morph identical to that formed on the natural host produced.
Specimen examined: Japan, Okinawa, Isl. Yonaguni, Kubura pond, on dead leaves of Typha latifolia, 23 Nov. 2008, K. Tanaka & K. Hirayama (holotype KT 2604 = HHUF 30138, culture ex-type CBS 139693 = JCM 19419 = MAFF 243851).

Notes: Among the 50 described species in Keissleriella (or Tri-chrometasphaeria), six are known to have 5-septate ascospores like K. yonaguniensis. These are K. abruptipapilla, K. gloeospora, T. papillisetosa, K. pindaundeensis, T. populi and K. taminensis. Among these, K. gloeospora, T. populi and K. taminensis differ from K. yonaguniensis in having asymmetrically-septate ascospores (Bose 1961, Barr 1992). Keissleriella pindaundeensis (Kobayasi 1971) and T. papillisetosa (Yuan & Barr 1994) are distinguished from K. yonaguniensis by larger ascospores that are more than 20 μm long. Keissleriella abruptipapilla (Barr 1990a) is similar but its ascospores are verruculose. In our phylogenetic tree (Fig. 1), K. yonaguniensis grouped with K. linearis (= Lentithecium lineare; Zhang et al. 2009c), Murientithecium with mufniform ascospores and conidia (Wanasisinghe et al. 2014), and Phragnocamarosporium spp. with phragmosporous conidia (Wijayawardene et al. 2015), although this clade received no support. We include this species as Keissleriella based on the morphology of its sexual morph pending further studies of related taxa.

**Lentithecium** K.D. Hyde et al., Fungal Divers. 38: 234. 2009.

Type species: *Lentithecium flaviatile* (Aptroot & Van Ryck.) K.D. Hyde et al.

Notes: *Lentithecium* was established by Zhang et al. (2009c) using *L. flaviatile* as the type species. This genus was characterised by the lenticular ascomata, but reexamination based on the holotype of *L. flaviatile* revealed that the species has globose ascomata (Hyde et al. 2013).

**Lentithecium cloninum** (Kaz. Tanaka et al.) Kaz. Tanaka & K. Hiray., comb. nov. MycoBank MB811308. Fig. 19.

Basionym: *Massarina clonina* Kaz. Tanaka et al., Mycoscience 46: 288. 2005.

Ascomata 210–280 μm high, 330–430 μm diam. Ostiolar neck 50–75 μm long, 75–125 μm wide. Ascomatal wall 15–23 μm thick at sides. *Pseudoparaphyses* 2 μm wide. Ascii clavate, (81.5–)86–118 (–128) × 15–19 (–21) μm (av. 100.1 × 17.2 μm, n = 70), short-stalked (5–23 μm long). Ascospores fusiform, (26–)27.5–34.5 (–37) × 7–10 (–11) μm (av. 31.0 × 8.7 μm, n = 70), lw 3.2–4.1 (av. 3.6, n = 70), with a septum mostly median (0.48–0.52; av. 0.50, n = 64), with a wing-like sheath staining with Black-Blue ink when fresh.

In culture ascomatal morph formed. Ascospores 27–35 × 8–11 μm (av. 31.0 × 9.3 μm, n = 50). No asexual morph observed.

Specimens examined: Japan, Hokkaido, Akkeshi, Bekanbeushi-river (near Bekanbeushi bridge), on submerged twigs of woody plant, 2 Jun. 2003, K. Tanaka & S. Hatakeyama (holotype KT 1149A = HHUF 28199, culture ex-type CBS 139694 = JCM 12703 = MAFF 239293); Hokkaido, Akkeshi, Tarabetsu-river, on submerged twigs of woody plant, 3 Jun. 2003, K. Tanaka & S. Hatakeyama (paratype KT 1220 = HHUF 28213, culture ex-paratype MAFF 243839).

Notes: This species was previously described as *Massarina* (Tanaka et al. 2005b), but we here transfer it to *Lentithecium*, because it has morphological similarities with *L. flaviatile*, the type species of the genus (see Fig. 43 in Zhang et al. 2012). Both have globose ascomata composed of small polygonal peridial cells, short pedicellate asci, and fusiform ascospores with obtuse ends. In our phylogenetic tree (Fig. 1), this species and *L. pseudoclioninum* nested on a well-supported branch (100 %) with *L. flaviatile*.

**Lentithecium pseudoclioninum** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811309. Fig. 20.

Etymology: Referring to its resemblance to *Lentithecium cloninum*.

Ascomata scattered to 2–3 grouped, immersed to erumpent, globose in section, 200–220 μm diam, with sparse brown hyphae around ascomata. Ostiolar neck central, papillate, 40–50 μm long, 30 μm diam, with periphyses. Ascomatal wall in longitudinal section uniformly 17.5–20 μm thick, composed of 5–6 layers of polygonal to subglobose, 5–12.5 × 2 μm, brown cells. *Pseudoparaphyses* septate, branched and anastomosed.
2–3 μm wide. Asci fissitunicate, clavate, 62.5–116 × 14–25 μm (av. 92.0 × 18.4 μm, n = 95), rounded at the apex and with a shallow ocular chamber, short-stalked (5–17.5 μm long; av. 9.9 μm, n = 67), with 8 biseriate ascospores. Ascospores clavate to broadly fusiform, slightly curved, 22–39 × 6.5–11.5 μm (av. 29.2 × 8.5 μm, n = 77), I/w (2.4–)2.8–4.1 (–4.6) (av. 3.5, n = 77), constriicted at the septum, hyaline, smooth, with an amorphous gelatinous sheath (1–4 μm wide) staining with Black-Blue ink when in fresh condition.

Colonies on PDA (after 4 wk) attaining a diam of 2.7–3.0 cm, smoke grey; reverse vinaceous buff to citrine; no pigment produced. In culture sexual morph identical to that formed on the natural host produced.

Specimens examined: Japan, Aomori, Hirosaki, Aoki, Mohei pond, on submerged twigs of woody plant, 3 May 2003, K. Tanaka & N. Asama, KT 1111 = HHUF 29053, culture JCM 19421 = MAFF 243840; ibid. (holotype KT 1113 = HHUF 29055, culture ex-type CBS 139695 = JCM 19422 = MAFF 243841).

Notes: Morphologically, this species is close to L. clioninum, but is clearly separated from it on the basis of its smaller ascospores with a supramedian septum. The wing-like sheath of ascospores found in L. clioninum was not observed in L. pseudoclioninum.

Neoophiosphaerella Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811310.

**Etymology:** After its morphological similarity to *Ophiosphaerella*.

Ascomata scattered to grouped, erumpent, subglobose to hemispherical with flattened base. Ostiolar neck central, terete, flush, covered by black clypeus. Ascomatal wall at sides composed of several layers of thin-walled brown cells. Pseudoparaphyses numerous, cellular, branched. Asci fissitunicate, cylindrical, short-stalked, with 8 parallel or twisted ascospores. Ascospores filiform, multiseptate, hyaline to pale yellowish brown, smooth, surrounded by a sheath. Asexual morph unknown.

Type species: *Neoophiosphaerella sasicola* (Nagas. & Y. Otani) Kaz. Tanaka & K. Hiray.

Notes: *Neoophiosphaerella sasicola*, the type species of this genus, was originally described as a species of *Phaeosphaeria* (Nagasawa & Otani 1977) and later transferred to *Ophiosphaerella* (Shoemaker & Babcock 1989). These two genera, however, belong to the *Phaeosphaeriaceae* in the *Pleosporineae* (Cámara et al. 2000, Schoch et al. 2009, Phookamsak et al. 2014), a family distantly related to the *Lentitheciaeae*. We therefore propose a new genus, *Neoophiosphaerella*, to accommodate this species. *Ophiosphaerella* has globose ascomata with a papillate ostiolar neck (Phookamsak et al. 2014), while *Neoophiosphaerella* is characterised by hemispherical ascomata without papilla but being covered by clypeoi.
Neooephasphaeria sasicola (Nagas. & Y. Otani) Kaz. Tanaka & K. Hiray., **comb. nov.** MycoBank MB811312. **Fig. 21.** Basionym: Phaeosphaeria sasicola Nagas. & Y. Otani, Rep. Tottori Mycol. Inst. 15: 39. 1977.

Specimens examined. Japan, Hokkaido, Ebestu, Nopporo, on Sasa senanensis, 15 May 1972, E. Nagasawa (holotype of Phaeosphaeria sasicola TMI 3176); Hokkaido, Isl. Rebun, Funadomari, Akaia, on dead culms of Sasa kurilensis, 5 Jun. 2004, K. Tanaka (epitype designated here KT 1706 = HHUF 29443, MBT202864, culture **ex-epitype** CBS 120247 = JCM 13134 = MAFF 239644).

**Note:** The collection HHUF 29443 is designated as epitype for N. sasicola, the type species of Neooephasphaeria.

Setoseptoria Quaedvl. et al., Stud. Mycol. 75: 382, 2013.

**Type species:** Setoseptoria phragmitis Quaedvl. et al.

**Notes:** Quaedvlieg et al. (2013) established the genus Setoseptoria typified by S. phragmitis on Phragmites. The sexual morph of this coelomycetous genus is presently unknown.

Setoseptoria arundinacea (Sowerby) Kaz. Tanaka & K. Hiray., **comb. nov.** MycoBank MB811313. **Fig. 22.** Basionym: Sphaeria arundinacea Sowerby, Col. Fig. Engl. Fung. 3: 139, t. 336. 1803.

Specimens examined. Japan, Aomori, Hiroaki, Sanpinaizai, on dead culms of Phragmites australis, 1 Jul. 2001, K. Tanaka, KT 552 = HHUF 27543, culture MAFF 239460; Aomori, Hiroaki, Kadoke, Owasawa-river, on dead culms of Phragmites australis, 29 Jul. 2001, K. Tanaka, KT 600 = HHUF 27544, culture MAFF 243842.

**Notes:** This species has been placed in various pleosporalean genera, such as Leptosphaeria (see Crane & Shearer 1991), Lophiostoma (Hyde et al. 2002), Massarina (Leuchtmann 1984), Metasphaeria (Vasilyeva 1998), and Phaeosphaeria (Hedjaroude 1968). Most recently, it has been transferred to Lentitheciaceae based on the results of phylogenetic analyses using SSU + LSU nrDNA and rpb2 (Zhang et al. 2009c).

However, later molecular studies (Schoch et al. 2009, Shearer et al. 2009, Zhang et al. 2009b, 2012, Liu et al. 2011), as well as our own work (Fig. 1), do not support this placement. This species and its phenotypically and phylogenetically close relative Massarina magniarundinacea (Tanaka et al. 2004) do not belong to any genera previously suggested. They should, therefore, be transferred to another genus. One candidate genus to accommodate these species would be Setoseptoria. The monotypic genus Setoseptoria typified by S. phragmitis was introduced for a stagonospora-like pycnidial coelomycete with (1–)3-septate, subcylindrical, hyaline conidia (Quaedvlieg et al. 2013). The sexual morph of Setoseptoria is unknown. In contrast, two massarina-like species, M. arundinacea and M. magniarundinacea, have been reported to produce only sexual morphs in culture (Lucas 1968, Leuchtmann 1984, Tanaka & Harada 2003b, Tanaka et al. 2004). Although there is no example of production of stagonospora-like asexual morphs from the massarina-like sexual morphs in culture, congeneric relationships have been suggested several times between Stagonospora elegans (Aptroot 1998, Eriksson & Hawksworth 2003) or S. vexata (Grove 1935) and M. arundinacea, based on their close association on the same host tissue. Furthermore, two stagonospora-like species (Setoseptoria phragmitis and “Stagonospora” macrosporica) and two massarina-like species (M. arundinacea and M. magniarundinacea) form a strongly supported clade (Fig. 1) and sequence similarities between these species in the LSU region are considerably higher (826/834 = 99.0 %). We therefore tentatively assign the two massarina-like species to the genus Setospaeria, although asexual morphs of these species are presently unknown. A species with both sexual and asexual morphs will be required to confirm the validity of our generic treatment.

The two isolates of S. arundinacea that we examined did not form a clade with S. arundinacea from GenBank (Fig. 1). This species has been reported many times as a common species on Phragmites culms (Aptroot 1998, Tanaka & Harada 2003b), but S. arundinacea may consist of several cryptic species with close morphological resemblance.
Setoseptoria magniarundinacea (Kaz. Tanaka & Y. Harada) Kaz. Tanaka & K. Hiray., comb. nov. MycoBank MB811314.

Fig. 23. 
Basionym: Massarina magniarundinacea Kaz. Tanaka & Y. Harada, Mycotaxon 90: 349. 2004.

Ascomata subglobose to hemispherical with flattened base, 150–280 μm high, 310–410 μm diam. Ostiolar neck central, short papillate. Ascomatal wall 12.5–20 μm thick at sides. Pseudoparaphyses cellular, 1.5–3.5 μm wide. Asci (119–) 125–182.5(–200) × 25–35(–47.5) μm (av.151.5 × 30.2 μm, n = 37). Ascospores 67–82 × 6.5–9 μm (av. 74.0 × 7.7, n = 50), l/w 8.4–11.0 (av. 9.6, n = 50), with a submedian primary septum (0.52–0.57; av. 0.54, n = 50).

In culture the ascomatal morph is similar to that observed on the natural host.

Specimen examined: Japan, Hokkaido, Akkeshi, Arikae, small stream, on submerged stems of herbaceous plant, 3 Jun. 2003, K. Tanaka & S. Hatakeyama (holotype KT 1174 = HHUF 28293, culture ex-type CBS 139702 = MAFF 239294).

Note: The ascospores of S. magniarundinacea are most similar in shape and colour to those of S. arundinacea, but are considerably larger (67–82 × 6.5–9 μm vs. 23–40 × 3.5–6 μm, Tanaka et al. 2004).

Tingoldiago K. Hiray. & Kaz. Tanaka, Mycologia 102: 740. 2010. 

Type species: Tingoldiago graminicola K. Hiray. & Kaz. Tanaka.

Notes: Tingoldiago, found in freshwater environments, is characterised by lens-shaped ascomata and narrowly fusiform ascospores, each of which has an elongated sheath (Hirayama et al. 2010; Fig. 27). This genus, however, was regarded as a synonym of Lentithecium, despite the fact that the Lentithecium clade that included Tingoldiago was not well-supported (21 %; Zhang et al. 2012). When Lentithecium was established, the lenticular ascomata with simple peridial structure and hyaline 1-septate ascospores were emphasised as important characters to define the genus (Zhang et al. 2009c), but this generic circumscription is incorrect (see Notes in Lentithecium).

Tingoldiago graminicola K. Hiray. & Kaz. Tanaka, Mycologia 102: 740. 2010. Fig. 24.

Specimens examined: Japan, Hokkaido, Isl. Rishiri, Himenuma (pond), on submerged culms of Phragmites australis, 27 Jul. 2007, K. Hirayama & K. Tanaka (holotype KH 68 = HHUF 30009, culture ex-type JCM 16485 = NBRC 106131); ibid., 26 Jul. 2008, K. Hirayama & K. Tanaka (paratype KH 155 = HHUF 30010, culture ex-paratype JCM 16486 = NBRC 106132); Aomori, Hirosaki, Kadoke, Oowasawa-river, on submerged culms of Phragmites japonica, 28 Sep. 2002, K. Tanaka (paratype KT 891 = HHUF 27882, culture ex-paratype MAFF 239472).

Notes: The morphological features of this species have been described by Hirayama et al. (2010). Tingoldiago graminicola and Setoseptoria arundinacea, formerly treated as Lentithecium by Zhang et al. (2009c, 2012), have lens-shaped ascomata, but are not in the clade of Lentithecium s. str. (Fig. 1). Instead, Lentithecium is restricted to species with globose ascomata (Figs 19C, 20C).
**Helminthosporium**

*Helminthosporium velutinum*.

Aug. 2015, the genus has been quite heterogeneous. Several
ascospores, and is rather similar to that of
*Massarina* (= *Cochliobolus*, Curvularia (= Pseudocochliobolus), Exserohilum (= Setosphaeria), and Pyrenophora (= Drechslera), all of which belong to the
*Pleosporaceae* (Sivanesan 1987, Hyde et al. 2013). Further
distantly related species (e.g., *H. asterinum*) in the Leotiomycetes were excluded from *Helminthosporium*, and this genus was restricted to species having phylogenetic affinity with the
*Massarinaeae* (Olivier et al. 2000, Kodseue et al. 2007, Hyde et al. 2013).

Little is known about the sexual morphs of *Helminthosporium s. str.* Hughes (1953a) reported that an ascospore isolate of a *Massaria* found on *Quercus* produced a *Helminthosporium* asexual morph. Subramanian & Sekar (1987) described *Splanchnonema kalakadense* as the sexual morph of *H. velutinum* based on cultural study. However, the validity of the generic classification based on the sexual morphs of these two examples remains unknown. The sexual morph of *H. massarinum* differs from those of *Massaria* (Massarinaeae; Voglmayr & Jaklitsch 2011) and *Splanchnonema* (*Pleosmassarinaeae*; Hyde et al. 2013) in its ellipsoidal hyaline ascospores, and is rather similar to that of *Massarina*, although *M. eburnea* (the type species of *Massarina*) does not have a hyphomycetous asexual morph like that of *Helminthosporium*.

*Helminthosporium massarinum* Kaz. Tanaka, K. Hiray. & Shirouzu. sp. nov. MycoBank MB811315. Fig. 25.

Eymology: Referring to the similarity of the sexual morph with that of the genus *Massarina*.

Ascomata numerous, scattered to 2–4 grouped, immersed below the host epidermis, hemispherical to subglobose with somewhat flattened base, 315–390 μm high, 300–430 μm diam. Ostiolar neck central, cylindrical to papillate, 125–165 μm long, 75–125 μm wide, composed of subglobose, 3–5 μm diam, brown cells, surrounded by dark brown cyphus-like structure, without periphyses. Ascomatal wall surface of texture prismatic, in a longitudinal section 12–18 μm wide at sides and base, composed of 5–7 layers of polygonal to rectangular, 5–15 × 2.5–6.5 μm, brown cells. Pseudoparaphyses cellular, 1.5–3 μm wide, septate at 7–16 μm long intervals, branched, anastomosed. Ascii fissitunicate, clavate, 82–135 × 13–16 μm (av. 111.0 × 14.8 μm, n = 90), rounded at the apex, with a narrow apical chamber and faint ring, short-stalked (7–24 μm long; av. 16.7 μm, n = 35), with 8 ascospores biseriate above and uniseriate below. Ascospores ellipsoidal with rounded ends, mostly straight, 20–25–(27) × 5–8 μm (av. 22.6 ± 7.0 μm, n = 100), l/w 2.7–3.9 (av. 3.2, n = 100), with a submedian septum (0.50–0.58; av. 0.54, n = 100), constricted at the septum, asymmetric, with wider upper cell, hyaline, guttulate, smooth, with a conspicuous gelatinous sheath of 2–3 μm wide in fresh condition (with a delimited firm sheath of 1 μm wide in dry condition).

Colonies on PDA (after 4 wk) attaining a diam of 5.5–7.1 cm, white to olivaceous grey; reverse smoke grey to buff; no pigmentation produced. In culture hyphomycetous asexual morph and spermatial morph formed. *Conidiophores* macronematous, mononematous, 380–810 μm long (av. 587 μm, n = 20); 7–9 μm wide at the apex, 13.5–21 μm wide at the base, arising singly or in groups of 4–5 from the stromata, straight or slightly curved, dark brown, guttulate, 15–25–septate at 8–45 μm long intervals, with small (ca. 1–2 μm diam) pores at the apex and beneath of septa, with thick wall of 1–4 μm wide. *Conidia* tretic, solitary or in short chains (5–6), 1–8–septate, 17–56.5 × 5–9 μm (av. 37.9 × 7.4 μm, n = 95), l/w 2.9–7.5 (av. 5.1, n = 95) [but mostly 4–6–septate, 27–53 × 6–9 μm (av. 38.7 × 7.4 μm, n = 64), l/w 4.1–6.8 (av. 5.3, n = 64)], obclavate, rostrate, pale brown, smooth, with or without guttules. Conidia germinating from both end cells. *Spermogonia* pycnidal, produced under the conidiophores, solitary or gregarious, 100–150(–300) μm diam, subglobose, uniculcet to multiloculate. *Spermatogenous cells* cylindrical, up to 5 μm long, appearing phialidic. *Spermatoz 3–4(–5) × 2–2.5 μm (av. 3.5 × 2.2 μm, n = 26), globose to subglobose, hyaline, smooth.

Specimens examined: Japan. Aomori, Towada, Sanbongi, Yangami, on vines of *Berchemia racemosa*, 15 Dec. 2001, S. Hatakeyama, KT 838 = HHUF 27573, culture JCM 13094 = MAFF 239604; ibid., 23 Nov. 2003, S. Hatakeyama.
(holotype KT 1564 = HHUF 29089; culture ex-type CBS 139690 = JCM 13095 = MAFF 239605; ibid., KT 1565 = HHUF 29090; ibid., KT 1566 = HHUF 29091; ibid., 2 Dec. 2003, K. Tanaka, S. Hatakeyama & N. Nakagawara, KT 1613–1615 = HHUF 29092–29094.

**Note:** This species is somewhat similar to *H. hypselodelphyos* in having solitary or catenate conidia but the latter has smaller conidia (15–28 × 6.5–8 μm, av. 25 × 7.1 μm) (Ellis 1961).

**Massarina** Sacc., Syll. Fung. 2: 153. 1883.

*Type species:* **Massarina eburnea** (Tul. & C. Tul.) Sacc.

*Notes:* Since establishment of the genus (Saccardo 1883), more than 176 taxa have been described within *Massarina* (Index Fungorum; http://www.indexfungorum.org, Aug. 2015), but the heterogeneity of the genus has been continuously suggested. Several taxonomic reassessments of many species within *Massarina* have been attempted based on morphology (Bose 1961, Barr 1992, Hyde 1995, Aptroot 1998, Hyde et al. 2002, Tanaka & Harada 2003b). It has more recently been revealed that the genus is highly polyphyletic based on molecular data (Liew et al. 2002), and most species in *Massarina* except for the type (*M. eburnea*) have been excluded from the genus. The genera segregated from *Massarina s. lat.* are phylogenetically diverse groups in the Pleosporales; *Halomassarina* (Trematosphaeriaceae; Suetrong et al. 2009), *Lentithecium* and *Tingoldiago* (Lentitheciaceae; Zhang et al. 2009c, Hirayama et al. 2010), *Lindgomyces* (Lindgomycetaceae; Hirayama et al. 2010), *Morosphaeria* (Morosphaeriaceae; Suetrong et al. 2009), and *Triplosphaeria* (Tetraplosphaeriaceae; Tanaka et al. 2009).

**Massarina eburnea** (Tul. & C. Tul.) Sacc., Syll. Fung. 2: 153. 1883. Fig. 26.
Ascomata scattered to 2–4 grouped, immersed, hemispherical with flattened base or depressed globose, 300–420 μm high, 570–680 μm diam. Ostiolar neck short papillate, 60–90 μm long, central, with black clypeus (250–400 μm wide). Ascomatal wall 12–18 μm thick at sides, composed of 3–5 layers of thin-walled prismatic cells (5–12.5 × 2–4 μm). Pseudoparaphyses numerous, cellular, 2–3(–4.5) μm wide. Asci fissitunicate, clavate, (110–120)–180 × 21.5–30 μm (av. 141.6 × 25.6 μm, n = 50), with a stipe of 12.5–25 μm long (av. 18.6 μm, n = 38). Ascospores broadly fusiform with rounded ends, 34–40 × 12–15(–16) μm (av. 37.2 × 13.9 μm, n = 50; including firm sheath of 1–2 μm thick), l/w 2.5–2.9 (av. 2.7, n = 50), 3-septate (primary septum submedian: 0.51–0.55, av. 0.53, n = 50), hyaline, smooth, with a sharply delimited firm sheath of 1–2 μm thick (but up to 6 μm thick when fresh).

Specimen examined: UK, Wales, Swansea, dead twigs of Fagus sylvatica, Apr. 2001, H 3953 = HHUF 26621, culture CBS 139697 = JCM 14422.

Notes: The morphological characteristics of the above specimen fit well with those in the description of *M. eburnea* (Hyde 1995). A pycnidial morph of *M. eburnea* reported as *Ceratophoma* sp. (Bose 1961, Sivanesan 1984) was observed in our isolate, but the "conidia" did not germinate on several agar media (e.g., water agar, PDA, CMA, and MEA) over 7 d. The *Ceratophoma* morph is therefore considered to be spermatial in function.

*Basionym:* Massaria eburnea Tul. & C. Tul., Select. Fung. Carp. 2: 239. 1863.

Stagonospora (Sacc.) Sacc., Syll. Fung. 3: 445. 1884.

**Type species:** Stagonospora paludosa (Sacc. & Speg.) Sacc.

**Notes:** Stagonospora has been defined morphologically based on a broad generic concept (Sutton 1980) and has been believed to have phylogenetic affinities with the Phaeosphaeriaceae (Zhang et al. 2012). However, in a comprehensive phylogenetic study on Stagonospora and morphologically similar genera, Quaedvlieg et al. (2013) revealed that Stagonospora is polyphyletic and Stagonospora s. str. (based on *S. paludosa*) belongs to the Massarineae. Several new genera, such as Neostagonospora and Parastagonospora, have been established to accommodate unrelated stagonospora-like species in the Phaeosphaeriaceae (Quaedvlieg et al. 2013).

Neottiosporina, typified by *N. apoda* (Subramanian 1961) may have phylogenetic relationships with Stagonospora, although phylogenetic placement of the type species has not been clarified. At least *N. paspali*, transferred from Stagonospora to Neottiosporina (Sutton & Alcorn 1974), should be regarded within Stagonospora, because this taxon has close morphological and phylogenetic affinity to Stagonospora species (Fig. 1).

*Stagonospora bicolor* (D. Hawksw. et al.) Kaz. Tanaka & K. Hiray., comb. nov. MycoBank MB811316.

**Basionym:** Leptosphaeria bicolor D. Hawksw. et al., Mycologia 71: 483. 1979.

≡ Saccharicola bicolor (D. Hawksw. et al.) D. Hawksw. & O.E. Erikss., Mycologia 95: 431. 2003.

Notes: Although we did not observe any material of this species, the illustration in the original description of *Leptosphaeria bicolor* (Kaiser et al. 1979), as well as SSU (GenBank U04202) and ITS (GenBank U04203) sequences derived from the type culture (ATCC 42652) of this species clearly indicates that it is a member of *Stagonospora*, as recently circumscribed by Quaedvlieg et al. (2013). Based on *L. bicolor*, Eriksson & Hawksworth (2003) erected *Saccharicola* for leptosphaeria-like species on sugarcane, but *Saccharicola* should be regarded as a synonym of *Stagonospora*. The sexual morph of *Stagonospora s. str.* has been referred to as didymella-like (Quaedvlieg et al. 2013), and some species of *Didymella* with a stagonospora-like asexual morph (e.g., *D. proximella* on Carex; Corlett & Smith 1978) may have phylogenetic affinity with *Stagonospora s. str.* based on their morphologies.

*Stagonospora perfecta* Quaedvlieg et al., Stud. Mycol. 75: 378. 2013. Fig. 27.
Ascomata scattered, immersed, globose to subglobose in section, 160–220 μm high, 140–250 μm diam. Ostiolar neck central, papillate to short cylindrical, 37–50 μm long, 52–75(–100) μm wide. Ascomatal wall in longitudinal section uniformly 12–20 μm thick, composed of 4–6 layers of polygonal to subglobose, brown cells of 5–20 × 3.5–10 μm. Pseudoparaphyses cellular, septate, branched and anastomosed, 2.5–4 μm wide. Asci fissitunicate, cylindrical, 75–115 × 15–20.5 μm (av. 89.8 × 17.5 μm, n = 30), rounded at the apex and with a shallow ocular chamber, short-stalked (7–14.5 μm long), with 8 biseriate ascospores. Ascospores broadly fusiform, 20–28 × 6.5–11 μm (av. 23.4 × 8.3 μm, n = 50), l/w 2.3–3.3 (av. 2.8, n = 50), with a submedian septum (0.54–0.58; av. 0.56, n = 50), constricted at the septum, hyaline, smooth, with an entire sheath; sheath gelatinous, 2–7 μm, staining with Black-Blue ink when in fresh condition, delimited and 1–3 μm wide when in dry condition.

In culture both sexual and asexual morphs formed. Conidiomata pycnidial, 80–100 μm high, 100–120 μm diam, scattered, globose in section. Conidiomatal wall in longitudinal section uniformly 6–13 μm wide, composed of 3–4 layers of polygonal, thin-walled, 7–17 × 2.5–6 μm, pale brown cells. Conidiophores absent. Conidiogenous cells anellidic, cylindrical to subglobose, 8–17 × 5–9 μm. Conidia cylindrical, 3(–5)-septate, hyaline, smooth, (25–)27–37(–48) × 8–11 μm (av. 32.9 × 9.5 μm, n = 60), l/w 2.7–4.1(–5.1) (av. 3.5, n = 60), without sheath. Ascospores in culture slightly larger than those on the natural host, 27–33 × 10–12 μm.

Notes: The characteristics of the above material match those in the original description of *S. perfecta* described from *Carex acutiformis* in the Netherlands (Quaedvlieg et al. 2013), except that the conidia in our material were wider (8–11 μm vs. 6–8 μm). LSU and ITS sequences obtained from our material and those from the ex-type of *S. perfecta* (GenBank LSU: KF251761, ITS: KF251258) were identical. The sexual morph of this species has been referred to as didymella-like (Quaedvlieg et al. 2013), and fits well with the generic concept of *Saccharicola* (Erikkson & Hawksworth 2003), but this genus should be synonymised under the older genus *Stagonospora* (Saccardo 1884).

*Stagonospora pseudoperfecta* Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811317. Fig. 28.

Etymology: After its morphological similarity to *Stagonospora perfecta*.

Ascomata scattered, immersed, globose in section, 200–250 μm high, 210–260 μm diam. Ostiolar neck central, papillate, 35–63 μm long, 63 μm wide. Ascomatal wall in longitudinal section uniformly 10–15 μm thick, composed of 3–5 layers of polygonal to subglobose, brown cells of 6–16.5 × 3.5–11.5 μm. Pseudoparaphyses cellular, numerous, 3–6 μm wide, septate, branched, anastomosed. Ascii fissitunicate, clavate, 66–100 × 13.5–17.5 μm (av. 86.3 × 15.4 μm, n = 20), rounded at apex and with a shallow apical chamber, short-stalked (7–17.5 μm long), with 8 irregularly biseriate to triseriate ascospores. Ascospores narrowly fusiform, straight or slightly curved, 21–30.5 × 5–7 μm (av. 26.0 × 5.7 μm, n = 40), l/w 3.3–5.9 (av. 4.6, n = 40), with submedian septum (0.50–0.57, av. 5.4, n = 40), slightly constricted at the septum, hyaline, with or without guttules, smooth, with an entire sheath; sheath gelatinous, 0.5–2 μm wide at side.
Colonies on PDA (after 2 wk) attaining a diam of 4.9–5.5 cm, white; reverse sepia to fuscous black; no pigment produced. In culture asexual morph formed. *Conidiomata* pycnidal. *Conidia* cylindrical, aseptate, hyaline, 21.5–26 x 4–5.5 μm (av. 24.1 ± 4.9 μm, n = 10), l/w 4.6–5.8 (av. 5.0, n = 10).

Specimens examined: Japan, Aomori, Hirosaki, Kadoma, Oowasawa-river, riverbank (Hokkoshi-bridge), on dead leaves of *Typha latifolia*, 8 Sep. 2002, K. Tanaka (holotype KT 889 = HHUF 29087, culture ex-type CBS 120236 = JCM 13097 = MAFF 239607); ibid., KT 888 = HHUF 29086.

Notes: Eight species are currently accepted in *Stagonospora* s. str. based on molecular evidence (Crous et al. 2013b, 2014b, Quaedvlieg et al. 2013). *Stagonospora pseudoperfecta* is similar to *S. perfecta*, but has slightly longer and more slender ascospores (l/w 4.6 vs. 2.8). In terms of overall morphology and host preference, *S. pseudoperfecta* superficially resembles “Massarina” *lacustris* sensu Leuchtmann (1984) (non Wettsteinina *lacustris* sensu Shoemaker & Babcock 1989, or Khashnobish & Shearer 1993) reported from *Typha* and *Schoenoplectus*. However, molecular data (SSU, rpb2, tef1) obtained from a strain studied by Leuchtmann (CBS 618.86) suggests that the latter fungus is a member of the *Lentilhecicaceae* (Schoch et al. 2009). In ITS analysis with other *Stagonospora* species (data not shown), *S. pseudoperfecta* positioned as a sister taxon to *S. duoseptata*, but similarity between the two taxa in this region was 95.2% (452/475) with 1.3% (6/475) gaps.

In culture, pycnidial conidiomata with cylindrical hyaline conidia were observed only once, but this may have been an immature condition because the conidia were aseptate and smaller (Fig. 28J). Unfortunately, the asexual morph in culture failed to be observed again, despite several attempts.

*Stagonospora tainanensis* W.H. Hsieh, Mycologia 71: 893. 1979. Fig. 29.

Ascii ovoid to cylindrical, 102–122.5 x 26.5–32.5 μm, 8-spored. *Ascospores* fusiform, 36–44 x 8.5–12 μm, l/w 3.6–4.7, with a submedian septum (0.53–0.56), hyaline, smooth, with an entire sheath (2–5 μm wide when fresh, 1–2 μm wide when dry).

In culture, both sexual and asexual morphs formed. *Ascospores* 32–40 x 10.5–13 μm, l/w 2.8–3.2, with a submedian septum (0.54–0.56). *Conidia* ellipsoid, 37–48(–55) x 12–13(–15) μm, l/w 3.0–3.8, 3-septate, hyaline.

Specimen examined: Japan, Kagoshima, Isl. Yakushima, Numbiknotaki park, on dead leaves of herbaceous plant, 19 Oct. 2005, K. Tanaka & T. Hosoya, KT 1866 = HHUF 30141, culture MAFF 243860.

Notes: The ITS sequence from this material is identical with the sequence (GenBank AF439464) of *Stagonospora taiwanensis* obtained from the ex-type culture (ATCC 38204; Hsieh 1979), and two ITS sequences (GenBank AF439462, AF439463) of *Saccharicola taiwanensis* on *Saccharum*. An unnamed “Saccharicola” on *Miscanthus* (O’Neill & Farr 1996), a grass genus related to *Saccharum*, is also considered to be conspecific, because these have identical ITS sequences (GenBank AF439467; Câmara et al. 2002) and morphological similarities (O’Neill & Farr 1996). Morphologically, our specimen agrees with the previous description of this species (as *Leptosphaeria taiwanensis*; Hsieh 1979, Sivanesan 1984, Sivanesan & Waller 1986), but the large ascospores reported by Shoemaker & Babcock (1989) were not observed.

*Morosphaeriaceae* Suetrong et al., Stud. Mycol. 64: 161. 2009.

Type genus: *Morosphaeria* Suetrong et al.

*Aquilomyces* D.G. Knapp et al., Persoonia 35: 93. 2015.

Type species: *Aquilomyces patris* D.G. Knapp et al.

Notes: *Aquilomyces* was erected by Knapp et al. (2015) to accommodate *A. patris*, a root endophyte of white poplar. There was no morphological information of this genus, because no fructifications were observed for *A. patris*.

*Aquilomyces rebunensis* Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811322. Fig. 30.

Etymology: After the locality where this fungus was collected.
Ascomata subglobose, 350–550 μm high, (430–600)–700 μm diam, covered with numerous brown hyphae of 2–3 μm thick. Ostiolar neck terete, central, 85–130 μm long, 75–130 μm wide, clypeate, with periphyses, composed of carbonaceous polygonal cells of 5–10 × 3–5 μm. Ascomatal wall at side wedge-shaped, up to 125 μm thick, composed of vertically orientated angular brown cells (5–8 × 2–5 μm); wall at the base 25–50 μm thick, composed of 3–8 μm diam, subglobose, brown cells. Pseudoparaphyses branched and anastomosed, septate, 1.5–2 μm wide. Asci fissitunicate, cylindrical to clavate, 97.5–147.5 × 15–21 μm (av. 121.3 × 18.3 μm, n = 45), with a short stipe of 7.5–25(−37.5) μm (av. 18.0 μm, n = 34). Ascospores fusiform, slightly curved, 30–38.5 × 6.5–11.5 μm (av. 35.1 × 8.8 μm, n = 50), I/w 3.3–5.0(−5.6) (av. 4.2, n = 50), with a supramedian septum (0.44–0.50; av. 0.47, n = 57), hyaline, smooth, with a sheath of 1–2 μm wide.

Colonies on PDA (after 4 wk) attaining a diam of 4.3–4.6 cm, pale olivaceous grey with white margin; reverse black to olivaceous grey; no pigment produced. In culture spermatial and ascomatal morphs formed. Spermatia 2–3 × 1.5–1.8 μm, subglobose to oblong. Ascospores slightly larger than those found on nature, 35–48 × 8–11 μm (av. 39.7 × 9.3 μm, n = 25).

Specimen examined: Japan, Hokkaido, Isl. Rebun, Kafuka, Nairo-river, on submerged twigs of woody plant, 30 Aug. 2001, K. Tanaka (holotype KT 732-2 = HHUF 27556, culture ex-type CBS 139684 = JCM 19427 = MAFF 243862).

Notes: We tentatively describe this aquatic fungus as Aquilomyces based on our molecular results. Phylogenetic analysis showed that A. patris, the type species of Aquilomyces, and A. rebunensis clustered into a distinct and moderately-supported clade (85 %, Fig. 1). Sequence similarities between these two taxa were 97.7 % (858/878) with 2.3 % gaps (20/878) in LSU and 95.4 % (576/604) with 0.7 % gaps (4/604) in ITS, suggesting that they are congeneric.

Clypeoloculus Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811318.
Etymology: Referring to the morphology of the ascomata covered by clypeus.

Ascomata scattered to 2–3 grouped, immersed to erumpent, subglobose or hemispherical with flattened base in section, covered with numerous brown hyphae around ascomata. Ostiolar neck terete to papillate, central, clypeate, composed of carbonaceous cells. Ascomatal wall wedge-shaped or “rim-like” at sides. Pseudoparaphyses septate, branched and anastomosed. Asci fissitunicate, clavate, with a short stipe, 8-spored. Ascospores narrowly fusiform, slightly curved, with a primary septum supramedian, 2.5–10 μm diam, composed of carbonaceous cells. Ascomatal wall in longitudinal section 37–100 μm wide at sides and base, composed of subglobose to globose, thick-walled, 2.5–155 × 17.5–27.5 μm (av. 125.1 × 20.9 μm, n = 30 μm), with a short stipe of (7.5−12−27.5−30) μm (av. 19.4 μm, n = 26) long, with 8 biseriate ascospores. Ascospores narrowly fusiform, slightly curved, 33.5–43 × 7−10 μm (av. 38.7 × 8.6 μm, n = 50), with a primary septum supramedian (0.44−0.50; av. 0.48, n = 47), constricted at the septum, hyaline, smooth, surrounded by an entire gelatinous sheath, 1.5–3 μm wide.

Colonies on PDA (after 4 wk) attaining a diam of 2.0−2.2 cm, greenish grey; reverse black to smoke grey; no pigment produced. Spermatial morph observed in culture. Spermatia oblong, hyaline, 2.8−4 × 1.3−1.9 μm (av. 3.3 × 1.7 μm, n = 30). Specimen examined: Japan, Akita, Kisakata, Akagawa-river, riverbank, on submerged twigs of woody plant, 23 Sep. 2001, K. Tanaka (holotype KT 788 = HHUF 27557, culture ex-type MAFF 239467).

Notes: In ascospore dimensions, C. akitaensis (av. 38.7 × 8.6 μm) is most similar to C. towadaensis (av. 38.7 × 8.7 μm), but the latter species has hemispherical ascomata with flattened bases and longer asci [(112−120−170) μm long]. In the ITS sequences of these two species, there were differences at 29 positions. They are distinct species, because M. peerallyi has broader asci based on its holotype [HKU (M) 2409] revealed that they are distinct species, because M. peerallyi has broader asci (80–127.5 × 25–35 μm) and larger ascospores (37–45 × 9−12 μm) with a supramedian septum (0.43−0.50 av. 0.48, n = 32). The morphological features of M. peerallyi are generally in accordance with the generic concept of Clypeolocus, but phylogenetic reassessment using molecular sequences will be necessary before a new combination is proposed for this species.

Type species: Clypeolocus akitaensis Kaz. Tanaka & K. Hiray. MycoBank MB811319. Fig. 31.

Etymology: Referring to the location where the specimen was collected.

Ascomata scattered to 2–3 grouped, immersed to erumpent, globose to subglobose in section, 400−550 μm high, 580–720 μm diam, covered with numerous brown hyphae around ascomata. Ostiolar neck terete, central, clypeate, composed of carbonaceous cells. Ascomatal wall in longitudinal section 37–100 μm wide at sides and base, composed of subglobose to globose, thick-walled, 2.5–10 μm diam, brown cells. Pseudoparaphyses septate, branched and anastomosed, 2–2.5 μm wide. Asci fissitunicate, clavate, (95−) 110−155 × 17.5−27.5 μm (av. 125.1 × 20.9 μm, n = 30 μm), with a short stipe of (7.5−12−27.5−30) μm (av. 19.4 μm, n = 26) long, with 8 biseriate ascospores. Ascospores narrowly fusiform, slightly curved, 33.5−43 × 7−10 μm (av. 38.7 × 8.6 μm, n = 50), with a primary septum supramedian (0.44−0.50; av. 0.48, n = 47), constricted at the septum, hyaline, smooth, surrounded by an entire gelatinous sheath, 1.5−3 μm wide.

Notes: A new genus, Clypeolocus, is proposed here for freshwater species having globose to subglobose ascomata with prominent clypeus, clavate asci, and 1-septate, hyaline ascospores with an entire sheath. These morphological characters are more prominent in C. akitaensis than in C. towadaensis. Clypeolocus can be distinguished from Massarina s. str. (Aptroot 1998, Tanaka & Harada 2003b), but Clypeolocus can be distinguished from Massarina s. str. by the ascomata with wedge-shaped or “rim-like” ascomatal wall and narrowly fusiform ascospores. Furthermore, species in Clypeolocus are located in the Morosphaeriaceae clade and are distantly related to M. eburnea, the type species of Massarina (Massarineae; Fig. 1).

Clypeolocus akitaensis Kaz. Tanaka & K. Hiray., sp. nov.

Etymology: Referring to the morphology of the ascomata covered by clypeus. Ascomata scattered to 2–3 grouped, immersed to erumpent, subglobose or hemispherical with flattened base in section, covered with numerous brown hyphae around ascomata. Ostiolar neck terete to papillate, central, clypeate, composed of carbonaceous cells. Ascomatal wall wedge-shaped or “rim-like” at sides. Pseudoparaphyses septate, branched and anastomosed. Asci fissitunicate, clavate, with a short stipe, 8-spored. Ascospores narrowly fusiform, slightly curved, with a primary septum median to supramedian, constricted at the septum, hyaline, smooth, surrounded by an entire gelatinous sheath, 1.5–3 μm wide.

Colonies on PDA (after 4 wk) attaining a diam of 2.0−2.2 cm, greenish grey; reverse black to smoke grey; no pigment produced. Spermatial morph observed in culture. Spermatia oblong, hyaline, 2.8−4 × 1.3−1.9 μm (av. 3.3 × 1.7 μm, n = 30). Specimen examined: Japan, Akita, Kisakata, Akagawa-river, riverbank, on submerged twigs of woody plant, 23 Sep. 2001, K. Tanaka (holotype KT 788 = HHUF 27557, culture ex-type CBS 139681 = JCM 19424 = MAFF 239467).

Notes: In ascospore dimensions, C. akitaensis (av. 38.7 × 8.6 μm) is most similar to C. towadaensis (av. 38.7 × 8.7 μm), but the latter species has hemispherical ascomata with flattened bases and longer asci [(112−120−170) μm long]. In the ITS sequences of these two species, there were differences at 29 positions. They are distinct species, because M. peerallyi has broader asci based on its holotype [HKU (M) 2409] revealed that they are distinct species, because M. peerallyi has broader asci (80–127.5 × 25−35 μm) and larger ascospores (37–45 × 9–12 μm) with a supramedian septum (0.43−0.50 av. 0.48, n = 32). The morphological features of M. peerallyi are generally in accordance with the generic concept of Clypeolocus, but phylogenetic reassessment using molecular sequences will be necessary before a new combination is proposed for this species.
Clypeoloculus hirosakiensis Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811320. Fig. 32.

**Etymology:** Referring to the collection site.

Ascomata scattered, immersed to erumpent, globose to subglobose in section, 350–520 μm high, 340–550 μm diam, covered with numerous brown hyphae around ascomata. Ostiolar neck terete, central, 75–100 μm long, 40–170 μm wide, clypeate, composed of carbonaceous cells. Ascomatal wall in longitudinal section at sides, 50–60 μm wide, composed of parallel rows of rectangular to polygonal, brown to dark brown cells of 7.5–12.5 × 3.5–9.5 μm; wall at the base 17–25 μm wide, composed of subglobose to polygonal, slightly thick-walled, 3–10 × 3.5–6.5 μm, brown cells. Pseudoparaphyses septate, branched and anastomosed, 1.5–3 μm wide. Ascii fusiform, clavate, 100–147.5 × (13.5–)15–20 μm (av. 118.6 × 16.5 μm, n = 50 μm), with a short stipe of (7.5–)10–25(–30) μm (av. 16.5 μm, n = 50 μm) long, with 8 biseriate ascospores. Ascospores narrowly fusiform, slightly curved, (24–)29–36 × 7–9.5 μm (av. 33.0 × 8.0 μm, n = 50 μm), l/w = 3.7–4.7 (av. 4.1, n = 50 μm), with a primary septum nearly median (0.47–0.52 μm, n = 50 μm), constricted at the septum, hyaline, smooth, surrounded by an entire gelatinous sheath, 3–7 μm wide.

Colonies on PDA (after 4 wk) attaining a diam of 2.7–3.0 cm, greenish grey to lavender grey; reverse chestnut; ochreous pigment produced. In culture spermatial morph formed. Spermatia oblong, hyaline, 2.6–3.5 × 1.2–1.5 μm.

Specimen examined: **Japan**, Aomori, Morioka, Lake Nizinoko, on submerged twigs of woody plant, 19 Jul. 2003, K. Tanaka & N. Asama (holotype KT 1283 = HHUF 30144, culture ex-typeCBS 139682 = JCM 19425 = MAFF 243864).

Note: The ascospores of *C. hirosakiensis* (av. 33.0 × 8.0 μm) are larger than those of *C. microsporus* (av. 29.9 × 7.0 μm) but smaller than those of *C. akitaensis* (av. 38.7 × 8.6 μm) and *C. towadaensis* (av. 38.7 × 8.7 μm).

Clypeoloculus microsporus Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811321. Fig. 33.

**Etymology:** Referring to the small ascospores.

Ascomata scattered to 2–3 grouped, immersed to erumpent, globose to subglobose in section, 290–310 μm high, 280–350 μm diam, covered with sparse brown hyphae around ascomata. Ostiolar neck central, papillate, 70–90 μm long, 100–120 μm wide, clypeate, composed of carbonaceous cells. Ascomatal wall in longitudinal section 25–38 μm wide at sides and 25–30 μm wide at the base, composed of subglobose brown cells (2.5–10 μm diam). Pseudoparaphyses branched and anastomosed, septate, 2–3 μm wide. Asci fusiform, cylindrical to clavate, 80–145 × 13.5–22.5 μm (av. 115.5 × 17.5 μm, n = 33), with a short stipe of (5–)7.5–15(–29.5) μm (av. 13.9 μm, n = 30 μm), long, with 8 biseriate to triseriate ascospores. Ascospores narrowly fusiform, slightly curved, 25.5–34.5 × 6–8(–9) μm (av. 29.9 × 7.0 μm, n = 56 μm), l/w = 3.4–5.2(–5.5) (av. 4.3, n = 56 μm), with a primary septum nearly median (0.47–0.52 μm, n = 50 μm), constricted at the septum, hyaline, smooth, surrounded by an entire gelatinous sheath of 2–4 μm wide.

Colonies on PDA (after 4 wk) attaining a diam of 3.1–3.3 cm, olivaceous grey; reverse amber to chestnut; amber pigment produced. In culture spermatial morph formed. Spermatia oblong, hyaline, 2.5–3.2 × 1.2–1.6 μm.

Specimen examined: **Japan**, Aomori, Kuroishi, Lake Nizinoko, on submerged twigs of woody plant, 3 May 2003, K. Tanaka & N. Asama (holotype KT 1131 = HHUF 30143, culture ex-type CBS 139683 = JCM 19426 = MAFF 243863).

Note: This species is distinguished from other species of *Clypeoloculus* by having the smallest ascospores known in the genus.

Clypeoloculus towadaensis Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811323. Fig. 34.
Etymology: Referring to the collection site.

Ascomata scattered to 2–3 grouped, immersed to erumpent, hemispherical with flattened base in section, 260–360 μm high, 550–700 μm diam. Ostiolar neck central, terete, 65–135 μm long, 75–88 μm wide, clypeate, composed of carbonaceous cells. Ascomatal wall at sides 95–150 μm wide and "rim-like", composed of vertically orientated, rectangular to subglobose, hyaline to pale brown cells of 6–10 × 3–6 μm; at the base 15–25 μm wide or poorly developed. Pseudoparaphyses septate, branched and anastomosed, 1–2 μm wide. Asci fissitunicate, cylindrical, (112–)120–170 × 17.5–25 μm (av. 136.7 × 21.3 μm, n = 35), with a short stipe of (7.5–)12.5–25 μm (av. 17.2 μm, n = 35) long, with 8 biseriate ascospores. Ascospores narrowly fusiform, slightly curved, 34–43 × 7–10 μm (av. 38.7 × 8.7 μm, n = 50), l/w 3.9–5.3 (av. 4.5, n = 50), with a primary septum nearly median (0.47–0.53; av. 0.50, n = 50), constricted at the septum, hyaline, smooth, surrounded by an entire gelatinous sheath of 1–5 μm wide. Senescent ascospores becoming brown, 1–3(–5)-septate.

Colonies on PDA (after 4 wk) attaining a diam of 1.9–2.2 cm, greenish grey; reverse buff to sepia; ochreous pigment produced. In culture spermatial morph formed. Spermatia oblong to subglobose, hyaline, 3–4 × 1.4–1.8 μm.

Specimen examined: Japan, Akita, Kazuno, Kosaka, Lake Towada, on submerged twigs of woody plant, 26 Jul. 2003, K. Tanaka & N. Asama (holotype KT 1340 = HHUF 30145, culture ex-type CBS 139685 = JCM 19428 = MAFF 243865).

Notes: The most distinctive feature of C. towadaensis is its hemispherical ascomata with "rim-like" ascomatal walls. The asci
of this species are longer than those of other species in Clypeolocus.

**Helicascus** Kohlm., Canad. J. Bot. 47: 1471. 1969.

Type species: **Helicascus kanaloanus** Kohlm.

Notes: **Helicascus** was revised by Zhang et al. (2013) who accepted six species: two marine (**H. kanaloanus** and **H. nypae**) and four freshwater species (**H. aegyptiacus**, **H. aquaticus**, **H. elaterascus** and **H. thalassioideus**). Recently, two additional species in freshwater habitat (**H. gallicus** and **H. unilocularis**) were described in the genus (Zhang et al. 2014b, 2015).

**Helicascus aquaticus** H. Zhang & K.D. Hyde, Sydowia 65: 155. 2013. Fig. 35.

Ascomata scattered to 2–3 grouped, immersed, hemispherical in section, 170–300 μm high (excluding the long ostiolar neck), 230–530 μm diam. Ostiolar neck cylindrical, oblique to central, 230–340 μm long, 110–160 μm wide, composed of polygonal to subglobose, thick-walled, 2.5–7.5 × 2–4 μm, brown to dark brown cells, with dense periphyses. Ascomatal wall in longitudinal section, 40–110 μm thick at sides, “rim-like”, composed of parallel rows of rectangular to polygonal, brown cells of 3.5–20 × 2.5–10 μm; at base poorly developed, 7–15 μm thick, composed of thin-walled flattened cells. Pseudoparaphyses septate, branched and anastomosed, 1.5–2(–3.5) μm wide, associated with gelatinous material. Asci fissitunicate, cylindrical to clavate, 80–122.5 × 15–19.5 μm (av. 102.8 × 17.5 μm, n = 20), with a stipe of 17.5–32.5 μm long (av. 24.7 μm long, n = 20), 8-spored. Ascospores broadly fusiform, slightly curved, 21.5–29 × 8–10.5 μm (av. 24.4 × 9.1 μm, n = 50), l/w 2.2–3.3 (av. 2.7, n = 50), with a submedian septum (0.51–0.60; av. 0.57, n = 50), constricted at the septum, pale greenish brown to brown, smooth, without sheath.

In culture spermatial morph formed. Spermatia oblong, hyaline, 2.4–4 × 1.5–2 μm.

Specimen examined: Japan, Aomori, Hirosaki, Aoki, Mohei-pond, on submerged twigs of woody plant, 25 Oct. 2003, K. Tanaka & N. Asama, KT 1544 = HHUF 30146, culture JCM 19423 = MAFF 243866.

Notes: The ITS sequence from the above isolate showed 100 % identity with that from the ex-type of **H. aquaticus** (GenBank KC886639), an aquatic species formerly known only from the type specimen collected on submerged wood in Thailand (Zhang et al. 2013). Our collection has a longer ascomatal neck (vs. 130–200 μm) and shorter asci [vs. 90–140(–185) μm] than described in the original publication. The ascospores possessing three septa were noted as the most distinctive feature of **H. aquaticus** (Zhang et al. 2013), but these were consistently 1-septate in our material.

**Helicascus elaterascus** (Shearer) H. Zhang & K.D. Hyde, Sydowia 65: 158. 2013. Fig. 36.

Basionym: **Kirschsteiniothelia elaterascus** Shearer, Mycologia 85: 963. 1994 (1993).

Ascomata scattered, immersed, depressed globose in section, 250–300 μm high (excluding the long ostiolar neck),
600–910 μm diam. Ostiolar neck 200–230 μm long, 110–160 μm wide, with dense periphyses. Pseudoparaphyses branched and anastomosed, septate, associated with gelatinous material. Asci fissitunicate, clavate, ca. 140 × 19 μm, with a long stipe, 8-spored. Ascosporoclavate, broadly fusiform, slightly curved, 26.5–31.5 × 9–12.5 μm (av. 29.0 × 10.6 μm, n = 30), l/w 2.4–3.1 (av. 2.8, n = 30), with a submedian septum (0.50–0.58; av. 0.54, n = 30), slightly constricted at the septum, pale greenish brown to brown, with an entire sheath slightly enlarged below. In culture only sexual morph observed.

Specimens examined: Japan, Okinawa, Isl. Ishigaki, Mt. Omoto (river), on submerged twigs of woody plant, 2 Dec. 2009, Y. Kurihara, KT 2673 = HHUF 30147, culture MAFF 243867; Okinawa, Isl. Iriomote, Aira-river, on submerged twigs of woody plant, 8 Dec. 2009, Y. Kurihara & A. Ooba, KT 2682 = HHUF 30451, culture CBS 139689.

Notes: The morphological features of the examined material matched well with those in the original description of this species (Shearer 1993, as Kirschsteiniothelia elaterascus) and the LSU sequences were identical with that of the species deposited in GenBank (GenBank AY787934; Kodsu et al. 2006). This species has been reported frequently from submerged wood in temperate and tropical freshwater habitats (Shearer & Raja 2010, Raja et al. 2011) including Japan (Tsui et al. 2003).

**Helicascus thalassioideus** (K.D. Hyde & Aptroot) H. Zhang & K.D. Hyde, Sydowia 65: 159. 2013.

**Basionym**: Massarina thalassioidea K.D. Hyde & Aptroot, Nova Hedwigia: 498. 1998.

Asci clavate, 80–120 × 15–17.5 μm (av. 100.2 × 16.7 μm, n = 30), with a stipe of 15–32.5 μm long (av. 23.0 μm, n = 30). Ascosporoclavate, 25–31 × 8–10 μm (av. 27.5 × 8.6 μm, n = 30), l/w 2.8–3.5 (av. 3.2, n = 30), with a median septum. Asexual morph unknown.

Specimens examined: Japan, Okinawa, Isl. Iriomote, Geta-river, on submerged twigs of woody plant, 22 Nov. 2008, K. Hirayama & K. Tanaka, KH 242 = HHUF 30069, culture JCM 17526 = NBRC 107811. China, Hong Kong, Lam Tsuen river, N.T. on submerged wood, culture CBS 110441 = JCM 14147.

Notes: A more detailed description of this species was provided by Hirayama & Tanaka (2011a). This species was originally described as Massarina (Hyde & Aptroot 1998) and has commonly been reported from submerged wood in freshwater habitats throughout the world including Australia, Brunei, China.
(Yunnan), French West Indies, Hong Kong, the Philippines, and Thailand (Zhang et al. 2013, 2015). Zhang et al. (2014b) suspected that helicascus-like taxa with a worldwide distribution might be a species-complex. However, ITS sequences obtained from the above two isolates were identical and differed by only one position (517/518) from that of *H. thalassioideus* collected in French West Indies (GenBank KP637162, Zhang et al. 2015).

**Morosphaeria** Suetrong et al., Stud. Mycol. 64: 161. 2009.

*Type species*: *Morosphaeria velatispora* (K.D. Hyde & Borse) Suetrong et al.

*Notes*: The genus *Morosphaeria* currently comprises two marine species, *M. ramunculicola* and *M. velatispora* (Suetrong et al. 2009). A freshwater fungus, *Kirschsteiniothelia elaterascus*, was transferred to *Morosphaeria* (Boonmee et al. 2012), but it is presently placed in *Helicascus* (Zhang et al. 2013).

**Morosphaeria ramunculicola** (K.D. Hyde) Suetrong et al., Stud. Mycol. 64: 162. 2009. Fig. 38.

*Basionym*: *Massarina ramunculicola* K.D. Hyde, Mycologia 83: 839. 1992 (1991).

Asci cylindrical to clavate, 121–187.5 × 22–32.5 μm, stalked (20–42.5 μm long). Ascospores 33–41 × 11–15 μm (av. 36.5 × 12.6 μm, n = 30), l/w 2.4–3.4 (av. 2.9, n = 30), with a submedian primary septum (0.50–0.56; av. 0.52, n = 30). Asexual morph unknown.

Specimen examined: Japan. Okinawa, Isl. Iriomote, Oomijya-river, on twigs of *Rhizophora mucronata*, 22 Nov. 2008, K. Hirayama & K. Tanaka, KH 220 = HHUF 30070, culture NBRC 107813.

*Notes*: The morphological features of the specimen cited here were identical to those of *M. ramunculicola* (Hyde 1991). There were only 1–2 bp differences between the LSU sequences (ca. 1280 bp) of our material and those of *M. ramunculicola* deposited in GenBank (GenBank GQ925853, GQ925854).

**Morosphaeria velatispora** (K.D. Hyde & Borse) Suetrong et al., Stud. Mycol. 64: 161. 2009. Fig. 39.

*Basionym*: *Massarina velatispora* K.D. Hyde & Borse, Mycotaxon 27: 161. 1986.

Asci clavate, (135–)165–245(–280) × 25–38 μm (av. 212.2 × 32.8 μm, n = 30), with a stipe of 25–55 μm long (av. 37.0 μm, n = 26). Ascospores 42–52 × 14–18 μm (av. 47.1 × 16.1 μm, n = 40), l/w 2.6–3.4 (av. 2.9, n = 40), 1–3-septate, with a median primary septum (0.49–0.53; av. 0.50, n = 40). Asexual morph unknown.

Specimens examined: Japan. Okinawa, Isl. Iriomote, Oomijya-river, on twigs of *Rhizophora mucronata*, 22 Nov. 2008, K. Hirayama & K. Tanaka, KH 218 = HHUF 30072; culture JCM 17529 = NBRC 107812; Okinawa, Isl. Iriomote, Geda river, on twigs of *Rhizophora mucronata*, 20 Nov. 2008, K. Hirayama & K. Tanaka, KH 221 = HHUF 30073, culture JCM 17530 = NBRC 107812.

*Note*: Hirayama & Tanaka (2011a) provided a more precise description based on the above specimens.
**Parabambusicolaceae** Kaz. Tanaka & K. Hiray., fam. nov. MycoBank MB811324.

**Etymology:** Referring to the name of the type genus.

Ascomata scattered to grouped, immersed to erumpent, globose to subglobose in surface view, depressed globose to hemispherical in section. Ostiolar neck or short papillate, central, sometimes compressed, composed of heavily melanised cells. Ascomatal wall composed of pale brown cells, with or without “rim-like” stromatic region. Pseudoparaphyses septate, branched and anastomosed. Ascii fissitunicate, clavate to broadly cylindrical, stipitate, with 8 ascospores. Ascospores clavate to fusiform, with a supramedian primary septum, multisepiticate, slightly constricted at septa, hyaline, smooth, with an entire sheath. Asexual morph where known sporodochial, monodictys-like hyphomycetes.

**Type genus:** Parabambusicola Kaz. Tanaka & K. Hiray.

**Notes:** This family superficially resembles Bambusicola, but can be distinguished from the latter by the ascomata surrounded by stromatic tissue (Parabambusicola) or compressed necks with wide ostioles (Aquastroma), and the multisepiticate, clavate to fusiform, hyaline ascospores.

**Aquastroma** Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811325.

**Etymology:** From the Latin aqua meaning water and stroma.

Ascomata scattered to grouped, immersed to erumpent, globose in surface view, depressed globose in section. Ostiolar neck central, compressed, composed of thick-walled, heavily melanised subglobose cells, with a wide ostiole. Ascomatal wall composed of pale brown, thin-walled cells. Pseudoparaphyses septate, branched and anastomosed. Ascii fissitunicate, clavate, stipitate, with 8 ascospores. Ascospores clavate to fusiform, slightly curved, with a supramedian primary septum, multisepiticate, slightly constricted at septa, hyaline, smooth, with an entire sheath. Asexual morph unknown.

**Type species:** Aquastroma magniostiolata Kaz. Tanaka & K. Hiray.

**Notes:** Aquastroma is superficially similar to Quintaria in having multisepiticate ascospores and aquatic habitat. However, the type species of Quintaria, *Q. lignatilis* known from marine habitats, has long-necked ascomata with black incrustations surrounding the sides of the ostiolar canal (Zhang et al. 2012), and is phylogenetically close to members of the family Amniculicilaceae (Shearer et al. 2009) or the Tastudinaceae/Platystomaceae (Suetrong et al. 2009, Zhang et al. 2012). Quintaria is regarded as a polyphyletic genus, because *Q. submersa* known from freshwater habitats does not cluster with *Q. lignatilis* and forms a sister clade to the Lindgomycetaceae (Zhang et al. 2012). An asexual morph was not observed for Aquastroma in culture, but this genus forms a clade with two hyphomycetes, Monodicits species, and their relationship is highly supported (100 %; Fig. 1). Monodicits, however, is not monophyletic and species in this genus are phylogenetically distributed in three ascomycete classes, Dothideomycetes, Leotiomycetes, and Sordariomycetes (see Notes in Monodicits). Aquastroma should be retained as a distinct genus, until sequence data of the type species of Monodicits (*M. putredinis*) become available to clarify the phylogenetic placement of Monodicits s. str.

**Aquastroma magniostiolata** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811326. Fig. 40.

**Etymology:** From the Latin mangi-, meaning large, and ostiola-, meaning ostiolar.

Ascomata scattered to 3–4 grouped, immersed to erumpent, globose in surface view, depressed globose in section, 180–250 μm high, 260–340 μm diam. Ostiolar neck central, compressed, 60–750 μm long, composed of thick-walled, heavily melanised, subglobose cells (2–3 μm diam), with a wide ostiole. Ascomatal wall in longitudinal section 25–30 μm thick at sides, composed of 5–7 layers of polygonal, thin-walled, 6–17 × 2.5–7.5 μm, pale brown cells; wall at the base 10–18 μm thick or poorly developed, composed of thin-walled flattened cells. Pseudoparaphyses septate, branched and anastomosed, 2–3 μm wide. Asci fissitunicate, clavate, 112.5–137.5 × 25–29.5 μm, with a stipe of 22–28 μm long, with 8 biseriate to triseriate ascospores. Ascospores clavate to fusiform, slightly curved, 30–44 × 9–13.5 μm (av. 36.5 × 10.3 μm, n = 39), lw 2.8–4.5 (av. 3.6, n = 39), with a supramedian primary septum (0.40–0.47; av. 0.43, n = 39), 6–8-septate (2+1+3, 2+1+4, 3+1+3, 3+1+4), slightly constricted at septa, hyaline, smooth, with an entire sheath; sheath delimiting 2–3 μm wide at first, diffuse and up to 10 μm wide at a later.

Colonies on PDA (after 4 wk) attaining a diam of 3.2–3.4 cm, greenish grey; reverse almost black; no pigment produced. In culture sexual morph formed. Ascii and ascospores larger than those on the natural host. Asci 130–170 × 22.5–37.5 μm (av. 148.9 × 29.9 μm, n = 30). Ascospores 39–47.5 × 11–16 μm (av. 43.5 × 13.5 μm, n = 50), lw 2.8–3.8 (av. 3.2, n = 50).

Specimen examined: **Japan**, Mie, Tsu, Kamihama, Hyouran pond, on submerged twigs of woody plant, 1 Jun. 2008, K. Tanaka & H. Yonezawa (holotype KT 2485 = HHIUF 30122, culture ex-type CBS 139680 = JCM 19429 = MAFF 243824).

**Notes:** Aquastroma magniostiolata is shown to be morphologically distinct from *Quintaria aquatica* by its ascospores with 6–8 septa [vs. (10–)11–13(–)14 septa in *Q. aquatica*; Hyde & Goh 1999]. It is also different from *Q. microspora* in its larger ascospores (vs. 26–31 × 5–5.5 μm in *Q. microspora*; Zhang et al. 2008a).

**Parabambusicola** Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811327.

**Etymology:** After its phylogenetic similarity to Bambusicola.

Ascomata mostly grouped, immersed to erumpent, subglobose in surface view, hemispherical with flattened base in section. Ostiolar neck short papillate, central. Ascomatal wall at the sides composed of pale brown, flattened cells; at the rim, composed of parallel rows of rectangular to polygonal cells. Pseudoparaphyses numerous. Ascii broadly cylindrical to clavate, short-stalked, 8-spored. Ascospores fusiform, multisepiticate, primary

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septum mostly supramedian, hyaline, smooth, with an entire sheath. Asexual morph unknown.

Type species: Parabambusicola bambusina (Teng) Kaz. Tanaka & K. Hiray.

Notes: A new genus Parabambusicola is established to accommodate P. bambusina formerly classified in Massarina (Teng 1936, Aptroot 1998, Tanaka & Harada 2003b). Parabambusicola differs from Massarina in its hemispherical to depressed globose ascomata surrounded by stromatic tissue and without prominent clypeus, broadly cylindrical asci, and fusiform ascospores with several septa. It is distantly related to Massarina (Fig. 1).

Parabambusicola bambusina (Teng) Kaz. Tanaka & K. Hiray., comb. nov. MycoBank MB811392. Fig. 41.

Basionym: Massarina bambusina Teng, Sinensia 7: 512. 1936.

Specimens examined: Japan, Hokkaido, Chitose, Shikotsuko, on dead twigs of Sasa kurilensis, 5 Sep. 2001, Y. Harada, H 4321 = HHUF 26590, culture MAFF 239462; Iwate, Hachimantai, Aspite line, on dead twigs of Sasa kurilensis, 25 Jul. 2009, K. Tanaka & Y. Harada, KT 2637 = HHUF 30120, culture MAFF 243822; Aomori, Hirosaki, Tokiwano, Kuromori, Top of Mt. Iwaki, on dead twigs of Sasa sp., 21 Jun. 2008, K. Hirayama & K. Tanaka, KH 139 = HHUF 30121, culture MAFF 243823.

Note: For further information on this species, see Teng (1936) and Tanaka & Harada (2003b).

Periconiaceae (Sacc.) Nann., Repert. mic. uomo 4: 482. 1934. emend.

= Periconiaceae Sacc., Syl. Fung. 4: 235. 1886.

Ascomata scattered to grouped, immersed to erumpent, globose. Ostiolar neck central, papillate, with hyaline periphyses. Ascomatal wall in longitudinal section composed of several layers of thin-walled, pale brown to brown cells. Pseudoparaphyses cellular, branched, anastomosed. Asci fissitunicate, oblong to cylindrical, 8-spored. Ascospores broadly fusiform, 1-septate, hyaline, smooth, with an entire sheath. Conidionata periconia- or noosia-like. Conidiophores macronematous, mononematous, sometimes lacking. Branches pale brown to brown, smooth to slightly echinulate. Conidial heads spherical. Conidiogenous cells monoblastic to polyblastic, discrete on stipe and branches. Conidia globose to ellipsoidal, aseptate, catenate, brown, verruculose to echinulate.

Type genus: Periconia Tode.

Note: Although Periconiaceae (Nannizzi 1934) has long been ignored in modern fungal systematics, it should be regarded as a natural taxon in the suborder Massarineae.
Periconia Tode, Fung. mecklenb. sel. (Lüneburg) 2: 2. 1791.

Type species: Periconia lichenoides Tode.

Notes: Among more than 185 taxa described as Periconia (http://www.indexfungorum.org, Aug. 2015), only two species have been reported to have sexual morphs. They are P. igniaria (the sexual morph was referred to as Didymosphaeria or Massarina in the Dothideomycetes; Booth 1968, Aprool 1998) and P. prolifica (Remisia or Okeanomyces in the Sordaromycetes; Kohlmeyer 1969, Pang et al. 2004), and therefore it is obvious that the genus Periconia is not monophyletic. DNA sequence data of the type species of this genus, P. lichenoides, are currently unavailable, but we judged that the lineage of Periconia in the Dothideomycetes, including typical members of Periconia, such as P. byssoides, P. cookei, P. igniaria, and P. digitata, corresponds to Periconia s. str., based on their morphological similarities with P. lichenoides (Mason & Ellis 1953). In contrast, P. prolifica, a marine fungus in the Sordaromycetes, does not have macronematous conidiophores (Anastasiou 1963, Kohlmeyer 1969), and is not regarded as Periconia s. str.

Periconia homothallica Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811328. Fig. 42.

Etymology: Referring to its homothallism.

Ascomata scattered, immersed to erumpent, globose, 140–190 μm high, 160–180 μm diam, with an ostiole. Ostiolar neck central, papillate, 24–40 μm long, 37–62 μm wide, with hyaline periphyses. Ascomatal wall in longitudinal section uniformly 11–15 μm thick, composed of 4–6 layers of polygonal, thin-walled, 3–15 × 2–5 μm, pale brown cells. Pseudoparaflagyses cellular, 2–2.5 μm wide at the apex, up to 5 μm wide at the base, branched, anastomosed. Asci fissitunicate, cylindrical to lageniform, 85–119.5 × 13–17.5 μm (av. 96.5 × 15.3 μm, n = 20), with a shallow ocular chamber, short-stalked (3.5–6 μm long), with 8 bisericate ascospores. Ascospores broadly fusiform, 22–31 × 7–10 μm (av. 26.3 × 8.7 μm, n = 60), l/w 2.6–3.7 (av. 3.0, n = 60), with a nearly median septum (0.48–0.53; av. 0.51, n = 38), hyaline, smooth, with an entire sheath; sheath gelatinous, up to 10 μm wide when fresh, later 1–2 μm wide.

Colonies on PDA (after 2 wk) attaining a diam of 4.3–5.6 cm, straw; reverse similar; no pigment produced. In culture sexual morph formed. Ascospores slightly smaller than those on the natural host, 20–28 × 6–9 μm (av. 24.0 × 7.8 μm, n = 45), l/w 2.7–3.5 (av. 3.1, n = 45).

Specimen examined: Japan, Yamagata, Moganmigun, Sakekawa, Magarikawa-river, riverbank, on dead leaves of Phragmites japonica, 13 Oct. 2002, Y. Ooki & Y. Harada (holotype KT 916 = HHUF 29105, culture ex-type CBS 139698 = JCM 13100 = MAFF 239610).

Notes: Although we were not able to observe a typical periconia-like asexual morph from our specimen and isolate, we introduce this as a new species of Periconia based on the morphology of the sexual morph. The above material shares many characteristics with sexual species in Periconia s. str. (i.e., P. igniaria and P. pseudodigita), as such as those with immersed globose ascomata with papillate necks, a peridium composed of thinned-walled polygonal cells, cylindrical ascii, and broadly fusiform hyaline ascospores with nearly median septum. Periconia homothallica, however, has shorter but wider asci than those of P. igniaria (85–119.5 × 13–17.5 μm vs. 150–165 × 8–12 μm, Booth 1968) and has wider ascospores than those of P. pseudodigita [22–31 × 7–10 μm vs. 19.5–27(–32) × 5–7 μm].

In our phylogenetic tree (Fig. 1), P. homothallica formed an unsupported clade with P. igniaria, as well as species in other hyphomycetous genera, such as “Sporidesmium” tengii that have macronematous conidiophores and multiseptate conidia (Wu & Zhuang 2005), and Noosia banksiae, a species that lacks conspicuous conidiophores (Crous et al. 2011a). The presence of these genera in this lineage may indicate that Periconia should be subdivided into several morphologically similar genera or that the taxonomic status of these Noosia/Sporidesmium isolates should be re-evaluated.
**Fig. 42. Periconia homothallica.** A, B. Ascomata on the natural host surface; C. Ascoma in culture (on rice straw); D. Ascoma in longitudinal section (in lactophenol cotton blue); E. Ascomatal wall; F. Pseudoparaphyses; G. Ascus; H–J. Ascospores (arrowheads indicate gelatinous sheath; J. in India ink); K. Germinating ascospores. A, B, D–H, K from KT 916; C, I, J from culture KT 916. Scale bars: A = 2 mm; B, C = 500 μm; D = 50 μm; E–K = 10 μm.

**Fig. 43. Periconia pseudodigitata.** A, B. Ascomata on the natural host surface; C. Ascomata in longitudinal section (in lactophenol cotton blue); D. Ascomatal wall; E. Pseudoparaphyses; F. Ascus; G–I. Ascospores (arrowheads indicate gelatinous sheath; H. in Black-Blue ink); J. Germinating ascospore; K. Conidiomata in culture (on rice straw); L–O. Conidial heads and conidiophores; P, Q. Conidia. A, B, E, G–J from KT 1395; C, D, F from KT 644; K–M from culture KT 1195; N from culture KT 644; O–Q from culture KT 1395. Scale bars: A = 1 mm; B, K = 500 μm; C = 100 μm; D–J, P, Q = 10 μm; L–O = 20 μm.
**Periconia pseudodigitata** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811329. Fig. 43.

**Etymology:** After its morphological and phylogenetic similarity to *Periconia digita*ta.

Ascomata numerous, scattered or 2–3 grouped, immersed to erumpent, globose, 160–200 μm high, 130–250 μm diam. **Ostiolar neck** central, papillate, 45–55 μm long, 45–65 μm wide, with hyaline periphyses, surrounded by clupeous-like structure composed of subglobose to polygonal, slightly thickened, 5–7 × 3–4 μm, dark brown cells. **Ascomatal wall** in longitudinal section 8–13 μm thick at side, 5–8 μm thick at the base, composed of 3–5 layers of thin-walled, 6–13 × 2–5 μm, brown cells. **Pseudoparaphyses** cellular, numerous, 2–2.5 μm wide at the apex, 4–6 μm wide at the base, septate, branched, anastomosed, guttulate, associated with gelatinous material. Asci fissitunicate, cylindrical, 70–110 × 10.5–15.5 μm (av. 88.4 × 12.2 μm, n = 33), rounded at the apex and with an apical chamber, short-stalked (5–15 μm long), with 8 irregularly biseriate asciospores. Asciospores broadly fusiform with rounded ends, straight or slightly curved, 19.5–27(–32) × 5–7 μm (av. 22.5 × 6.1 μm, n = 134), l/w 2.9–4.5 (av. 3.7, n = 134), with almost median septum (0.48–0.55, av. 5.1, n = 36), slightly constricted at the septum, hyaline, with or without gullets, smooth, with an entire sheath; sheath gelatinous, 1–2 μm wide at side and 2–4 μm wide at both ends in fresh, becoming delimited sheath in dry condition. Senescent spores brown, echinulate, 1-septate. Asciospores germinating from one or both ends.

Colonies on PDA (after 4 wk) attaining a diameter of 3.2–4.6 cm, straw to amber with white margin; reverse pale luteous; no pigment produced. In culture conidial and spermatial morphs formed. **Conidiophores** macronematous, mononematous, single or rarely 2–3 together on stromata, 250–450 μm long, mostly 8.5–15 μm wide (16–24 μm wide at basal stromatic portion), 4–7-septate at 35–90 μm long intervals, with several branches. **Branches** 10–50 μm long, septate, pale brown to brown, slightly echinulate. **Conidial heads** spherical, ca. 60–120(–150) μm diam. **Conidigenous cells** monoblastic, discrete on stipe and branches. **Conidia** catenate, globose, brown, verruculose to shortly echinulate, 7–9.5 μm (av. 8.3 μm, n = 90). Spermogonia globose to subglobose, single to gregarious, unicellular to multicellular, 140–340 μm diam. **Spermatia** subglobose, hyaline, smooth, 3–5 × 1.5–2 μm (av. 3.7 ± 1.7 μm, n = 30).

**Notes:** *Periconia pseudodigitata* is phylogenetically and morphologically closest to *P. digita*ta, but the conidial dimensions of *P. pseudodigitata* (7–9.5 μm) are slightly smaller than those reported for *P. digita*ta by Ellis (1971; 7–11 μm). Sequence similarity between these two taxa in the ITS region was 95.8 % (503/525) with 0.8 % (4/525) gaps. *Periconia pseudodigitata* superficially resembles *P. igniaria* (= *Massarina igniaria*), which also has an ascomatal morph. The sexual morph of *P. pseudodigitata*, however, differs from that of *P. igniaria* (Booth 1968) by its narrower ascospores (5–7 μm vs. 8–9 μm) surrounded by a mucilaginous sheath, and shorter but wider asci (70–110 × 10.5–15.5 μm vs. 150–165 × 8–12 μm) with biseriate ascospores. The asexual morph of *P. pseudodigitata* has verruculose to shortly echinulate conidia, while that of *P. igniaria* has conidia with conspicuous spines about 1 μm long (Mason & Ellis 1953, Ellis 1971, Matsushima 1971, Bunning & Griffiths 1984).

**Sulcatisporaceae** Kaz. Tanaka & K. Hiray., fam. nov. MycoBank MB814431.

**Etymology:** Referring to the name of the type genus.

Ascomata scattered to grouped, immersed to erumpent, globose in surface view, subglobose to hemispherical in section. **Ostiolar neck** short papillate, central, with periphyses. Ascomatal wall composed of several layers of compressed cells, poorly developed at the base. **Pseudoparaphyses** trabeculate, branched and anastomosed. Asci clavate, short-stalked, 8-spored. Asciospores broadly fusiform, 1-septate, hyaline, with an entire sheath. **Conidiomata** pycnidial, globose. **Conidigenous cells** cylindrical to doliform, annelidic or phialidic. **Conidia** ellipsoid to subglobose, hyaline to dark brown, 1–10 multi-septate (occasionally muriform), with or without striate ornamentation.

**Type genus:** *Sulcatispora* Kaz. Tanaka & K. Hiray.

**Note:** A new family, *Sulcatisporaceae* is established here for *Magnicamarosporium* and *Sulcatispora* genera nova and *Neo-bambusicola* (Crous et al. 2014b).

**Magnicamarosporium** Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811292.

**Etymology:** After its morphological similarity to *Camarosporium* and its large-sized conidiomata.

Conidiomata pycnidial, scattered, immersed, depressed globose in section. **Ostiolar neck** central, papillate to short cylindrical. **Paraphyses** filamentous, sometimes branched, associated with gelatinous material. **Conidiophores** absent. **Conidigenous cells** holoblastic, cylindrical to doliform. **Conidia** subglobose to obvoid, sometimes obpyriform, muriform, dark brown. Sexual morph unknown.

**Type species:** *Magnicamarosporium iromotensis* Kaz. Tanaka & K. Hiray.

**Notes:** Several coelomycetous genera are known to have dicystosporous pigmented conidia and their taxonomic revision has been reported (e.g., Van Warmelo & Sutton 1981, Nag Raj 1989, Verkley et al. 2005, Crous et al. 2015b). *Amarenographium* is characterised by longer and branched conidiophores and conidia with cap-like gelatinous appendages (Eriksson 1982). Species in this genus are reported from marine environments (Kohlmeyer &
Magnicamarosporium iriomotense Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811293. Fig. 44.

**Etyymology:** Referring to the location where the specimen was collected.

Conidiomata pycnidial, scattered, deeply immersed, depressed globose in section, 330–440 μm high, 700–760 μm diam. Ostiolar neck central, papillate to short cylindrical, 120–150 μm long, 80–100 μm wide, composed of polygonal to rectangular, thick-walled, dark brown cells of 2–5 μm diam. Conidiomatal wall in longitudinal section uniformly 10–20 μm thick, composed of 3–6 layers of polygonal to subglobose, thin-walled, pale brown cells of 2.5–7 × 2.5–5 μm. Paraphyses sometimes branched, 20–50(–80) μm long, 1.5–2.5 μm wide, associated with gelatinous material. Conidiophores absent. Conidiogenous cells holoblastic, 7–11 × 4.5–6 μm, cylindrical to doliiform. Conidia subglobose to obovoid, sometimes obpyriform, 29–40.5(–42.5) × 19.5–25(–27) μm (av. 34.7 × 22.2 μm, n = 100), l/w 1.2–2.0 (av. 1.6, n = 100), with 4–6 trans- and 1–2 vertical-septa, frequently with oblique septa, dark brown, smooth, without sheath.

Colonies on PDA (after 4 wk) attaining a diam of 1.1 cm, olivaceous black with buff margin; reverse buff to honey; no pigment produced. In culture asexual morph formed. Conidiomata pycnidial, 130–170 μm diam, scattered to 2–3 grouped, globose to subglobose. Conidia 29.5–43 × 18–23 μm (av. 35.3 × 20.3 μm, n = 31), l/w 1.5–2.1 (av. 1.7, n = 31). Sexual morph unknown.

**Notes:** There are more than 500 names in Camarosporium (http://www.indexfungorum.org, Aug. 2015). Many of these taxa have been described on the basis of their host associations (Sutton 1980, Marinowitz et al. 2008), but there is no record of Camarosporium from host plants within the Rubiales, which includes Diplospora dubia, the host of M. iriomotense.

**Sulcatispora** Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811294.

**Etyymology:** From the Latin sulcatus meaning “furrowed” and spora meaning “spore”, referring to the striate ornamentation of the conidia.

Ascomata scattered to grouped, immersed to erumpent, globose in surface view, subglobose to hemispherical in section. Ostiolar neck short papillate, central, with periphyses. Ascomatal wall composed of several layers of compressed cells, poorly developed at the base. Pseudoparaphyses trabeculate, branched and anastomosed. Asci fissitunicate, clavate, short-stalked. Ascospores broadly fusiform, 1-septate, hyaline, with an entire sheath. Conidiomata pycnidal, globose. Conidiogenous cells cylindrical, annelidic. Conidia ellipsoid, yellowish brown, multiseptate, with striate ornamentation.

**Type species:** Sulcatispora acerina Kaz. Tanaka & K. Hiray.

**Notes:** Ascomatal features of Sulcatispora are most similar to those of Massarina s. str. (Massarinaceae) but the ascomata lack a prominent clypeus, in contrast to species within Massarina s. str. The most distinctive feature of Sulcatispora is the striated conidia. Some species in Phaeophleospora (e.g., P. stria; Taylor & Hyde 2003) are known to have such conidia, but Phaeophleospora (type species: P. eugeniae) is phylogenetically placed in the Mycosphaerellaceae of the Capnodiales (Crous et al. 2007, 2009b). Sclerotagastospora also has conidia with striate ornamentation (e.g., S. opuntiae; Huhndorf 1992), but some species of Sclerotagastospora have phylogenetic affinities with members of the Phaeosphaeriaceae, such as “Phoma” caloplaeae and “Phoma” foliaeiphila (Crous et al. 2011a, Lawrey et al. 2012), and may have phaeosphaeria-like sexual morphs (Quaedvlieg et al. 2013). Sulcatispora is phylogenetically related to Bambusicola, which also has a similar asexual morph. Bambusicola, however, has conical ascomata with flattened bases, narrower asci (up to 14 μm wide), and narrowly fusiform ascospores (Dai et al. 2012).

**Sulcatispora acerina** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811295. Fig. 45.

**Etyymology:** Referring to the generic name of the host.

Ascomata scattered, immersed to erumpent, globose in surface view, depressed globose to hemispherical in section, 200–250 μm high, 260–450 μm diam. Ostiolar neck inconspicuous short papillate, 60–85 μm diam, central, with periphyses. Ascomatal wall in longitudinal section 12–25 μm thick at sides, composed of polygonal, 5–8 × 2–3 μm, compressed cells, surrounded by short, brown hyphae (2.5–3.5 μm thick), poorly developed at the base. Pseudoparaphyses trabeculate, 1.5–2 μm wide, branched and anastomosed, associated with gelatinous material. Asci fissitunicate, clavate, 87–113 × 15–20 μm (av. 98.4 × 17.1 μm, n = 17), rounded at the apex, with an apical chamber and faint ring, short-stalked (15–22 μm long). Ascospores broadly fusiform, slightly acute at the apex, (23–)26–32 × 7–9 μm (av. 28.5 × 7.7 μm, n = 50).
w 3.2–4.2 (av. 3.7, n = 50), with a submedian primary septum (0.50–0.57; av. 0.53, n = 50), hyaline, surrounded by an entire sheath; sheath 2–3 μm wide at first, later diffuse, 4–5 μm wide.

Colonies on PDA (after 4 wk) attaining a diam of 2.1–2.4 cm, grey olivaceous to honey; reverse olivaceous to black; no pigment produced. In culture asexual morph formed. 

**Conidiomata** pycnidial, 180–270 μm high, 160–240 μm diam, immersed, scattered, globose, ostiolate. 

**Ostiorlar neck** short papillate, 25–45 μm long, 35–45 μm diam. **Conidiomatal wall** uniformly 10–20 μm thick, composed of 4–7 layers of polygonal, 6–10 × 2–3 μm, dark brown cells. **Conidiophores** absent. 

**Conidiogenous cells** cylindrical to lageniform, 10 μm wide at the apex, 3.5–5.5 μm wide at the base, annellidic. **Conidia** ellipsoid, rounded at the apex, truncate at the base, yellowish brown, 20–28(−30) × 6.5–8 μm (av. 25.9 × 7.2 μm, n = 50), l/w 3.1–4.2 (av. 3.6, n = 50), 3(−5)-septate (1+1+1, rarely 2+1+2), with striate ornamentation.

**Ascomata** scattered to 2–4 grouped, immersed to erumpent, globose in surface view, subglobose to hemispherical in section, 150–280 μm high, 350–530 μm diam. **Ostiorlare neck** short papillate, ca. 60 μm diam, central, with periphyses. **Ascomatal wall** in longitudinal section 10–18 μm thick at sides, composed of 3–6 layers of 7–18 × 2 μm compressed cells, poorly developed at the base. 

**Pseudoparaphyses** trabeate, 1.5–2.5 μm wide, branched and anastomosed, associated with gelatinous material. Asci fissitunicate, clavate, 77.5–100 × 13.5–18 μm (av. 90.1 × 15.2 μm, n = 20), rounded at the apex, with an apical chamber and faint ring, short-stalked (13–15 μm long). Ascospores broadly fusiform, 22–29 × 5.5–7 μm (av. 26.0 × 6.4 μm, n = 50), l/w 3.5–4.4(−4.7) (av. 4.1, n = 50), with a submedian primary septum (0.50–0.57; av. 0.53, n = 49), hyaline, surrounded by an entire sheath; sheath delimited, 2 μm wide at first, later diffuse, up to 6 μm wide.

**Sulcatispora bercheniae** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811296. 

**Etymology:** Referring to the generic name of the host.

Colonies on PDA (after 4 wk) attaining a diam of 2.7–2.8 cm, white to buff; reverse buff to greyish sepia; no pigment produced. In culture asexual morph formed. **Conidiomata** pycnidial, 90–130 μm high, 90–150 μm diam, immersed, scattered, globose to subglobose, ostiolate. **Ostiorlare neck** short papillate. **Conidiomatal wall** uniformly 12–17.5 μm thick, composed of flattened, thin-walled, polygonal cells (3.5–6 × 1.5–2.5 μm). **Conidiophores** absent. **Conidiogenous cells** cylindrical, 12–15 μm long, 2 μm wide at the apex, 4–8 μm wide at the base, annellidic. **Conidia** ellipsoid, 20–30 × 6.5–8 μm (av. 24.8 × 7.1 μm, n = 50), l/w 2.9–4.2 (av. 3.5, n = 50), rounded at

**Fig. 44.** Magnicamarosporium riomotense. A. Immersed conidiomata and discharged conidia lying on the natural host surface; B. Conidiomata produced in culture (on rice straw); C. D. Conidiomata in longitudinal section (C. on nature; D. in culture); E. Conidiomatal wall; F. Paraphyses; G. Conidiogenous cell (in trypan blue); H–L. Conidia; M. Immigrating conidium; A. C, E, H–J, N from KT 2822; B, D, F, K–M from culture KT 2822. Scale bars: A, B = 500 μm; C, D = 50 μm; E–N = 10 μm.

**Specimen examined:** Japan, Fukuoka, Kasuya, Hisayama, Yamada, Mt. Tachibananayama, on dead twigs of *Acer palmatum*, 31 Mar. 2012, K. Tanaka (holotype KT 2982 = HHUF 30449, culture ex-type CBS 139703).

**Note:** The conidia of *S. acerina* are very similar to those of *S. bercheniae*, but *S. acerina* can be distinguished from the latter by its larger ascospores [(23−)26–32 × 7–9 μm vs. 22–29 × 5.5–7 μm].
the apex, truncate at the base, yellowish brown, 3(–5)-septate (1+1+1, rarely 2+1+2), with striate ornamentation.

Specimens examined: Japan, Aomori, Towada, Sanbongi, Yagami, on vines of *Berchemia racemosa*, 2 Dec. 2003, K. Tanaka, S. Hatakeyama & N. Nakagawara (holotype KT 1607 = HHUF 29097, culture ex-type CBS 139704 = JCM 13101 = MAFF 239611); ibid., KT 1608 = HHUF 29098.

**Note:** This species is closely related to *S. acerina* with regard to its LSU sequences (similarity 1295/1302 = 99.5 %), but the ITS sequence shows a great deal of variation compared to the ITS of *S. acerina* (similarity 770/850 = 90.6 %, with gaps 29/850 = 3.4 %).

**Fig. 45.** Sulcatispora acerina. A, B. Ascomata on the natural host surface; C. Ascoma in longitudinal section; D. Ascomatal wall; E. Pseudoparaphyses; F. Ascus; G−K. Ascospores (arrowheads indicate mucilaginous sheath); L. Germinating ascospore; M. N. Conidiomata in culture (on rice straw); O. Conidioma in longitudinal section; P. Conidiomatal wall; Q. Conidiogenous cells (arrowheads indicate annellations); R−W. Conidia. A−L from KT 2982; M−W from culture KT 2982. Scale bars: A = 1 mm; B, M, N = 500 μm; C, O = 50 μm; D−L, P−W = 10 μm.
Type genus: *Trematosphaeria* Fuckel.

*Trematosphaeria* Fuckel, Jb. Nassau. Ver. Naturk. 23–24: 161. 1870.

Type species: *Trematosphaeria pertusa* Fuckel.

Notes: Although more than 200 species have been assigned to *Trematosphaeria* (http://www.indexfungorum.org, Aug. 2015), most of these species have not had their generic placements verified by molecular evidence. The type species of this genus, *T. pertusa*, usually grows on terrestrial wood, but also can survive within freshwater (Suetrong *et al.* 2011b). Recently, *Madurella grisea*, originating from a human infection, water and pastry gel, was added to *Trematosphaeria* based on a multi-gene phylogeny (Ahmed *et al.* 2014).

*Trematosphaeria pertusa* Fuckel, Jb. Nassau. Ver. Naturk. 23–24: 161. 1870. Fig. 47.

Ascomata gregarious, immersed or becoming superficial by weathering of host tissue, globose to pyriform in section,
270–380 μm high, 190–350 μm diam. Ostiolar neck central, papillate to cylindrical, 70–140 μm long, 90–130 μm wide, composed of thick-walled, heavily melanised cells (2–4 μm diam), with periphyses. Ascomatal wall composed of thick-walled, heavily melanised cells (2–4 μm diam), with periphyses. Ascomata wall uniformly 17–25 μm thick, composed of 6–9 layers of polygonal to rectangular, thin-walled, brown cells (2–15 × 2–5 μm). Pseudoparaphyses branched and anastomosed, 1.5–2.5 μm wide. Ascii fissitunicate, clavate to cylindrical, 73.5–102.5 × 12.5–17 μm (av. 89.8 × 14.6 μm, n = 20), with a stipe of 8.5–22 μm long, with 8 biseriate ascospores. Ascospores fusiform, slightly curved, 20–27.5 × 8–6 μm (av. 23.9 × 7.1 μm, n = 50), l/w 2.8–4.0 (av. 3.4, n = 50), with a nearly median or somewhat supramedian primary septum (0.43–0.53; av. 0.48, n = 50), rarely 3-septate, slightly constricted at the septum, reddish brown, smooth, without sheath.

In culture spermatial morph formed. Spermatia subglobose, hyaline, 2.8–3.9 × 1.9–2.3 μm (av. 3.4 × 2.1 μm, n = 20), l/w 1.4–1.9 (av. 1.6, n = 20).

Specimens examined: Japan, Aomori, Hirosaki, Aoki, Mohei-pond, on submerged twigs of woody plant, 27 Sep. 2003, K. Tanaka & N. Asama, KT 1496 = HHUF 30153, culture JCM 19430 = MAFF 243879; Hokkaido, Isl. Rebun, Nairo, Nairo-river, on submerged twigs of woody plant, 16 Aug. 2013, K. Tanaka, KT 3314 = HHUF 30452, culture CBS 139705; ibid., KT 3315 = HHUF 30453, culture CBS 139706.

Notes: We identified our specimens/isolates as *T. pertusa*, the type species of *Trematosphaeria*, based on close similarities between sequences obtained from the above isolates and an ex-epitype strain of the species (CBS 122368; Ahmed et al. 2014), i.e., 484/485 (99.8 %) in ITS (GenBank KF015668) and 900/907 (99.2 %) in tef1 (GenBank KF015701) regions. In comparison with the description of *T. pertusa* based on the neotype (Zhang et al. 2008b), our specimens have shorter asci (73.5–102.5 μm vs. 100–145 μm) and ascospores (av. 20–27.5 μm vs. 27.5–32.5 μm). Further collections of this species are needed to clarify the taxonomic significance of the intraspecific morphological variation.

**Unknown Clade I**

*Fuscostagonospora* Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811330.

Etymology: From the Latin fusco-, meaning dark brown and the generic name, *Stagonospora*.

Ascomata scattered, immersed, globose to subglobose. Ostiolar neck clypeate, central, short papillate, with periphyses. Ascomatal wall composed of pale brown, compressed cells. Pseudoparaphyses appearing tuberose, branched and anastomosed, associated with gelatinous material. Ascii fissitunicate, cylindrical, with a long stipe. Ascospores narrowly fusiform, 1(–3)-septate, hyaline, with an entire sheath. Conidiomata pycnidial, scattered, immersed, depressed globose, ostiolate. Conidiomatal wall composed of thin-walled cells. Conidiophores absent. Conidiogenous cells doliform, annelidic. Conidia yellow to pale brown and 3-septate.

Type species: *Fuscostagonospora sasae* Kaz. Tanaka & K. Hiray.

Notes: The new genus, *Fuscostagonospora*, is introduced to accommodate the bambusicolous fungus, *F. sasae*. This genus is reminiscent of *Stilbospora* in having pigmented phragmosporous conidia, but the latter genus has acervular conidiomata filled with paraphyses and phylogenetically groups within the
Diaporthales in the Sordariomycetes (Crous et al. 2012, Voglmayr & Jaklitsch 2014). The conidial morphology of Fuscostagonospora is also similar to that of Sclerostagonospora, but the latter genus has phylogenetic affinity with species in the Phaeosphaeriaceae (Pleosporales) and may have a phaeosphaeria-like sexual morph (Quaedvlieg et al. 2013). In overall morphology, such as the narrowly fusiform ascospores and pigmented septate conidia, as well as in host preferences, Fuscostagonospora is most similar to Bambusicola (Bambusicolaceae; Dai et al. 2012). Fuscostagonospora, however, has ascomata with a prominent clypeus and phylogenetically deviates from the Bambusicolaceae, forming an Unknown Clade I (Fig. 1).

**Fuscostagonospora sasae** Kaz. Tanaka & K. Hiray., sp. nov. MycoBank MB811331. Fig. 48.

*Etymology:* Referring to the host genus.

Ascomata scattered, immersed, globose to subglobose, 220–250 \( \mu \)m high, 400–450 \( \mu \)m diam. Ostiolar neck clypeate, central, short papillate, 50–65 \( \mu \)m long, 75–90 \( \mu \)m wide, with periphyses. Ascomatal wall in longitudinal section 10–15 \( \mu \)m thick at sides, composed of 3–4 layers of compressed, 5–10 × 2–3 \( \mu \)m, pale brown cells. Pseudoparaphyses appearing trabecular, 1–1.5 \( \mu \)m wide, branched and anastomosed, associated with gelatinous material. Asci fissitunicate, cylindrical, 90–140 × 8.5–14.5 \( \mu \)m (av. 107.6 × 9.8 \( \mu \)m, \( n = 30 \)), with an apical chamber, with a relatively long stipe (20–32.5 \( \mu \)m long). Ascospores narrowly fusiform, 1(–3)-septate, 22–31.5(–36) × 3–5.5 \( \mu \)m (av. 27.5 × 4.1 \( \mu \)m, \( n = 25 \)), Iw 5.6–8.3 (av. 6.8, \( n = 25 \)), with a nearly median septum (0.48–0.57; av. 0.52, \( n = 20 \)), hyaline, surrounded by an entire gelatinous sheath up to 7 \( \mu \)m wide.

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**Fig. 48.** Fuscostagonospora sasae. A, B. Ascomata on the natural host surface; C, D. Ascomata in longitudinal section; E. Ascomatal wall; F. Pseudoparaphyses; G. Ascus; H–J. Ascospores (arrowheads indicate gelatinous sheath; H, I. in India ink); K. Germinating ascospore; L, M. Conidiomata in culture (on rice straw); N. Conidioma in longitudinal section; O. Conidiomatal wall; P, Q. Conidiogenous cells (arrowheads indicate annellations); R. Conidia. A–K, N, O from KT 1467; L, M, P–R from culture KT 1467. Scale bars: A, L = 1 mm; B, M = 500 \( \mu \)m; C, D, N = 100 \( \mu \)m; E–K, O–R = 10 \( \mu \)m.
**Conidiomata** on the natural host pycnidial, scattered, immersed, depressed globose in section, 250 μm high, 500 μm diam, ostiolate. Conidiomatal wall in longitudinal section 12–20 μm thick, composed of thin-walled, hyaline to pale brown cells. In culture same coelomycetous asexual morph formed. Conidiophores absent. Conidiogenous cells doliform, annelidic, 5–12 × 3–7 μm (av. 9.7 × 5.3 μm, n = 20). Conidia hyaline and aseptate at first, later yellow to pale brown and 3-septate, 17–22.5 × 4–5 μm (av. 19.8 × 4.4 μm, n = 50), l/w (3.4–)3.7–5.5 (av. 4.5, n = 50).

Colonies on PDA (after 4 wk) attaining a diam of 2.8 cm, brown, with paler end cells. Sexual morph unknown. Conidiomata on natural substratum scattered, dark brown, glistening. Colonies immersed in agar medium, pale brown to reddish brown. Mycelium immersed in agar, pale brown to reddish brown. Stromata lacking. Conidiophores branched, septate, brown. Conidiogenesis holoblastic. Conidia broadly fusiform, with several trans-septa of thick-walled, yellowish brown to dark brown with paler end cells. Chlamydospores absent. Sexual morph unknown.

**Type species:** Pseudoxylomyces elegans (Goh et al.) Kaz. Tanaka & K. Hiray.

**Notes:** A new genus Pseudoxylomyces is proposed to accommodate Xylomyces elegans. The type species of Xylomyces (X. chlamydosphorus) is known to have phylogenetic affinities with the freshwater genus, Jahnula in the Jahnulales (Campbell et al. 2007, Sivichai et al. 2011). Therefore, Xylomyces is now regarded as a synonym of Jahnula (Hyde et al. 2013). Xylomyces elegans was excluded from the genus (Suetrong et al. 2011a), because it did not cluster with the type species of Xylomyces in phylogenetic analyses using ITS sequences (Shearer et al. 2009). However, no taxonomic decision has been made for X. elegans.

Xylomyces is characterised by its lack of conidiophores and conidigenous cells but it produces large, dark, thick-walled, multiseporate, intercalary, narrowly fusiform chlamydospores (Goos et al. 1977, Goh et al. 1997). In contrast, Pseudoxylomyces typified by P. elegans is quite distinctive in producing broadly fusiform conidia holoblastically at the tip of the conidiophores (Fig. 49A, B).

**Pseudoxylomyces elegans** (Goh et al.) Kaz. Tanaka & K. Hiray., comb. nov. MycoBank MB811333. Fig. 49.

*Basionym:* Xylomyces elegans Goh et al., Mycol. Res. 101: 1324. 1997.

Mycelium immersed in agar, pale brown to reddish brown. Conidiophores up to 40 μm long. Conidiogenesis holoblastic. Conidia broadly fusiform, 4–7-septate, 72.5–98 × 35–41 μm, l/w 2.0–2.8, brown, with paler end cells. Sexual morph unknown.

Unknown Clade IV

**Pseudoxylomyces** Kaz. Tanaka & K. Hiray., gen. nov. MycoBank MB811332.

**Etymology:** After its morphological similarity to Xylomyces.

Colonies on natural substratum scattered, dark brown, glistening. Mycelium immersed in agar medium, pale brown to reddish brown. Stromata lacking. Conidiophores branched, septate, brown. Conidiogenesis holoblastic. Conidia broadly fusiform, with several trans-septa of thick-walled, yellowish brown to dark brown with paler end cells. Chlamydospores absent. Sexual morph unknown.

**Type species:** Pseudoxylomyces elegans (Goh et al.) Kaz. Tanaka & K. Hiray.

**Notes:** A new genus Pseudoxylomyces is proposed to accommodate Xylomyces elegans. The type species of Xylomyces (X. chlamydosphorus) is known to have phylogenetic affinities with the freshwater genus, Jahnula in the Jahnulales (Campbell et al. 2007, Sivichai et al. 2011). Therefore, Xylomyces is now regarded as a synonym of Jahnula (Hyde et al. 2013). Xylomyces elegans was excluded from the genus (Suetrong et al. 2011a), because it did not cluster with the type species of Xylomyces in phylogenetic analyses using ITS sequences (Shearer et al. 2009). However, no taxonomic decision has been made for X. elegans.

Xylomyces is characterised by its lack of conidiophores and conidigenous cells but it produces large, dark, thick-walled, multiseporate, intercalary, narrowly fusiform chlamydospores (Goos et al. 1977, Goh et al. 1997). In contrast, Pseudoxylomyces typified by P. elegans is quite distinctive in producing broadly fusiform conidia holoblastically at the tip of the conidiophores (Fig. 49A, B).

**Pseudoxylomyces elegans** (Goh et al.) Kaz. Tanaka & K. Hiray., comb. nov. MycoBank MB811333. Fig. 49.

*Basionym:* Xylomyces elegans Goh et al., Mycol. Res. 101: 1324. 1997.

Mycelium immersed in agar, pale brown to reddish brown. Conidiophores up to 40 μm long. Conidiogenesis holoblastic. Conidia broadly fusiform, 4–7-septate, 72.5–98 × 35–41 μm, l/w 2.0–2.8, brown, with paler end cells. Sexual morph unknown.

Unknown Clade VI

**Monodictys** S. Hughes, Canad. J. Bot. 36: 785. 1958.

**Type species:** Monodictys putredinis (Wallr.) S. Hughes, Canad. J. Bot. 36: 785. 1958.

**Notes:** More than 60 species have been described in Monodictys (http://www.indexfungorum.org, Aug. 2015), but their phylogenetic placements are mostly unknown. Apparently, Monodictys is a heterogeneous group of hyphomycetes. Several species within this genus such as *M. arctica* (Leptosphaeriaceae; Day et al. 2006), *M. capensis* (Meliannomataceae; Samuels 1980), Monodictys spp. (Parabasbucilaceae; Fig. 1), and *M. capensis* (Unknown Clade IV; Fig. 1) are scattered within the Dothideomycetes. Monodictys pelagica is known to have phylogenetic relationships with the Sordariomycetes (Mouzouras & Jones 1985, Campbell et al. 2002), and Monodictys sp. is reported as an asexual morph of *Hyaloscypha abohayalina* var. *monodictys* (Hosoya & Huhtinen
2002; currently Hyaloscypha monodictys, Han et al. 2014) in the Leotiomyceeta. Phylogenetic reassessment of many species of Monodictys including the type species of this genus (M. putredinis) is needed for taxonomic revision of this genus.

Monodictys capensis R.C. Sinclair et al., Mycotaxon 59: 359. 1996. Fig. 50. Specimen examined: Russia, St. Petersburg, Botanical garden of the Komarov Botanical Institute of the Russian Academy of Sciences, on dead wood of Padus avium, 19 Oct. 2005. V. Mel’nik, HR 1 = HHUF 29712 = LE 226298, culture CBS 134928 = VKM F-4506.

Notes: This material has been reported as M. capensis by Mel’nik & Shabunin (2010). In culture, abundant conidia similar to those on the natural host were produced on rice straw agar (RSA).

DISCUSSION

New familial lineages

The Parabambusicolaceae is erected here to accommodate Aquastroma (Fig. 40) and Parabambusicola (Fig. 41), as well as two unnamed “Monodictys” species. This family is superficially similar to the Bambusicolaceae in having depressed globose to hemispherical ascomata. In particular, Parabambusicola, the type genus of the Parabambusicolaceae, has a bambusicolous habitat like that of Bambusicola (Dai et al. 2012). However, members of the Parabambusicolaceae have ascomata surrounded by stromatic tissue (Parabambusicola) or compressed necks with wide ostioles (Aaquastroma), and also multisepitate, clavate to fusiform, hyaline ascospores, unlike those of the Bambusicolaceae. Asexual morphs possessing sporodochial conidiomata and muriform conidia like those of Monodictys are not found in the Bambusicolaceae.

A new family Sulcatisporaceae is introduced to encompass Magnicamarosporium and Sulcatispora genera nova, as well as Neobambusicola (Crous et al. 2014b). These three genera form a strongly supported clade (97 %), which is a sister of the Bambusicolaceae. The sexual morphs of species in the Sulcatisporaceae are superficially similar to those of Bambusicolaceae, but subglobose to obovoid conidia with muriform septation (Magnicamarosporium) or 1 to several septate conidia or without striate ornamentation (Neobambusicola, Sulcatispora) are not found in species of the Bambusicolaceae.

We resurrect the Periconiaceae as a sister taxon of the Massarinaeae (Fig. 1). The name of “Periconia” was originally used for dematiaceous hyphomycetes that have macronematous conidiophores and 1-celled, pigmented conidia forming conidial heads (Saccardo 1886). Later, the group was raised to familial rank, and Periconia and Stachybotrys were assigned to the Periconiaceae (Nannizzi 1934), the latter genus now being placed in its own family, Stachybotryaceae (Crous et al. 2014a). The Periconiaceae has long been ignored in modern fungal systematics, but it should be regarded as a natural taxon in the suborder Massarinaeae. The main genus Periconia has been treated as a member of the Massarinaeae based on a topology of genealogical trees (Kosue et al. 2007, Schoch et al. 2009, Zhang et al. 2009b, c, 2012, Hyde et al. 2013). Species of Periconia, however, are separated from the Massarinaeae and form a strongly supported clade of the Periconiaceae (100 %; Fig. 1). Sexual morphs within the Periconiaceae (Figs 42, 43) differ from those of Helminthosporium (Fig. 25) and Massarina (Fig. 26) in the Massarinaeae. Members in the latter family possess medium to large subglobose ascospores, which are covered by a clypeus, and have clavate asci. The small ascomata of Periconia superficially resemble those of Stagonospora (= Saccharicola, Massarinaeae; Figs 27–29) but differ in having a peridium composed of small-sized compressed cells. The most diagnostic features of the Periconiaceae are the asexual morphs of Periconia; these have macronematous, mononematous conidiophores with globose to cylindrical, elastic conidia (Mason & Ellis 1953, Ellis 1971).

Dictyosporium and phenotypically similar genera, such as Aquaticheirospora and Pseudodictyosporium, have been considered to belong in the Massarinaeae (Wijayawardene et al. 2012). However, the group including dictyosporium-like fungi forms a distinct lineage (as Dictyosporiaceae nom. prov.; see Liu et al. 2015), independent from the Massarinaeae (Fig. 1). One of the diagnostic features of the Dictyosporiaceae is their multicellular cheiroid conidia (Fig. 2), and these morphological features separate it from other families in the Massarinaeae. Sexual morphs observed in the Dictyosporiaceae (Gregarintheicum and Pseudocoleophoma; Figs 3–5) are somewhat similar to those of the Massarinaeae (e.g., Stagonospora; Figs 27–29) or the Periconiaceae (e.g., Periconia; Figs 42, 43), but can be differentiated by their subglobose to hemispherical ascospore with or without surrounding stromatic tissue, short ascostal necks without clypeus, cylindrical asci with a short stipes, and narrowly fusiform, 1-septate, hyaline ascospores.

Summary of accepted families and genera incertae sedis of the Massarinaeae

Based on our phylogenetic analyses and morphological evaluation of fungi in the Massarinaeae, we recognise the following 12 families, as well as “Massarinaeae, incertae sedis”.

Bambusicolaceae. This family was established by Hyde et al. (2013) to accommodate Bambusica species on bamboo (Dai et al. 2012). Palmiascoma on dead fronds of palms.
in Thailand was also reported as a member of *Bambusicolaceae* (Liu et al. 2015).

**Dicytosporiaceae** (Figs 2–5). *Dicytosporiaceae* (nom. prov., see Liu et al. 2015) includes the four asexual genera *Aqua-
ticheirospora* (Kodsub et al. 2007), *Dendyryphiella* (Jones et al. 2008), *Dicytosporium* (Fig. 2) and *Pseudodicytosporium* (Kirschner et al. 2013), and two new genera with sexual morphs, *Gregarthecium* (Fig. 3) and *Pseudocoleophoma* (Figs 4, 5). The two asexual monotypic genera *Cheirosporium* (Cai et al. 2008) and *Kamata* (Kirschner et al. 2013) also belong in the *Dicy-
tosporiaceae*. *Diplococcium* asperum (Pirozynski 1972, Goh & Hyde 1998) is located in the *Dicytosporiaceae* (Fig. 1), but the type species of *Diplococcium* (*D. spicatum*) has phylogenetic affinity with the *Helotiales* (Shenoy et al. 2010). This species as well as *Diplococcium pulneyense*, the asexual morph of *Otthia pulneyens* (Subramanian & Sekar 1987), are both related to the *Dothideomycetes*, and should be excluded from *Diplococcium* s. str. Likewise, *Paraconiothyrium* flavescens in the *Dicytosporiaceae* clade should be renamed, because the type lineage of the genus, represented by *P. estuarium*, groups with the *Didymo-
sporphaeaceae* (= *Montagnulaceae*) (Verkley et al. 2014). The *Dicytosporiaceae* clade includes *Digitodesmium bambusicola* (Cai et al. 2002), but the phylogenetic placement of the generic type *D. elegans* is unknown at present.

**Didymosphaeriaceae** (Figs 6–11). Ariyawansa et al. (2014) accepted 16 genera including *Karstenula* (Fig. 6), *Neokalmusia* (Figs 7, 8), and *Paraphaeosphaeria* (Fig. 9) as members of the *Didymosphaeriaceae*, and subsequently three genera, *Para-
camarosporium*, *Pseudocamarosporium*, and *Pseudotrichia* were also added to this family (Thambugala et al. 2014, Wijayawardene et al. 2014d). We assigned the hyphomycetous genus *Spygazzinia* (Figs 10, 11) with basaical conidigenesis and pigmented conidia with spine-like appendages, to the *Didymosphaeriaceae*, although it has long been treated as “Asco-
ymycota, genera incertae sedis” (Wijayawardene et al. 2012). However, taxonomic reassessment will be required for several genera, such as *Neokalmusia*, *Paraconiothyrium*, *Para-
phaeosphaeria* and *Pseudocamarosporium*, because their monophyletic status was not supported in this study. In addition to these genera, the type species of *Cucurbitidos* (*C. ptyphilia*) resides in the *Didymosphaeriaceae* (Fig. 1). *Phaeodothis winteri* with a didymosphaerilla-like sexual morph (Aptroot 1995), and *Sporidesmiella fusiformis* with macronematous conidiophores and obclavate, multi-distoseptate, pigmented conidia (*Wu & Zhuang 2005*) are placed in the *Didymosphaeriaceae*, but sequences of the type species of these genera are presently un-
known. Two species of *Camarosporium* with muriform conidia, *C. brabejii* and *C. leucadeni* (Marincovitz et al. 2008), are positioned in the *Didymosphaeriaceae*, and have subsequently been allocated to *Pseudocamarosporium* and *Para-
camarosporium*, respectively (Crous et al. 2015b). In contrast, the type species of *Camarosporium* (*C. quaternatum*) is known to cluster within the *Pleosporineae* (Crous et al. 2006, Wijayawardene et al. 2014b). *Munkovalsaria appendiculata* (Aptroot 2004) groups with *Montagnula* species (*M. aoeae*, *M. opulenta* and *M. graminicola*). However, *Munkovalsaria* is apparently polyphyletic, because *M. rubra* is found outside the *Pleosporales* (Voglmayr & Jaklitsch 2011, Hernández-Restrepo et al. 2014). Although *Munkovalsaria* is regarded as a member of the *Dacampiaceae* (Hyde et al. 2013), molecular data from the generic type (*M. donacina*) are needed to clarify its phylogenetic position.

**Latoruaceae**. This family was established by Crous et al. (2015a) to accommodate two hyphomycetous genera, *Latorua* and *Polythecium*, both mostly known from soil (Ellis 1976, Shenoy et al. 2010, Crous et al. 2015a). More recently, a new genus *Matsushimamyces* from soil has been added to this family (Sharma et al. 2015).

**Lentitheciaceae** (Figs 12–24). *Darksidea* (Knapp et al. 2015), *Katamota* (Fig. 12), *Keisserliella* (Figs 13–18), *Lenti-
theicum* (Figs 19, 20), *Munilentheicum* (Wanasinghe et al. 2014), *Phragmocamarosporium* (Wijayawardene et al. 2015), *Poaceascorna* (Phokamsak et al. 2015) and *Tingdilago* (Fig. 24) have been assigned in the *Lentitheciaceae*, and we add another two genera, *Neophosphosphaerea* (Fig. 21) and *Sefoseptoria* (Figs 22, 23). The clade comprising species of these six genera received moderate BP support (71 %; Fig. 1). “Wettsteinia” lacustris is also a member of this clade (Schoch et al. 2009). In our preliminary analysis using SSU and LSU sequences, *Ascorhombispora aquatica* (Cai & Hyde 2007b) resided in the *Lentitheciaceae* (data not shown), but the phylo-
genetic affinity of this species with members in the *Dicytosporiaceae* (Cai & Hyde 2007b) or *Didymosphaeriaceae* (Shearer et al. 2009) has also been suggested. Further investigation us-
ing additional sequence data is needed to confirm familial placement of this genus.

**Macrodiplodiopsidaceae**. Three species with coelomycet-
tous asexual morphs, i.e., *Camarographium koreanum* (on *Corus*, Verkley et al. 2005), *Macrodiplodiopsis desmazerii* (on *Platanus*, Barr 1982), and *Pseudoachaetosphaeromona lairense* (a human pathogen, Ahmad et al. 2014) comprise the *Macro-
diplodiopsidaceae*, which was recently established by Crous et al. (2015a).

**Mannasarinae** (Figs 25–29). *Byssothecium* (Boise 1883), *Helminthosporium* (Fig. 25), *Mannaris* (Fig. 26), *Stagonospora* (Figs 27–29) and *Suttonomyces* (Wijayawardene et al. 2015) are accepted in the *Mannasarinae* (Fig. 1). *Neottiosporina paspali* (Sutton & Alcorn 1974) should be treated as *Stagono-
spora paspali* (Atkinson 1897) based on the phylogenetic topo-
alogy (Fig. 1) as well as the morphological resemblance with *S. paludos*, the type species of *Stagonospora* (Quaedvlieg et al. 2013). The two *Corynespora* species *C. leucadenri* (Quaedvlieg et al. 2013) and *C. olivacea* (Ellis 1960) clustered in this family but are not congenic. The type species of *Corynespora* (*C. mazi = C. cassicola*, Wei 1950) is sister of the clade of the *Pleosporineae + Massarineae* (Hyde et al. 2013), hence the *Corynespora* species in the *Massarineae* should be renamed. “Didymosphaeria” *sparti* has been previously transferred to *Montagnula* (Aptroot 1995) and also to *Didymosphaerella* (Chlebicki 2009), but these generic placements are inappropriate (Fig. 1). A cultural study of *D. sparti* (Scheinfug 1958, using CBS 183.58) indicated that it has a dendrophoma-like asexual morph with conidia 4–7 × 1–2 μm in size.

**Morosphaeriaceae** (Figs 30–39). In addition to *Aquiloconyces* (Fig. 30), *Helicascus* (Figs 35–37) and *Morosphaeria* (Figs 38, 39), which were previously recognised as members of the *Morosphaeriaceae* (Suetrong et al. 2009, Hyde et al. 2013, Knapp et al. 2015), we add the new genus *Clypeoloculus* (Figs 31–34) to this family. Species in these four genera are only known to have sexual morphs. A pleurophomopsis-like conidial state has been reported for *H. aquaticus* (Zhang et al. 2013) as its asexual morph, and we also observed this for *H. aquaticus*, as well as for four species in *Clypeoloculus*, but these should be regarded as spermatial morphs. “Pithomyces” *valparadisicus*
(Kirk 1983, Marincowitz et al. 2008) is basal to Clypeolocus species, and is found to be a rare case in which a species known only from an asexual form belongs to the Morosphaeriaceae (Fig. 1). A hyphomycetous genus Pithomyces is regarded as a heterogenous group comprising more than three lineages (Phookamsak et al. 2013), and the generic type (P. flavus) has phylogenetic affinity with Astrosphaeriella basal to family Agia-laceae (Pratihwa & Prabhugaonkar 2015).

**Parabambusicolaceae** (Figs 40, 41). This new family includes two new sexual genera, Aquastrum (Fig. 40) and Parabambusica (Fig. 41). Multisepotospora formerly classified in Pleosporales, genera incertae sedis (Liu et al. 2015) is also accepted as a member of the Parabambusicolaceae. Two unnamed Monodictys species with murnif conidia are also located in this clade, but this genus is obviously heterogenous (see Notes in Monodictys capensis).

**Periconiaceae** (Figs 42, 43). Bambusistroma (Adamčík et al. 2015), Flavomyces (Knapp et al. 2015), Periconia (Figs 42, 43) and Noosia (Crous et al. 2011a) are accepted in this family. "Sporidesmium" tengii is also placed in the Periconiaceae, but the phylogenetic position of the type species of Sporidesmium (S. atrum) is currently unknown. According to Sheny et al. (2006), this genus is not monophyletic and species in Sporidesmium are phylogenetically distributed in seven lineages between two major ascomycte classes, Dothideomycetes and Sordariomyctes. Periconia species used in this study did not form a single clade. Therefore, a taxonomic revision of Periconia species along with Noosia and "Sporidesmium" tengii should be conducted in future.

**Sulcatisporaceae** (Figs 44–46). Macrodiplodiopsidaceae on Diplospora (Rubiaeaceae) and two species of Sulcatispora, S. acerna (Fig. 45) on Acer (Aceraceae) and S. berchemiae (Fig. 46) on Berchemia (Rhamnaceae), are assigned to the Sulcatisporaceae. Neobambusicola (on Grewia sp.; Malvaceae) previously placed in the Bambusicolaceae (Crous et al. 2014b) is accepted here as a member of the Sulcatisporaceae.

**Trematosphaeriaceae** (Fig. 47). This family was established by Suetrong et al. (2011b) to accommodate the three genera, Falciformispora, Halomassarina, and Trematosphaeria (Fig. 47) (Hyde et al. 2013). Later, Bryosphaeria, Hadrospora, and Mediopsis were listed as additional members of the Trematosphaeriaceae (Wijayawardene et al. 2014c). However, the placement of Bryosphaeria has not been verified by molecular data. Hadrospora may have affinity with the Lindgomycelaceae (Tanaka, unpublished data), and Mediopsis belongs to the Pleosporineae, rather than the Massarinae (Ahmed et al. 2014). A coelomycete species, Amarenographium solium with pigmented murnif conidia (Hodhod et al. 2012), has been reported to have phylogenetic affinity to the Trematosphaeriaceae/Didymosphaeriaceae, but molecular data from the generic type (A. metableticum, Eriksson 1982) are currently unavailable.

**Massarinae incertae sedis** (Unknown Clades I–V; Figs 48–50). Fuscoastagonospora (Fig. 48) on bamboo is located in the Unknown Clade I and its familial placement remains unresolved. Pseudoxylymes (Fig. 49), from freshwater environments, occupies a basal position in the Trematosphaeriaceae (Unknown Clade II, Fig. 1). Bactrodesmium cubense (Unknown Clade III), a sporodochial fungus with pigmented phragmocoindia (Zucconi & Lunghini 1997), is a sister taxon of the Morosphaeriaceae (Fig. 1). Monodictys capensis (Fig. 50), without a known sexual morph (Melnik & Shabunin 2010), and Inflatispora pseudostomatica, without a known asexual morph (Zhang et al. 2011), groups in Unknown Clade IV.

**Morphological characteristics of sexual morphs**

The Massarinae clade is supported by high BP support (100%, Fig. 1), but it is somewhat difficult to circumscribe based on their sexual morphs. The Massarinae mainly contains two types of sexual morphs; massarina-like and stagonospora-like. The sexual morph observed in Helminthosporium (Fig. 25) and Massarina (Fig. 26) have immersed, hemispherical, medium to large (ca. 400–700 μm diam) ascomata with short papillate necks covered by a clypeus, clavate asci, and broadly fusiform to ellipsoid, 1- to 3-septate, hyaline ascospores surrounded by a thick conspicuous sheath. Those of Stagonospora (Figs 27–29) are characterised by globose, small (ca. 200–300 μm diam) ascomata lacking a clypeus, cylindrical to clavate asci, and fusiform, 1-septate, hyaline ascospores with a thin sheath. This family, however, includes further sexual species, such as "Didymosphaeria (or Montagula)" sparti with globose ascoma and thick-walled, 1-septate, pigmented ascospores (Aptroot 1995, Chlebicki 2009), and Byssothecium circinans with subglobose ascomata with broadly papillate necks and versicoloured ascospores (Boise 1983). Further molecular investigation using additional taxa close to Massarina and Stagonospora may provide sufficient data to subdivide this family.

**Bambusicolaceae**, **Macrodiploidiopsidaceae**, **Parabambusicolaceae** and **Sulcatisporaceae** presently include only a few species. One to two genera with sexual morphs are recognised in each family: Bambusicola (Dai et al. 2012) and Pseudomassarinaceae (Liu et al. 2015) in the Bambusicolaceae, Macrodiploidiopsidaceae (Crous et al. 2015a) in the Macro diploidiopsidaceae, Aquastrum (Fig. 40) and Parabambusica (Fig. 41) in the Parabambusicolaceae, and Sulcatispora (Figs 45, 46) in the Sulcatisporaceae. The sexual morphs in the Bambusicola, Parabambusicolaceae and Sulcatisporaceae are similar to those of Massarina s. lat. (Aptroot 1998, Tanaka & Harada 2003b) in having immersed to erumpent, hemispherical to depressed globose ascomata. Species in the Bambusicolaceae have conical ascomata with short ostiolar necks, narrow pseudoparaphyses, cylindrical ascis, and narrowly fusiform, 1-septate ascospores, whereas those in the Parabambusicolaceae lack a prominent neck, and have relatively wide pseudoparaphyses, clavate to broadly cylindrical ascis, and clavate to fusiform ascospores with multiple transverse septa. Species in the Sulcatisporaceae have subglobose ascoma, trabeculate pseudoparaphyses, clavate ascis, and broadly fusiform ascospores, and occur on woody host plant rather than herbaceous host. On the other hand, the sexual morphs in the Macrodiploidiopsidaceae are similar to those of Pleomassariaceae s. lat. (Barr 1982). Macrodiploidiopsidaceae desmazeri (= Splanchonema platani) in this family is characterised by large- sized ascomata (500–900 μm diam) with thick ascomatal wall, clavate ascis, and dark brown ascospores with 3–5(–6) eudis tosepta (Barr 1982, Crous et al. 2015a).

**Morosphaeriaceae** (Figs 30–39) and **Trematosphaeriaceae** (Fig. 47), mostly found from aquatic environments, are characterised by immersed to erumpent, medium to large, black, carbonaceous ascomata with or without papillate necks, but necks are prominent and/or surrounded by a clypeus in members of the Morosphaeriaceae. Asexual morphs are relatively...
rare in these families with few exceptions, i.e., *Pithomyces val- paradisacus* (Morosphaeriaceae, Kirk 1983), and *Trematosphaeria grisea* (Trematosphaeriaceae, Ahmed et al. 2014). This tendency has been observed in the Aliquandostipitaceae (Jahnulales), which also occurs in aquatic habitats, and a few asexual species in the genera Brachiosphaera, Speiropsis, and Xylomyces (Suetrong et al. 2011a).

We tentatively accept the Lentitheciaceae as a diverse assemblage. Four groups seem to be recognised based on morphological variations in the sexual morphs: Lentithecium with immersed, globose ascomata without clypeus, and broadly fusiform, 1-septate, hyaline ascospores (Figs 19, 20), Keissleriella with small, globose to subglobose ascomata with setose necks and several septate ascospores (Figs 13–18), Setoseptoria (Figs 22, 23) and Tingoldiago (Fig. 24) with single to grouped, hemispherical ascomata and cylindrical to fusiform ascospores, Katumota (Fig. 12) and Neooephiosphaerella (Fig. 21) with subglobose ascomata without prominent necks and fusiform or filiform ascospores. The morphological diversity of the family, as well as relatively low phylogenetic support of the clade (71 %, Fig. 1), strongly suggests polyphyly of the Lentitheciaceae s. lat. used in this study.

Similarly, various sexual morphs are observed in the Didymosphaeriaceae (Figs 6–9). Most of the species in this family have previously been placed in several genera of the Pleosporineae, which include Didymosphaeria (Montagnula opulenta, Phaeodothis winteri), Leptosphaeria (Paraconiothyrium fuckelii, Neokalmusia scabrispora), and Phaeosphera (Neokalmusia brevispora). The type species of Montagnula (M. infernalis; Berlese 1896) has been treated as Leptosphaeria or Pleospora (Wehmer 1961). Species having muriiform ascospores similar to Pleospora are known in Deniqulata (Ariyawansa et al. 2013) and Tremateia (Kohlmeier et al. 1995). Sexual morphs in the Didymosphaeriaceae have small to medium, globose to subglobose ascomata with papillate necks and melanised, didymo/ phragmo/dictyo-ascospores resembling those of the Pleosporineae, but the ascomata are surrounded by abundant hyphae that form an apical clypeus at times, as was defined by Barr (2001). In addition, Bimuria (Hawksworth et al. 1979), a soil-borne ascomycete, with unique morphological characters such as ascomata composed of very thin peridium, 2-spored asci, and muriiform, dark brown, verrucose ascospores, also belongs in the Didymosphaeriaceae. The family includes a wide variety of sexual morphs with dark coloured ascospores, as well as coniothyrium-like or Spagazzinia asexual morphs, and the clade receives 99 % BP support (Fig. 1).

In contrast, the Dictyosporiaceae and Periconiaceae mostly comprise asexual species. The few known sexual morphs in these families are characterised by single to grouped, globose to hemispherical ascomata with or without surrounding stromatic tissue, cylindrical asci with short stipes, and fusiform to broadly fusiform, 1-septate, hyaline ascospores. Examples are Dictyosporium (e.g., *D. meiosporum*; Liu et al. 2015), Gregarithecium (Fig. 3) and Pseudocoleophoma (Figs 4, 5) in the Dictyosporiaceae and Bambusistroma (Adamčík et al. 2015) and Periconia (Figs 42, 43) in the Periconiaceae. These morphological features agree in most respects with those of Massarina s. lat. (Aptroot 1998, Tanaka & Harada 2003b) and are similar to those of species in the Massarinaceae (e.g., Stagonospora). In the Latoraceae, no sexual morphs are known at present (Crous et al. 2015a).

**Morphological characteristics of asexual morphs**

Although various asexual genera are found in the Massarinaceae, hyphomycetous species with macroconidium, mononematous conidiophores are restricted to the Massarinaceae [Helminthosporium (Fig. 25) and Corynespora], Periconiaceae [Periconia (Fig. 43) and Sporidesmium], Dictyosporiaceae (Diplococcum and Dendryphiella), and Didymosphaeriaceae (Sporidesmiella). Similarly, synnematosus hyphomycetes are extremely rare in this suborder and have only been observed in one instance, in *Aquaticherospora* (Kodueb et al. 2007) in the Dictyosporiaceae. Hyphomycetous asexual morphs without prominent conidiophores are found in the Periconiaceae (Noosia), Latoraceae (Latorua and Polyschema), and the Mo- sphaeriaceae (Pithomyces). Sporodochial hyphomycetes are scattered through the Dictyosporiaceae [Dictyosporium (Fig. 2) and its morphologically similar genera], Didymosphaeriaceae (Spagazzinia, Figs 10, 11), Parabambusicolaceae (Monodictys), and Unknown Clades III (Bactrodesmum) and IV (Monodictys, Fig. 50). In contrast, coelomycetous genera seem to be more common than hyphomycetous asexual morphs and are present throughout this suborder, i.e., in the Bambusicolaceae (Bambus- sica), Dictyosporiaceae (Pseudocoleophora, Figs 4, 5), Didymosphaeriaceae [Paracamarosporum, Paraconiothyrium, Pseudocamarosporum, Karstenula, Paraphosphaeria (Fig. 9)], Lentitheciaceae [Keissleriella (Figs 13, 16), Seto- septoria], Macronidiopsidaceae (Camarographium, Macro- diopsid, Pseudochaetosphaeronema), Massarinaceae (Stagonospora, Figs 27–29), Sulcatisporaceae [Magni- camarasporum (Fig. 44), Sulcatispora (Figs 45, 46)] and Unknown Clades I (Fuscostagonospora, Fig. 48).

In general, Dictyosporiaceae is characterised by hyphomy- cetous asexual morphs with pigmented cheiroconidia. These usually have sporodochial (e.g., Dictyosporium, Digoedodesmum, and Pseudodictyosporum) or synnematosus conidiodoma (e.g., *Aquaticherospora*). Dendryphiella and Diplcococcum have macroconidium, mononematous conidiophores with pigmented, multi-celled, tretic conidia. The coelomycetous morphs known in this family are *Paraconiothyrium flavescens* and *Pseudocomo- lephora* species, with phialidic, 1-celled conidia. In contrast, most asexual species in the Periconiaceae have mono- nematous, macroconidematous conidiophores and produce conidia in chains (e.g., *Periconia*), but some deviating species, such as *Sporidesmium tengii* have monoblastic, obpyriform, multi- septate, pigmented conidia (Wu & Zhuang 2005), and Noosia which lacks a prominent conidiophore (Crous et al. 2011a), are also known in the family. Further phylogenetic investigations of asexual genera exhibiting morphological resemblance to these two groups but without molecular information, such as dictyosporium-like (e.g., *Cheiromycomella*, Digitomycomes, Para- tetrapola; Seifert et al. 2011) and periconia-like genera (e.g., *Laclinopsis*, Sadashivania, *Trichobotrys*; Seifert et al. 2011), should be conducted to evaluate the phylogenetic significance of these phenotypic characters at familial level, and/or to clarify taxonomic understanding of the Dictyosporiaceae and Peri- coniaceae. Although in some families (e.g., the Didymos- phaeriaceae and Massarinaceae), asexual morphs are extremely diverse and thus asexual characters alone appear insufficient for familial circumscriptions, there are many recent examples of families that are well defined by asexual
morphological characters along with their phylogenetic information. These include the Coniothyriaceae (De Gruyter et al. 2013), Cladosporiaceae (Bensch et al. 2012), Kirschsteiniotheliaceae (Boonme et al. 2012), Planitromellaceae (Minnis et al. 2012), and Tetraplosphaeriaceae (Tanaka et al. 2009).

**Habitat**

In contrast to the Pleosporaceae which comprises numerous plant pathogens (Zhang et al. 2009b), such as necrotrophs (e.g., Alternaria, Bipolaris) and hemibiotrophs (e.g., Leptosphaeria, Setosphaeria) on economically important crops (Ohm et al. 2012), the Massarineae, a sister lineage of the Pleosporaceae, mostly includes saprobes on various plant substrates.

Species in the Morosphaeriaceae and Trematosphaeriaceae have been reported mostly as saprobes on decomposed woody substrates submerged in freshwater or marine habitats. Recently, several human pathogenic species have been reported in genera in the Trematosphaeriaceae, and an association of the virulence factors with oligotrophism or halotolerance has been suggested (Ahmed et al. 2014). This may further indicate the presence of undescribed lineages of mycetoma agents in the Morosphaeriaceae.

Most other families in the Massarineae do not seem to have specific habitat preferences in each family. Species in the Dictyosporiaceae, for example, are from ecologically diverse environments, i.e., terrestrial monocots and dicots (e.g., Dictyosporium streitzieae and Diplorococcus asperum; Pirzynski 1972, Crous et al. 2009a), submerged wood in freshwater (e.g., Aqualichespeira lonicola; Kodsub et al. 2007), mangroves or drift wood in marine ecosystems (Dictyosporium inflatum; Kirscher et al. 2013), and rhizosphere soil (Pseudodictyosporium elegans; De Gruyter et al. 2013). In the Didymosphaeriaceae, many coelomycetous species similar to Phoma s. lat. are generally soil-borne fungi (Verkley et al. 2014), but species with other ecological features, e.g., endophytes (Dendrothyrium; Verkley et al. 2014), mycoparasites (Paraphaeosphaeria mini- tans; Campbell 1947), symbionts with scale insects (Cucurbit-dothis pilyphila; Casagrande 1969, Barr 1990b), and marine saprobes (Tremateia halophila; Kohlmeyer et al. 1995) are also known. Paraconiothyrium fuckelii in the Didymosphaeriaceae is known as an agent of mycetoma and a serious plant pathogen of the Rosaceae (Verkley et al. 2014).

In the suborder Massarineae, relatively few species are known as plant pathogens. They are restricted to the Didymosphaeriaceae (Paraconiothyrium tiliae, Deniguelata barkingtoniae; Butn & Kehr 1995, Ariyawansa et al. 2013), Massarineae (Byssothecium circinans, Stagonospora spp., Helminthosporium solan; Kaiser et al. 1979, Semieniuk 1983, Errampalli et al. 2001) and Periconiaceae (Periconia igniaria; Kolomiets et al. 2008); lineages rich in asexual species. Coprophilous species such as those in the Sporormiaceae (Kruys & Wedin 2009) and lichenicolous species such as Arthopyrenia salicis (Nielson et al. 2009) are not known from the Massarineae.

**Future studies**

We examined the morphology of 106 taxa belonging to the Massarineae and analysed their phylogenetic relationships based on sequences from SSU rDNA, LSU rDNA and tef1, along with sequences of 131 taxa previously assigned to the Massarineae. Our results delineated 10 new genera and 29 new species/new combinations in more than 12 families and five unknown lineages (Fig. 1). Our study has contributed to the understanding of species diversity within the Massarineae, and improves the classification of these species, as well as based on our phylogenetic analysis, although we have tentatively accepted the family at this point. Furthermore, the presence of several lineages (Unknown Clades I to V), which we were unable to assign to any existing families, makes it certain that there are many undiscovered taxa, which should form a new family in the suborder.

Several comprehensive works have been published recently that have shown interest in the phylogeny of the Dothideomycetes. Schoch et al. (2006) provided a fundamental overview of the class, and its composition of two subclasses, the Pleosporomycetidae (pseudoparaphyses present) and the Dothideomycetidae (pseudoparaphyses absent), based on phylogenetic analyses of four loci (nucSSU, nucLSU rDNA, tef1, rpb2) from 96 taxa. Schoch et al. (2009) reconstructed the dothideomycete phylogeny based on five genes (nucSSU, nucLSU rDNA, tef1, rpb1, rpb2) from 356 isolates, and discussed the evolutionary transitions of ecological characteristics. Following these publications, the understanding of the natural relationships among dothideomycetous taxa and their taxonomic revision have tremendously progressed, and the number of accepted families in this class has been increased from 41 (Schoch et al. 2009) to 105 (Hyde et al. 2013) with or without molecular evidence. Monographic revision based on the type specimens along with phylogenetic analyses have been published by Zhang et al. (2012) who concentrated on reassessment of genera in the Pleosporales, and by Hyde et al. (2013) who circumscribed each family in the Dothideomycetes. The phylogenies of plant pathogenic taxa in this class, such as Alternaria (Woudenberg et al. 2013), Cercospora (Groenewald et al. 2013), Cladosporium (Bensch et al. 2012), Phoma (De Gruyter et al. 2013), Pseudocercospora (Crous et al. 2013a), Septoria (Quaedvlieg et al. 2013, Verkley et al. 2013) and several genera in the Botryosphaeriales (Phillips et al. 2013, Slippers et al. 2013, Wikee et al. 2013), have been intensively studied. More recently, a special issue of Phytotaxa has been published, comprising 26 articles focused on the taxonomy and phylogeny of the Dothideomycetes (Moenzie et al. 2014).

However, these works on Dothideomycetes include relatively few species belonging to the Massarineae. The number of Massarineae taxa used in phylogenetic analyses of the Dothideomycetes was only six (among 96 taxa; Schoch et al. 2006), and 35 (among 356 taxa; Schoch et al. 2009). In the revision of the Pleosporales by Zhang et al. (2012) who recognised the validity of Massarineae, only 46 taxa of the suborder were phylogenetically analysed. Furthermore, most families in this suborder including the Bambusicolaceae (Hyde et al. 2013), Lentitheciaceae (Zhang et al. 2009b), Morosphaeriaceae (Suetrong et al. 2009), and Trematosphaeriaceae (Suetrong et al. 2011b), have been lineages recently recognised based on molecular data, and are currently characterised morphologically by only a few genera. To provide more precise circum- scription of these families, as well as of the unnamed lineages we
have found (Clades I to V, Fig. 1), further phylogenetic analyses using a greater number of taxa should be conducted with priority. These should include a fundamental taxonomic approach to species discovery along with sequence verification, such as the work undertaken by Fungal Planet (Crous et al. 2016c), Fungal Diversity Notes (Liu et al. 2015) and Fungal Systematics and Evolution (FUSE) (Crous et al. 2015b).

In due course further phylogenetic study is also necessary of the more than 1500 asexual genera treated as “Ascomycota, genera incertae sedis” (Wijayawardene et al. 2012); those without sexual links or molecular phylogenetic information. However, asexual characters alone may not provide good resolution for familial circumscription for some aquatic lineages, such as Morosphaeriaceae and Trematosphaeriaceae, in which predominantly sexual species are known. In contrast, species in the Dictyosporiaceae and Periconiaceae comprise a high proportion of asexual taxa. These have previously been treated as Massarinaceae (Hyde et al. 2013), but we have further characterised these as independent families based on their sexual morphs, in addition to their distinct asexual morphologies. Recognition of the Dictyosporiaceae and Periconiaceae partially indicates the phylogenetic significance of asexual taxa, but further comprehensive taxonomic work based on the holomorph and not weighted towards a particular fungal morph (e.g., Crous et al. 2009b, Tanaka et al. 2009, 2010, Voglmayr & Jaklitsch 2011, Dai et al. 2012, Phillips et al. 2013, Boonmee et al. 2014) should be conducted to revise sexual morph-based fungal systematics.

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