Phylogenetic revision of Camarosporium (Pleosporineae, Dothideomycetes) and allied genera

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Available online 23 August 2017; http://dx.doi.org/10.1016/j.simyco.2017.08.001.

INTRODUCTION

Morphological characteristics, cultural studies and host-fungal association have been considered as important aspects in the traditional taxonomy of coelomycetous fungi (Sutton 1980, Sivanesan 1984, Nag Raj 1993, Jeewon et al. 2002, 2003b, 2004, Wijayawardene et al. 2016). However, morphological plasticity of several coelomycetous genera led to poor generic and species delimitation, often resulting in incorrect taxonomic placement (Jeewon et al. 2003a, Shenoy et al. 2007, Wijayawardene et al. 2016). Proposing new genera (e.g. Vermisporium/Seimatosporium, fide Barber et al. 2011) and linking asexual genera with more than one sexual genus (e.g. Phoma and Camarosporium, fide Crous & Groenewald 2017) have resulted in taxonomic controversies among taxonomists and plant-pathologists (Wijayawardene et al. 2012a, b, Hyde et al. 2017).
et al. (2001). DNA-based sequence analyses have so far provided reliable evidence for more precise generic boundaries (e.g. Pestalotiopsis fide Jeewon et al. 2003b, 2004, Maharachchikumbura et al. 2012, 2014a, b, Phoma fide de Gruyter et al. 2009, 2012, Chen et al. 2015, Camarosporium fide Crous et al. 2013, Wijayawardene et al. 2014b, 2015, 2016, Coniothyrium fide Verkley et al. 2004, 2014, Wijayawardene et al. 2016) and resolution of species complexes (e.g. Diplodia fide Phillips et al. 2008, Colletotrichum fide Damm et al. 2012, 2014).

The genus Camarosporium was introduced by Schulzer (1870) with Cm. quaternatum as the type species, and it is one of the largest coelomycetes genera, comprising over 500 epithets in Index Fungorum (2017). Several Camarosporium species have been reported as important plant pathogens with a worldwide distribution. Camarosporium pistaciae is known as a common pathogen responsible for blight of the shoots and panicles in pistachio production in Greece (Assimakopoulos & Elena 2010). Smith et al. (1988) listed Camarosporium dalmaticum, Cm. flaccidum, Cm. pistaciae, and Cm. stroblinum as plant pathogens in Europe. Camarosporium species are reported as causing damage in the cut-flower industry in the USA. (Taylor et al. 2001). Camarosporium species are also reported as common pathogens of deciduous trees in Europe and Cm. pini induces severe infection that can result in significant growth reduction to pine plantations (Ivanová & Bernadovcová 2010).

Sutton (1980) pointed out the heterogeneity of the genus, citing Camarosporium propinquum as an example. Sutton’s (1980) prediction was confirmed by Wijayawardene et al. (2014c), who reported that Cm. propinquum should be accommodated in Didymosphaeriaceae. Camarosporium has been linked to Cucurbittaria (Kirk et al. 2008, Wijayawardene et al. 2012b, Doilm et al. 2013), Leptosphaeriaceae (Schoch et al. 2009) and Botryosphaeriaceae (Kirk et al. 2008, Liu et al. 2012, Wijayawardene et al. 2012b), although Crous et al. (2006) reported that Cm. quaternatum (based on CBS 134.97 culture, now described as Libertasomyces quercus; Crous & Groenewald 2017) does not belong to the Botryosphaeriaceae. Further evidence was provided that camarosporium-like taxa are polyphyletic within Pleosporales (Crous et al. 2014a, b, Wanasinghe et al. 2014a, Wijayawardene et al. 2014a, c, 2016, Crous & Groenewald 2017), leading to more taxonomic confusion of Camarosporium and camarosporium-like taxa. In a recent study, Crous & Groenewald (2017) designated an epitype for Cm. quaternatum and treated Camarosporium s. str. in Coniothyriaceae, and reported this complex to have phoma-like synasexual morphs, and pleospora-like sexual morphs. To date there is DNA sequence data for only a small number of species, and the validity of taxonomic concepts and other species remains uncertain. Therefore, it has been necessary to recollect these taxa from type localities, isolate them in axenic culture, and analyse their DNA sequence data to better understand their morpho- and phylotaxonomy. Given the considerable taxonomic confusion among Camarosporium and its allies and its familial placement, this study was undertaken to answer the following questions: (i) Do camarosporium-like taxa represent a natural group?; (ii) What are the allied sexual and synasexual morphs of camarosporium-like taxa?; (iii) Where does Camarosporium quaternatum position itself within the Pleosporineae?

MATERIALS AND METHODS

Specimens and isolates

Fresh camarosporium-like specimens were collected in Europe (Russia and Italy) and Asia (Thailand and Uzbekistan) from various host plants. Uzbekistan specimens were loaned from Tashkent Mycological Herbarium (TASM), Tashkent. The specimens were examined following the methods described in Wanasinghe et al. (2014a). Axenic strains were established from single spores as described in Chomnunti et al. (2014), with a modification of the incubation temperature at 16 °C overnight in the dark. Germinated ascospores and conidia were observed with a Motic SMZ 168 Stereo Zoom microscope and transferred to potato dextrose agar (PDA; 39 g/L distilled water, Difco potato dextrose) for extraction of DNA, determination of growth rates and observation of cultural characteristics. The specimens are deposited at Mae Fah Luang University (MFLU) Herbarium, Chiang Rai, Thailand and the New Zealand Fungal Herbarium (PDD). Living cultures are deposited at the Culture Collection of Mae Fah Luang University (MFLUCC) and the Westerdijk Fungal Biodiversity Institute in Utrecht, the Netherlands (CBS)

Morphological classification

Digital images of the fruiting structures were captured with a Canon 450D digital camera fitted to a Nikon ECLIPSE 80i compound microscope. Squash mount preparations were prepared to determine micro-morphology, and free hand sections of sporo-caps made to observe the shapes of ascomata/conidiomata and peridium structures. Measurements of morphological structures were taken from the widest part of each structure. Whenever possible, more than 30 measurements were made. The lengths and widths were measured using the Tarosoft (R) Image Frame Work program and images used for figures processed with Adobe Photoshop CS3 Extended v. 10.0 (Adobe®, San Jose, CA). Three sets of duplicate cultures of each isolate were measured to determine colony characteristics on PDA at 16 °C in the dark. Colony size was determined, and colour rated according to the colour charts of Rayner (1970) after 3 wk of incubation.

DNA extraction, PCR and sequencing

Isolates were grown on PDA for 3–4 wk at 16 °C and total genomic DNA was extracted from 50 to 100 mg of mycelium scraped from the edges of the growing cultures (Wu et al. 2001). Mycelium was ground to a fine powder in liquid nitrogen and DNA was extracted using the Biospin Fungus Genomic DNA Extraction Kit, BSC14S1 (BioFlux, P.R. China) following the instructions of the manufacturer. When fungi failed to germinate and grow in culture, DNA was extracted directly from ascomata using a DNA extraction kit (E.Z.N.A.® Forensic DNA kit, D3591-01, Omega Bio-Tek) following the instructions of the manufacturer.

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Samuels 1994) and L5R (Vigaly & Hester 1990), the SSU using the primers NS1 and NS4 (White et al. 1990), and tef1 using primers EF1-983F and EF1-2218R (Rehner & Buckley 2005). The polymerase chain reaction (PCR) was carried out with a final volume of 25 μL under the following protocol: 12.5 μL of 2 x Power Tag PCR MasterMix (a premix and ready to use solution, including 0.1 Units/μL Taq DNA Polymerase, 500 μM dNTP Mixture each (dATP, dCTP, dGTP, dTTP), 20 mM Tris-HCL pH 8.3, 100 mM KCl, 3 mM MgCl2, stabilizer and enhancer), 1 μL of each primer (10 μM), 1 μL genomic DNA extract and 9.5 μL deionised water. The reaction was then allowed to run for 35 cycles. The PCR profile was as follows: initial denaturation 95 °C for 5 min, 35 cycles of denaturation at 95 °C for 90 s, annealing for 90 s, elongation at 72 °C for 1 min, and final extension at 72 °C for 10 min. The annealing temperature was 55 °C for ITS, LSU, tef1 and 48 °C for SSU. The amplified PCR fragments were sequenced by BGI, Ltd., Shenzhen, P.R. China. Sequences were deposited in GenBank (Tables 1 and 2).

**Sequence alignment and phylogenetic analyses**

Sequences generated from different primers of the four genes were analysed with other sequences retrieved from GenBank. Sequences with high similarity indices were determined from a BLAST search to find the closest matches with taxa in Pleosporineae, and from recently published data (Liu et al. 2015, Grum-Grzhimaylo et al. 2016, Crous & Groenewald 2017, Tibpromma et al. 2017). The sequences were aligned in MAFFT v. 7 with the web server (http://mafft.cbrc.jp/alignment/server), using iterative refinements as E-INS-i method for ITS & tef1, and as G-INS-i method for LSU and SSU (Kato & Standley 2013). The alignment was edited where necessary with BioEdit v. 7.0.5.2 (Hall 1999). The alignment properties for the individual genes are shown in the Table 3. The final alignment and tree were deposited in TreeBASE, submission ID: 21397 (http://www.treebase.org/).

The final alignment (combined LSU, SSU, tef1 and ITS loci) included 212 strains, (representing 16 selected families within the Pleosporineae), the new taxa proposed in this study, and Cyclothyriella rubronotata (CBS 141496 & CBS 121892) as the outgroup taxon. Phylogenetic analyses of both individual and combined aligned data were based on Maximum Likelihood (ML), Maximum Parsimony (MP) and Bayesian analyses. The sequence alignments were converted to NEXUS file format (.nex) for maximum parsimony and Bayesian analyses using ClustalX2 v. 1.83 (Thompson et al. 1997). The NEXUS file was prepared for MrModeltest v. 2.2 after deleting the symbols =ABCDEFGH-IKMNOPQRSTUVWXYZ (Nylander 2004) in PAUP (Phylogenetic Analysis Using Parsimony) v. 4.0b10 (Swofford 2003). For the Randomized Accelerated Maximum Likelihood (RAxML) analysis, sequence alignments were converted to PHYLIP file format (.phy) using ALTER (alignment transformation environment: http://sing.ei.uvigo.es/ALTER; 2017).

The MP bootstrap analysis was performed with PAUP, with 1000 bootstrap replicates using 10 rounds of heuristic search replicates with random addition of sequences and subsequent TBR branch swapping (MULTREES option in effect, steepest descent option not in effect) during each bootstrap replicate, with each replicate limited to 1 M rearrangements. All characters were unordered and given equal weight; gaps were treated as missing data; the COLLAPSE command was set to minbrlen. Descriptive tree statistics for parsimony were calculated for trees generated under different optimality criteria: Tree Length (TL), Consistency Index (CI), Retention Index (RI), Relative Consistency Index (RC) and Homoplasy Index (HI). The Kishino-Hasegawa tests (Kishino & Hasegawa 1989) were performed to determine whether trees were significantly different. Other details are outlined in Jeewon et al. (2003b) and Prompuththara et al. (2007).

The evolutionary models for Bayesian analysis and ML were selected independently for each locus using MrModeltest v. 2.3 (Nylander 2004) under the Akaike Information Criterion (AIC) implemented in PAUP v. 4.0b10. The GTR + I + G model was selected as the best-fit model for each locus in both Bayesian and ML analyses.

The Bayesian analysis was performed in MrBayes v. 3.1.2 (Huelsenbeck & Ronquist 2001) to evaluate Posterior probabilities (PP) (Rannala & Yang 1996, Zhaxybayeva & Gogarten 2002) by Markov Chain Monte Carlo sampling (BMCMC). Six simultaneous Markov chains were ran for 5 M generations and trees were sampled every 500th generation. The distribution of log-likelihood scores was examined to determine the stationary phase for each search and to decide if extra runs were required to achieve convergence, using the program Tracer v. 1.5 (Rambaut & Drummond 2007). All sampled topologies beneath the asymptote (10 %) were discarded as part of a burn-in procedure; the remaining trees were used for calculating PP in the majority rule consensus tree.

The ML trees were generated using the RAxML-HPC2 on XSEDE (v. 8.2.8) (Stamatakis et al. 2008, Stamatakis 2014) in the CIPRES Science Gateway platform (Miller et al. 2010) using a GTR + I + G model of evolution. Phylograms were visualised with FigTree v. 1.4.0 (Rambaut 2012) and annotated in Microsoft PowerPoint (2007) or Adobe Illustrator® CS5 (v. 15.0.0, Adobe®, San Jose, CA).

**RESULTS**

**Phylogenetic analyses**

Topologies of trees (ML, MP and PP) for each gene dataset were compared and the overall tree topology was congruent to those obtained from the combined dataset.

The RAxML analysis of the combined dataset yielded a best scoring tree (Fig. 1) with a final ML optimisation likelihood value of −24419.107973. The matrix had 1 273 distinct alignment patterns, with 24.87 % of undetermined characters or gaps. Parameters for the GTR + I + G model of the combined LSU, SSU, tef1 and ITS were as follows: Estimated base frequencies; A = 0.24346, C = 0.239263, G = 0.26821, T = 0.249067; substitution rates AC = 1.464074, AG = 3.479937, AT = 2.089279, CG = 0.715575, CT = 7.524749, GT = 1.000; proportion of invariable sites I = 0.630738; gamma distribution shape parameter α = 0.492847. The maximum parsimomious dataset consisted of 3 461 characters, of which 2 583 were constant, 745 parsimony-informative and 133 parsimony-uninformative. The parsimony analysis of the data matrix resulted in the maximum of 1 000 equally most parsimonious trees with a length of 3 928 steps (CI = 0.341, RI = 0.793, RC = 0.27, HI = 0.659) in the first tree. The Bayesian analysis resulted in 10 000 trees after 5 M generations. The first 1 000 trees, representing the burn-in phase of the analyses, were discarded, while the remaining 9 000 trees were used or calculating posterior probabilities in the majority rule consensus tree.
| Taxon | Culture accession no.¹ | GenBank accession no.² | References |
|-------|-----------------------|------------------------|------------|
| *Acrocalymma aquaticum* | MFLUCC 11-0208 | NR_121544 JX276952 JX276953 – | Zhang et al. (2012) |
| *A. ficus* | CBS 317.76 | NR_137953 KP170712 – KP170663 | Trakunyingcharoen et al. (2014) |
| *A. medicinalis* | CPC 24340 | KP170625 KP170718 – Trakunyingcharoen et al. (2014) |
| *A. alternaea* | MFLUCC 14-1184 | KP334711 KP334701 KP334721 KP334735 | Anyawansa et al. (2015c) |
| *A. eureka* | CBS 193.86 | KX584331 KX584589 – | Woudenberg et al. (2013) |
| *A. alternaee* | CBS 134021 | KC609333 – – – | Woudenberg et al. (2013) |
| *A. helianthus* | CBS 327.69 | KC609335 KX584369 KX584627 – | Woudenberg et al. (2013) |
| *Boeremia exigua* | CBS 431.74 | JF427001 EU754184 – | De Gruyter et al. (2009) |
| *Camarosporidiella aborescentis* | MFLUCC 14-0604 | KP711377 KP711378 KP711379 – | Liu et al. (2015) |
| *Cuscuta ephedricola* | CBS 121892 | JF740191 GQ387606 GQ387545 – | Schoch et al. (2006) |
| *C. telephii* | CBS 141486 | KX650544 KX650544 KX650507 KX650519 | Jaklitsch & Voglmayr (2016) |

References: Crous & Groenewald (2017), Schoch et al. (2016), Wijayawardene et al. (2014a), et al. (2015), et al. (2014), et al. (2010), et al. (2016), et al. (2007), et al. (2013), et al. (2006), et al. (2015a), et al. (2015c), et al. (2014), et al. (2009), et al. (2015a), et al. (2017), et al. (2014a), et al. (2010), et al. (2012), et al. (2014).
| Taxon                                      | Culture accession no. | GenBank accession no. | References                  |
|-------------------------------------------|-----------------------|-----------------------|-----------------------------|
| Didymella exigua                          | CBS 183.55            | GU237794 EU754155 EU754056 – | De Gruyter et al. (2009)    |
| Didymellocamarosporium tamariscis         | MFLUCC 14-0241        | – KU848183 KU848182 – | Wijayawardene et al. (2016) |
| Dimorphosporicola tragani                 | CBS 570.85            | KU728497 KU728536 – – | Crous & Groenewald (2016)   |
| Dothidiotrichia aspera                    | CPC 12926             | – EU673272 EU673225 – | Phillips et al. (2008)      |
|                                           | CPC 12930             | – EU673276 EU673228 – | Phillips et al. (2008)      |
|                                           | CPC 12932             | – EU673274 EU673226 – | Phillips et al. (2008)      |
|                                           | CPC 12933             | – EU673275 EU673227 – | Phillips et al. (2008)      |
| D. symphoricarpri                         | CPC 12929             | – EU673273 EU673224 – | Phillips et al. (2008)      |
| Foliolphoma fallens                       | CBS 161.78            | KY929147 GU238074 GU238215 – | Crous & Groenewald (2017)   |
|                                           | CBS 284.70            | KY929148 GU238078 GU238218 – | Crous & Groenewald (2017)   |
| Haloljuella avicenniae                    | BCC 20173             | – GU371822 GU371830 GU371815 | Schoch et al. (2009)        |
|                                           | BCC 18422             | – GU371823 GU371831 GU371816 | Schoch et al. (2009)        |
|                                           | JK 5326A              | – GU479790 GU479756 – | Schoch et al. (2009)        |
| Leptosphaeria maculans                    | CBS 260.94            | JF740235 JF740307 – – | De Gruyter et al. (2012)    |
| Leptosphaerula austricalis                | CBS 317.83            | GU237829 GU301830 GU296160 GU349070 | Schoch et al. (2009)        |
| Libertasomyces mycopori                   | CPC 27354             | NR_145200 KX282332 – – | Crous & Groenewald (2017)   |
| L. platani                               | CPC 29609             | KU173416 KU173507 – – | Crous & Groenewald (2017)   |
| L. quercis                               | CBS 134.97            | KY929152 DQ377883 – – | Crous & Groenewald (2017)   |
| Macroenturia anomochaeta                  | CBS 525.71            | GU237881 GU237984 GU238208 GU456262 | Aveskamp et al. (2009)      |
| Melnikia anthoxanthii                     | MFLUCC 14-1010        | – KU848204 KU848205 – | Wijayawardene et al. (2016) |
| Neocamarosporium betae                    | CBS 109410            | – EU754179 EU754079 GU349075 | De Gruyter et al. (2009)    |
|                                           | CBS 523.66            | FJ426981 U43383 U43466 – | Aveskamp et al. (2009)      |
| N. calvescens                             | CBS 246.79            | – EU754131 EU754032 – | De Gruyter et al. (2009)    |
| N. chenopodi                              | CBS 344.78            | – EU754132 EU754033 – | De Gruyter et al. (2009)    |
| N. chersiae                               | CPC 27298             | KY929153 KY929182 – – | Crous & Groenewald (2017)   |
| N. chichastianum                          | CBS 137502            | K004455 K004483 – – | Crous et al. (2014b)        |
| N. goegapense                             | CPC 23676             | KJ869163 KJ869220 – – | Crous et al. (2014b)        |
| N. obtiones                               | CBS 432.77            | GU230752 JF740267 JF740966 – | De Gruyter et al. (2012)    |
| Neocamarosporium sp.                      | M303*                 | KJ443253 KJ443123 KJ443078 KJ443210 | Grum-Grzhimaylo et al. (2016) |
|                                           | M305*                 | KJ443255 KJ443125 KJ443080 KJ443212 | Grum-Grzhimaylo et al. (2016) |
|                                           | M311*                 | KJ443260 KJ443130 KJ443085 KJ443217 | Grum-Grzhimaylo et al. (2016) |
| Neophaeosphaeria agaves                    | CPC 21264             | KF777174 KF777227 – – | Crous et al. (2013)         |
| N. filamentosa                            | CBS 102203            | – JX681104 – – | Verkley et al. (2014)       |
|                                           | CBS 102202            | JF740259 GQ387577 GQ387516 GU349084 | De Gruyter et al. (2010)    |
| Neophytosporidales aloicola                | CPC 24435             | KR476719 KR476754 – – | Crous et al. (2015a, b)     |
| Ochrocladosporium elatum                   | CBS 146.33            | EU040233 EU040233 – – | Crous & Groenewald (2017)   |
| O. frigida                                | CBS 103.81            | EU040234 EU040234 – – | Crous & Groenewald (2017)   |
| Paradendryphiella salina                  | CBS 142.60            | DQ411540 FK156158 FK156098 DQ414251 | De Gruyter et al. (2012) & Woudenberg et al. (2013) |
| Paraleptosphaeria dryadis                  | CBS 643.86            | JF740213 GU301828 KC584632 GU349009 | De Gruyter et al. (2012) & Woudenberg et al. (2013) |
| P. rubi                                   | MFLUCC 14-0211        | KT454726 KT454718 KT454733 – | Phookamsak et al. (2014)    |
| Phaeosphaeria chiangraina                  | MFLUCC 13-0231        | KM343270 KM343280 KM343289 KM343298 Phookamsak et al. (2014) |
|                                           | MFLUCC 11-0133        | KM343267 KM343277 KM343287 KM343296 Phookamsak et al. (2014) |
| P. musae                                  | MFLUCC 11-0563        | KM343266 KM343276 KM343286 KM343295 Phookamsak et al. (2014) |
| P. thyrsolaenica                          | MFLUCC 11-0193        | KM343274 KM343284 KM343293 KM343302 Phookamsak et al. (2014) |
| Phaeosphaeriopsis draecenioides            | MFLUCC 11-0157        | KM343273 KM343283 KM343292 KM343301 Phookamsak et al. (2014) |
| Phoma herbarum                            | CBS 276.37            | FAJ20227 DO678066 DO678014 DO677909 | Schoch et al. (2006)        |
|                                           | CBS 615.75            | KF251212 KF251715 EU754087 KR184186 | Schoch et al. (2006)        |
| Plenodomus guttolatus                     | MFLUCC 15-1876        | KT454721 KT454713 KT454729 – | Arýjawansa et al. (2015b)   |
| P. salviae                                | MFLUCC 13-0219        | KT454725 KT454717 KT454732 – | Arýjawansa et al. (2015b)   |

(continued on next page)
form a monophyletic clade (Clade B) in the stable and in this concatenated analysis, these taxa are basal to Fig. 1). In different analyses, the placement of this clade is un-

statistical support (86 % ML, 70 % MP and 1.00 PP, Clade C, genus *Cucurbitaria elongata* (MFLUCC 17-0721), the type species of *MFLUCC 17-0814*) grouped with *S. rhamnicola* (MFLUCC 15-0957) and *C. uniseriatum* (CPC 23676), the type species of *C. laburnicola* (CBS 344.78), with relatively good support, this study also clari

**Table 1. (Continued).**

| Taxon                            | Culture accession no.¹ | GenBank accession no.² | References                                      |
|----------------------------------|-------------------------|------------------------|-------------------------------------------------|
| *Pleospora tarda*                | CBS 714.68              | KC584238               | Woudenberg et al. (2013)                         |
| *Pyrenochea cava*                | CBS 257.68              | JF740260               | De Gruyter et al. (2009)                         |
| *P. nobilis*                     | CBS 407.76              | EU930011               | Schoch et al. (2006)                            |
| *P. phaeocomes*                  | DAOM 222769             | DQ491507 DQ499595 DQ497607 Schoch et al. (2006) |
| *Shiria bambusicola*             | NBRC 30772              | AB354991 AB354972      | Morakotkarn et al. (2008)                        |
| *S. lyciicola*                   | CPC 30998               | KY929150 KY929180      | Crous & Groenewald (2017)                        |
| *S. aptrocii*                    | CPC 31014               | KY929151 KY929181      | Crous & Groenewald (2017)                        |
| *Stenophylium vesicatorium*      | CBS 191.86              | KC584239 GU238160 GU238232 DQ471090 Woudenberg et al. (2017), Aveskamp et al. (2010) & Spatafora et al. (2006) |
| *Subplenodomus valerianae*       | CBS 630.68              | JF470261 GU238150 GU238229 Aveskamp et al. (2009) |
| *S. violicola*                   | CBS 306.68              | JF470261 GU238150 GU238229 Aveskamp et al. (2009) |
| **Neocamarosporiaceae**          |                         |                        |                                                  |
| **Newly generated sequences**    |                         |                        |                                                  |
| *Neocamarosporiaceae*            |                         |                        |                                                  |
| *Camarosporiaceae*               |                         |                        |                                                  |

1 *BCC*: Belgian Coordinated Collections of Microorganisms; *CBS*: Culture Collection of the Westerdijk Fungal Biodiversity Institute, Utrecht, the Netherlands; *CPC*: Personal collection of P.W. Crous, Utrecht, the Netherlands; *DAOM*: Canadian Collection of Fungal Cultures, Ottawa, Canada. *E.G.S.*: Personal collection of Dr. E.G. Simmons; *IBC*: Iranian Biological Resources Center, Academic Center for Education Culture and Research (ACECR), Tehran, Iran; *K.J.*: Kohlmeyer, *MFLUCC*MFLU: Mae Fah Luang University Culture Collection, Chiang Rai, Thailand; *NBRC*: NITE Biological Resource Center, Department of Biotechnology, National Institute of Technology and Evaluation, Kisarazu, Chiba, Japan. *Strain designation from GenBank.*

2 *ITS*: Internal transcribed spacers; *LSU*: partial 28S nrDNA; *SSU*: partial 18S nrDNA; *tef1*: translation elongation factor 1-alpha gene.
| Taxon                      | Original no. | Culture no. | Specimen no. | Host or substrate | Country | GenBank accession no. |
|---------------------------|--------------|-------------|--------------|-------------------|---------|-----------------------|
| **Ca. caraganicola**      |              | MFLUCC 17-087 = CBS 143105 | MFLU 15-222 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0005       | MFLUCC 17-087 = CBS 143105 | MFLU 15-222 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0011       | MFLUCC 17-087 = CBS 143105 | MFLU 15-222 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0538       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
| Ca. celiditis             | T-0193       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0332       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0002       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
| Ca. elaeagnicola          | T-0220       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0051       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0055       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0061       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0813       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-0815       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
|                           | T-1186       | MFLUCC 17-0967 = CBS 143107 | MFLU 16-1782 | Caragana frutex    | Russia  | MF434122               |
| Ca. eufemiana             | T1621        | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
| Ca. halimodendri          | T-0018       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
|                           | T-0041       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
|                           | T-0050       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
|                           | T-0066       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
|                           | T-0419       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
|                           | T-0468       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
| Ca. italicca              | IT1283       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
| Ca. laburni               | T-0003       | MFLUCC 17-0207 = CBS 143116 | MFLU 16-1822 | Cytisus sp.        | Italy   | MF434145               |
| Taxon | Original no. | Culture no. | Specimen no. | Host or substrate | Country | GenBank accession no. |
|-------|--------------|-------------|--------------|-------------------|---------|----------------------|
|       |              | MFLUCC 17-0704 = CBS 143122 | MFLU 15-2954 | Laburnum anagyroides | Russia | MF434155 MF434243 MF434331 MF434418 |
| Ca. mackenziei | T-0001 | MFLUCC 14-0883 = CBS 143123 | MFLU 14-0849 | Caragana arborescens | Russia | MF434159 MF434247 MF434335 MF434422 |
| Ca. melnikii | T-0318 | MFLUCC 17-0684 | MFLU 15-2022 | Caragana frutex | Russia | MF434162 MF434250 MF434338 MF434425 |
| Ca. mirabellensis | IT2139 | – | MFLU 17-228 | Robinia pseudoacacia | Russia | MF434163 MF434251 MF434339 MF434426 |
| Ca. moricola | T-0232 | – | MFLU 15-1936 | Morus alba | Russia | MF434164 MF434252 MF434340 MF434427 |
| Ca. premicurensis | IT1681 | MFLUCC 17-0208 = CBS 143127 | MFLU 16-0185 | Cytisus sp. | Italy | MF434176 MF434264 MF434352 MF434439 |
| Ca. robinicola | T-1303 | MFLUCC 17-0725 | MFLU 16-1770 | Morus alba | Russia | MF434175 MF434263 MF434351 MF434438 |
| Ca. schluzeri | T-0010 | MFLUCC 14-0892 = CBS 143128 | MFLU 17-0456 | Gleditsia triacanthos | Russia | MF434177 MF434265 MF434353 MF434440 |
| Ca. spartii | T-0371 | MFLUCC 17-0687 | MFLU 15-2075 | Morus alba | Russia | MF434169 MF434257 MF434345 MF434432 |
| Neocamarosporium korfi | CR006 | MFLUCC 17-0745 = CBS 143135 | MFLU 17-1436 | Bassia prostrata | Russia | MF434190 MF434278 MF434366 MF434453 |
| N. lamiacearum | T-0846 | MFLUCC 17-0560 = CBS 143136 | MFLU 15-2989 | Lamiaeae sp. | Russia | MF434191 MF434279 MF434367 MF434454 |
| N. salicornicola | CHAM025 | MFLUCC 17-0567 | MFLU 15-2999 | Salicornia sp. | Uzbekistan | MF434191 MF434282 MF434370 MF434456 |
**Type genus:** Camarosporium Schulzer.

**Notes:** To better resolve interfamilial/intergeneric level relationships and improve taxonomic issues within Pleosporineae, we validate Camarosporiaceae (Camarosporiaceae Looq. 1984 was not validly published, Art. 39.1) to accommodate Camarosporiaceae and Camarosporomyces. Wijayawardene et al. (2014b) also proposed Camarosporiaceae to accommodate *Camarosporium* s. *str.* but it was not formerly introduced.

**Camarosporium** Schulzer, Verh. K.K. Zool.-Bot. Ges. Wien 17: 717. 1870.

**Description and illustration:** Crous & Groenewald (2017).

**Type species:** Camarosporium quaternatum (Hazsl.) Schulzer.

**Notes:** *Camarosporium* morphologically resembles genera such as Camarosporium, Camarosporipis, Camarosporula, Dichomera, Didymellocamarosporium, Hazslinszkyomyces, Libertasomyces, Magnicamarosporium, Melanocamarosporium, Melnikia, Murlinenthecium, Neocamarosporium, Paracamarosporium, Phragmocamarosporium, Pseudocamarosporium, Psuedohendersonia, Suttonomyces and Xenocamarosporium in conidial shape and septation. However, these taxa are phylogenetically distinct and have subtle but specific morphological differences (Sutton 1980, Butin 1993, Crous et al. 2011, 2013, 2014b, 2015a, b, Wijayawardene et al. 2014a, 2014b, 2014c, 2015, 2016, Tanaka et al. 2015, Tian et al. 2015, Crous & Groenewald 2017).

*Camarosporium quaternatum* was introduced by Schulzer (1870) as the type species of *Camarosporium*. Schulzer (1870) did not provide any illustrations for *Camarosporium*.

### Notes

1. Type species: Camarosporium quaternatum (Hazsl.) Schulzer.

2. Synonym: Camarosporiaceae Looq., Mycol. gén. struct. (Paris): 210 (1984); nom. inval., Art. 39.1 (Melbourne).

Saprobic, endophytic, pathogenic on leaves and wood in terrestrial habitats. Asexual morph: Conidiomata dimorphic, pycnidial, subcorticolous, single to gregarious, partly caespitose, globose, ostiole central, terete, short papillate. Conidiomata wall few-layered, consisting of a texture globulosa-angulares with red brown, thick-walled, and smooth cells. Conidiogenous cells formed from the inner cells of the pycnidial wall, doliform, hyaline, thin-walled, annellidic. Conidia multicelled, muriformly septe, with one longitudinal or diagonal septum per cell and 1–2 per conidium, ellipsoidoid, pyroid, clavate, straight to slightly curved, yellowish not brown, basal cell often paler or hyaline, wall golden. Synasexual morph: conidiomata separate, pycnidial, immersed to superficial, brown, globose, with 1–2 papillate ostioles, exuding a crystalline conidial mass. Conidiophores reduced to conidiogenous cells. Conidiogenous cells lining the inner cavity, hyaline, smooth, ampulliform. Conidia solitary, hyaline, smooth, subcylindrical, straight, rarely curved, apex obtuse, base truncate. Sexual morph: Ascomata gregarious to solitary, immersed to erumpent, globose to subglobose, black, uniloculate, ostiolate. Ostiole black, papillate. Peridium with several cell layers of textura angularis, outer layer brown to reddish brown, inner layer hyaline to sub hyaline. Asci stipitate, cylindrical, bitunicate, 2–4–8-spored. Ascospores uniseriate, ellipsoidoid, medium brown, mostly with obtuse ends, muriform, 3–8 transverse septa, with 1–2 longitudinal septa, constricted at septa.

### References

Suttonomyces, *Camarosporiopsis*, *S. rhamnicola*.
quaternatum in his article and mentioned it is completely similar to Clinterium lycii, described in Hazslinszky (1865). The microfungal collections of F.A. Hazslinszky von Hazslin are preserved in the Hungarian Natural History Museum (BP), but the type of Cm. quaternatum has been lost. Therefore, in a recent study Crous & Groenewald (2017) designated the original illustrations as lectotypes, to facilitate epitypification.

**Camarosporomyces** Crous, IMA Fungus 8: 141. 2017.

**Description and illustration:** Crous & Groenewald (2017).

**Type species:** Camarosporomyces flavigenus (Constant. & Aa) Crous.

**Notes:** Camarosporomyces was introduced by Crous & Groenewald (2017) to accommodate Camarosporomyces flavigenus, a phoma-like fungus which was originally described as Phoma flavigina. In our molecular analyses, Camarosporomyces flavigenus is basal to other strains of Cladosporiaceae. The taxa studied here are treated below according to the phylogenetic clades (Subclades A1–A12, Fig. 1) as follows:

**Camarosporidiellaceae** Wanas., Wijayaw., Crous & K.D. Hyde, gen. nov. MycoBank MB821940; Facesoffungi number: FoF 03529.

**Etyymology:** Resembling the genus Camarosporium.

Saprobic or endophytic or pathogenic on leaves and wood in terrestrial habitats. **Asexual morph:** Conidiomata pycnidial, immersed to sub-peridomeral, globose, brown to black, unilocular. Conidiomata wall thick-walled, dark brown, composed of cells of **textura angularis**, inner layer with hyaline cells. Ostiole single, circular, centrally papillate. Macroconidiogenous cells entero-blastic, anellidic, integrated to discrete, doliform, lageniform or cylindrical, smooth, hyaline, formed from the inner cells of the pycnidial wall. Conidia medium brown to dark brown, phragmosporous to muriform, variable in shape, mostly ellipsoidal, curved to straight, truncate at the base, obtuse at apex, continuous or constricted at the septa. **Sexual morph:** Ascomata gregarious to solitary, immersed to erumpent, globose to subglobose, black, unilocular, ostiolate. Ostiole black, papillate. **Peridium** with several cell layers of **textura angularis**, with outer layer brown to reddish-brown, inner layer hyaline to sub hyaline. **Asci** stipitate, cylindrical, bitunicate, (2–4)–8-spored. Ascosporas uniseriate, ellipsoidal, medium brown, mostly with obtuse ends, muriform, 3–8 transverse septa, with 1–2 longitudinal septa, constricted at septa.

**Type genus:** Camarosporidiella Wanas., Wijayaw. & K.D. Hyde.

**Notes:** Camarosporidiellaceae forms a highly-supported monophyletic lineage (97 %/97 %/1.00; Fig. 1, clade A) but lacks internal support. Morphological features are not informative for generic distinction within Clade A. The taxa studied here are treated below according to the phylogenetic clades (Subclades A1–A12, Fig. 1) as follows:

Camarosporidiella Wanas., Wijayaw. & K.D. Hyde, gen. nov. MycoBank MB821940; Facesoffungi number: FoF 03529.

**Etyymology:** Referring to the name of the type genus.
Fig. 1. RAxML tree based on a combined dataset of LSU, SSU, tef1, and ITS partial sequences. Bootstrap support values for ML and MP equal to or greater than 60%, Bayesian posterior probabilities (PP) equal to or greater than 0.95 are defined as ML/MP/PP above the nodes. Species used for morphological observation in this study are indicated in bold. Families, where known, and selected genera are indicated with coloured blocks. The tree is rooted to Cyclothyriella rubronotata (CBS 141486 & CBS 121892). The new isolates are in blue. Asterisk marks origin of isolates from single ascospore. The ex-type strains are noted with superscripted T. The scale bar represents the expected number of nucleotide substitutions per site.
Fig. 1. (Continued).
Fig. 1. (Continued).
osiolate. Ostiole central, short. Peridium composed of blackish to dark brown cells of *textura angularis*, cells towards the inside lighter, composed of thin-walled cells of *textura angularis*. *Hamathecium* comprising numerous, branched septate, pseudoparaphyses. Asci 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate. Ascosporas overlapping uniseriate, muriform, mostly ellipsoidal, 3–8-transversely septate, with 2–4 vertical septa, constricted at middle septum, initially hyaline, becoming brown at maturity, slightly paler, conical and narrow at the ends, not surrounded by a mucilaginous sheath.

Type species: *Camarosporiella caraganicola* (Phukhams. et al.) Phukhams., Wanas. & K.D. Hyde.

*Camarosporiella caraganicola* (Phukhams. et al.) Phukhams., Wanas. & K.D. Hyde, comb. nov.: See Liu et al. (2015). Sexual morph: *Ascomata* 400–550 μm high, 450–500 μm diam (x = 436.2 × 457.8 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, rough or hairy, osiolate. Ostiole central, short, slightly sunken, minute, inconspicuous on surface, smooth, with osioral canal filled with hyaline cells. *Peridium* 60–80 μm wide at the base, 50–70 μm wide in sides, comprising 8–10 layers, with outer layer heavily pigmented, thick-walled, comprising blackish to dark brown cells of *textura angularis*, cells towards inside lighter, with inner layer composed 3–4 layers, hyaline, flattened, thin-walled cells of *textura angularis*. *Hamathecium* comprising numerous, 2.5–3 μm (n = 40) wide, filamentous, branched, septate, pseudoparaphyses. Asci 150–190 × 10–15 μm (x = 170.8 × 13.1 μm, n = 40), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, rounded at apex with a minute ocular chamber. Ascosporas 20–30 × 7–10 μm (x = 24.9 × 8.7 μm, n = 50), overlapping uniseriate, muriform, mostly ellipsoidal, 3–5-transversely septate, with 2–4 vertical septa, constricted at middle septum, initially hyaline, becoming brown at maturity, slightly paler, conical and narrow at the ends, not surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin white at first, greenish grey after 6 wk, reverse greenish grey, flat on the surface, without aerial mycelium.

Materials examined. Russia, Rostov region, Rostov-na-Don city, Botanical garden of Southern Federal University, Systematic Arboretum, on dead twigs of *Caragana frutex* (Fabaceae), 26 Apr. 2014, T.S. Bulgakov T-046 (MFLU 14-0794, holotype; ex-type culture MFLUCC 14-0605; Roslov region, Roslov-na-Don city, Botanical garden of Southern Federal University, 47°, 234635° N, 39°, 656986° E, 3 Mar. 2014, T.S. Bulgakov T-005 (MFLU 17-0453, paratype; ex-paratype culture MFLUCC 14-0807 = CBS 143105); Roslov region, Oktyabrsky district, natural monument, 47°, 5049392° N, 40°, 1539564° E, 26 Apr. 2014, T.S. Bulgakov T-013, MFLUCC 17-0459, living culture MFLUCC 14-0896 = CBS 143106; Roslov region, Krasnosulinsky district, Donskoye forestry, Kabanya Balta, 47°, 8643133° N, 40°, 2421045° E, 28 Jun. 2015, T.S. Bulgakov T-538, MFLUCC 15-2242, living culture MFLUCC 17-0697 = CBS 143107, ibid. 18 Feb. 2016, T.S. Bulgakov T-1488, MFLUCC 16-1782, living culture MFLUCC 17-0726 = CBS 143108.

Notes: *Camarosporiella caraganicola* (MFLUCC 14E-0605) is based on a strain derived from the asexual morph that was described by Liu et al. (2015). In this study, we have examined two specimens of the sexual morph of *Camarosporiella caraganicola* (T-005 and T-013). These two taxa were collected from the same host (*Caragana frutex*) in the Rostov Region, Russia. By considering the identical host and statistical support, we conclude that these two taxa represent the holomorph of *Camarosporiella caraganicola*. Also, we have observed another three specimens of the asexual morph of *C. caraganicola* (T-538 and T-1488). All strains of this species cluster together with significant statistical support of 95 % for ML, 98 % for MP and 1.00 for PP (Clade A7, Fig. 1).

Other accepted species

*Camarosporiella aborescentis* (Phukhams. et al.) Phukhams., Wanas. & K.D. Hyde, comb. nov.: See Liu et al. (2015) for illustrations. Sexual morph: *Ascomata* 350–450 μm high, 500–600 μm diam (x = 406.4 × 529.7 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, sometimes
scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, rough or hairy, ostiolate. Ostiole central, short, slightly sunken, minute, inconspicuous on surface, smooth, with ostiolar canal filled with hyaline cells. Peridium 15–25 μm wide at the base, 25–50 μm wide in sides, comprising 6–10 layers, with outer layer heavily pigmented, thick-walled, comprising blackish to dark brown cells of textura angularis, cells towards inside lighter, with inner layer composed of 3–4 layers, hyaline, flattened, thin-walled cells of textura angularis. Hamathecium comprising numerous, 2–3 μm (n = 40) wide, filamentous, branched, septate, pseudoparaphyses. Asci 170–210 × 15–18 μm (x = 186.2 × 16.1 μm, n = 40), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, rounded at apex with a minute ocular chamber. Ascospores 28–32 × 12–13 μm (x = 29.9 × 12.4 μm, n = 50), overlapping uniseriate, muriform, mostly ellipsoidal, 5–7-transversely septate, with 1–2 vertical septa, constricted at middle septum, initially hyaline, becoming brown at maturity, slightly paler, conical and narrow at the ends, not surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, greenish-grey after 6 wk, reverse greenish-grey, flat on the
surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Materials examined: Italy, Forlì-Cesena Province, near Predappio, on dead branches of *Colutea arborescens* (Fabaceae), 25 Oct. 2015, E. Camporesi IT2674, MFLU 15-3630, living culture MFLUCC 17-0660. Russia, Rostov region, Rostov-on-Don city, Botanical Garden of Southern Federal University, Systematic Arboretum, parkland, 47.2350724° N, 39.6541643° E, on *Colutea orientalis*, 30 May 2015, T.S. Bulgakov T-477, MFLU 15-2181; on *Amorpha* sp., 14 Jun. 2016, T.S. Bulgakov NK076, MFLU 16-2387, living culture MFLUCC 17-0738.

Notes: *Camarosporidiella aborescentis* is morphologically similar to *Camarosporium feurichii* in having black conidiomata and brown, smooth-walled, oblong, 3-transversely septate conidia and usually with one longitudinal septum (Liu et al. 2015). In this study, we add another three strains to *Camarosporidiella aborescentis* from Italy and Russia. Altogether strains of this taxon cluster together with high statistical support of 98 % for ML, 94 % for MP and 1.00 for PP (Clade A9, Fig. 1).

*Camarosporidiella arezzoensis* (Tibpromma et al.) Wan. & K.D. Hyde, comb. nov. MycoBank MB821943; Facesoffungi number: FoF 03532. Fig. 6.

Basionym: *Camarosporium arezzoensis* Tibpromma et al., Saudi Journal of Biological Sciences 23: 2. 2016.

Saprobic or weakly necrotrophic on dead twigs and branches of *Amorpha fruticosa*. Asexual morph: Conidiomata pycnidial, 300–400 μm high, 300–350 μm diam (x = 347.9 × 324.5 μm, n = 10), solitary or gregarious, black, immersed, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, unilocular, with a papillate ostiolate. Ostiole 60–100 μm long, 100–150 μm diam (x = 82.2 × 115.4 μm, n = 6), central, long, smooth, ostiolar canal filled with hyaline or pale brown cells. Pycnidial wall multi-layered, 25–45 μm wide at the base, 25–35 μm wide in sides, thick, comprising 5–6 layers, outer layer heavily pigmented, thick-walled, comprising blackish or dark reddish-brown cells of *textura angularis*, cells towards the inside lighter, inner layer composed of 1–2 layers, hyaline, thin-walled cells of *textura angularis*. Conidiophores reduced to conidiogenous cells. Macroconidiogenous cells enteroblastic, annellidic, doliiform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. *Macroconidia* 20–28 × 6–9 μm (x = 24 × 7.8 μm; n = 40), cylindrical, straight to slightly curved, rounded at both ends, 4–7-transverse septate, with 1–2-longitudinal septa, muriform, smooth, brown to blackish-brown. *Microconidiogenous cells* intermingled with macroconidiogenous cells, hyaline, discrete, enteroblastic with percurrent annellidic, ampulliform to subcylindrical. *Microconidia* 5–7.5 × 3.5–4.5 μm (x = 6.3 × 4 μm; n = 25), hyaline, round to...
Fig. 4. Sexual morph of Camarosporidella caraganicola (MFLU 17-0453). A. Appearance of ascomata on host substrate. B. Section of ascoma. C. Close-up of ostiole. D. Pseudoparaphyses. E–H. Asci. I–M. Ascospores. Scale bars: A = 500 μm; B = 100 μm; C = 50 μm; D, I–M = 10 μm; E–H = 20 μm.
Fig. 5. Sexual morph of Camarosporidella aborescentis (MFLU 15-3630). A. Appearance of ascomata on host substrate. B. Section of ascoma. C. Peridium. D. Pseudo-paraphyses. E–H. Asci. I–N. Ascospores. Scale bars: B = 100 μm; C, D = 10 μm; E–H = 20 μm; I–N = 10 μm.
Fig. 6. Asexual morph of Camarosporidella arezzoensis (MFLU 17-0455). A. Conidiomata on host surface. B. Vertical section through conidioma. C. Microconidia. D–G. Conidiogenous cells and developing conidia. H–M. Macroconidia. Scale bars: A = 500 µm; B = 100 µm; C = 10 µm; D–M = 5 µm.
oblong or ellipsoidal, with a few small guttules. **Sexual morph:** See Tibpromma et al. (2015).

**Colonies on PDA:** Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, dirty white, reverse creamy grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Materials examined: **Russia,** Rostov Region, Rostov-on-Don city, Botanical garden of Southern Federal University, Lower Park, 47,2313935° N, 39,6602583° E, on *Amorpha fruticosa* (Fabaceae), 14 Apr. 2013, T.S. Bulgakov T-009 (MFLU 17-0455, living culture MFLUC 14-0891); Azov district, Delta of Don river, sand dunes near Polushkin village, 47,1981111° N, 39,4148684° E, on *Cytisus austriacus* (Fabaceae), 8 May 2014, T.S. Bulgakov T-072, MFLU 17-0478, living culture MFLUC 14-0916 = CBS 143103; Rostov-on-Don city, Botanical garden of Southern Federal University, Systematic Arboretum, 47,2360559° N, 39,6555951° E, on *Cytisus australis* (Fabaceae), 5 Mar. 2014, T.S. Bulgakov T-016, MFLU 17-0462, living culture MFLUC 14-0899 = CBS 143102.

**Notes:** *Camarosporidium arenzoensis* was reported as a sexual morph and is similar to *Cucurbitaria* species in having long cylindrical asci and narrowly fusiform, muriform ascospores, being 5–7-transversely septate, with 4–6 vertical septa (Tibpromma et al. 2015). An asexual morph was undetermined. In this study, we introduce the asexual morph of *Ca. arenzoensis* with four new collections from Russia on *Amorpha fruticosa* and *Cytisus australis*. Strains of *Camarosporidium arenzoensis* cluster together with 60 % for ML, 67 % for MP and 0.96 for PP support (Clade A8, Fig. 1). *Camarosporium amorphae* (= *Cucurbitaria amorphae*) and *Cm. amorphica* are also found on *Amorpha fruticosa* in Canada and Central Asia (Farr & Rossman 2017), but *Cm. amorphae* (20–24 × 9 μm, 4–5 transverse septa) has fewer transverse septa (*Saccardo 1883*) compared to the asexual morph of *Camarosporidium arenzoensis* (20–28 × 6–9 μm, 4–7 transverse septa). Records are lacking for comparison of *Camarosporium amorphica* with our new taxon. Our collection differs from known other members in *Camarosporidium* in having cylindrical conidia.

**Camarosporidium celtidis** (Shear) Thambug., Wanas. & K.D. Hyde, **comb. nov.** MycoBank MB821945;Facesoffungi number: FoF 03533. Figs 7, 8.

**Basionym:** *Cucurbitaria celtidis* Shear, Bull. Torrey bot. Club 29: 451. 1902.

**Synonym:** *Camarosporium uniseriatum* Thambug. et al., Stud. Fung. 1: 94. 2016.

**Notes:** *Cucurbitaria celtidis* was introduced by Shear (1902) from Celtis occidentalis. Thambugala et al. (2016) placed this species in the genus *Camarosporium* based on DNA sequence data from a fresh collection and introduced *Cm. uniseriatum*. However, in the present study, we accommodate *Cucurbitaria* in the new genus *Camarosporidium* and the asexual morph of the species is described and illustrated (Fig. 7). Nine new isolates cluster in the *Ca. celtidis* clade (Subclade A5, Fig. 1), and they are differing from known other members in *Camarosporidium* in having conidia without longitudinal septa. However, this clade is only moderately supported ≤ 60 % ML & 77 % MP and < 0.95 PP.

**Camarosporidium lepadis** (Wijayaw. et al.) Wijayaw., Wanas. & K.D. Hyde, **comb. nov.** MycoBank MB821946; Facesoffungi number: FoF 03534.

**Basionym:** *Camarosporium lepadis* Wijayaw. et al., Phytotaxa 183: 19. 2014.
Illustrations: See Wijayawardene et al. (2014a).

Notes: Wijayawardene et al. (2014a) introduced this species from Clematis vitalba in Italy. The sexual morph has not been reported. In this study Camarosporidiella clematidis groups with Ca. laburnicola (Tibpromma et al. 2017), which was reported as the sexual morph. This subclade (Subclade A3, Fig. 1) is not supported and therefore the lifecycle link between these two taxa is ambiguous.

Camarosporidiella elaeagnicola Wanas., Bulgakov & K.D. Hyde sp. nov. MycoBank MB821947; Facesoffungi number: FoF 03535. Fig. 9.

Etymology: Named after the host genus from which it was collected, Elaeagnus.

Necrotrophic on dying branches of Elaeagnus angustifolia. Asexual morph: Conidiomata pycnidial, 300–500 μm high, 300–550 μm diam (\( \bar{x} = 384.2 \times 410.8 \mu m; n = 10 \)), solitary or gregarious, black, immersed, uni- to multi-locular, with a papillate ostiole. Pycnidial wall multi-layered, 15–20 μm wide at the base, 30–40 μm wide in sides, comprising 5–8 layers, with heavily pigmented outer layer, thick-walled, comprising blackish to dark brown cells of textura angularis, with lighter cells towards the inside, with inner layer composed of 2–4 layers, hyaline, thin-walled cells of textura angularis. Macroconidiophores reduced to conidiogenous cells. Macroconidiogenous cells enteroblastic with percurrent annellations, doliform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. Macroconidia 18–25 × 9–13 μm (\( \bar{x} = 19.5 \times 10.8 \mu m; n = 30 \)), oblong, straight to slightly curved, rounded at both ends, 2–3-transversely septate, with one longitudinal septum.
muriform, smooth, pale to dark brown. Microconidiogenous cells intermingled with macroconidiogenous cells, hyaline, discrete, enteroblastic with percurrently annellidic, ampulliform to sub-cylindrical. Microconidia 5–6.5 × 3.5–4.5 μm (x = 5.9 × 4.1 μm; n = 25), hyaline, round to oblong or ellipsoidal, with a few small guttules. Sexual morph: Undetermined.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, white at the centre, greenish grey towards margin, reverse greenish-grey, flat on the surface, without aerial mycelium.

Materials examined. Russia, Rostov Region, Oktyabsky District, Shakhty city, near Grushevsky pond, shelterbelt artificial forest, 47.7250642° N, 40.2564812° E, on Elaeagnus angustifolia (Elaeagnaceae), 18 May 2014, T.S. Bulgakov T-051 (MFLU 17-0470, holotype, ex-type culture MFLUCC 14-0908 = CBS 143113); Rostov-on-Don city, Botanical garden of Southern Federal University, Higher Park, 47.2360559° N, 39.655591° N, on Elaeagnus angustifolia, 26 Mar. 2014, T.S. Bulgakov T-055, MFLU 17-0473, living culture MFLUCC 14-0911 = CBS 143114; Azov district, Delta of Don river, riverside bushes of channel near Obukhovka village, 47.60741° N, 39.4727690° E, on Elaeagnus angustifolia, 8 May 2014, T.S. Bulgakov T-061, MFLU 17-0474, living culture MFLUCC 14-0912 = CBS 143115; Rostov region, Shakhty city, 20th anniversary of Red Army microdistrict, Balka Solenaya, 47.708985° N, 40.2537786° E, on Elaeagnus angustifolia, 1 May 2015, T.S. Bulgakov T-220, MFLU 15-1924; Krasnosulinsky district, Donskoye forestry, Kabanya Balka, 47.5672211° N, 40.227426° E, on Elaeagnus angustifolia, 18 Jun. 2015, T.S. Bulgakov T-511, MFLU 15-2215; Rostov-on-Don city, Botanical Garden of Southern Federal University, Systematic Arboretum, parkland (47.2350724° N, 39.6541843° E), on Elaeagnus angustifolia, 28 May 2015, T.S. Bulgakov T-813, MFLU 15-2956, living culture MFLUCC 17-0705, ibid. 30 May 2015 T-819, MFLU 15-2962, living culture MFLUCC 17-0707, ibid. 18 Feb. 2016 T-1186, MFLU 16-

Fig. 8. Asexual morph of Camarosporidiella celtidis (MFLU 17-0466). A. Conidiomata on host surface. B. Vertical section through conidioma. C. Conidiomata wall. D, E. Conidiogenous cells producing conidia. F–H. Conidia. Scale bars: A = 500 μm; B = 100 μm; C = 20 μm; D–H = 10 μm.
Notes: In our phylogenetic analyses, 11 strains of Camarosporidiella elaeagnicola cluster together with 80 % ML and 84 % MP support (Subclade A6, Fig. 1). Ten of these isolations were collected on Elaeagnus angustifolia from Russia and one from Elaeagnus rhamnoides in Germany. Camarosporium elaeagnellum and Cm. elaeagni have also been found on Elaeagnus angustifolia from California, Canada and Ukraine (Farr & Rossman 2017). The relationship between these Camarosporium spp. with Camarosporidiella elaeagnicola cannot be investigated due to lack of morphological and molecular data for Camarosporium elaeagnellum and Cm. elaeagni. Thus, we introduce Camarosporidiella elaeagnicola as a new species.
Camarosporidiella elongata (Fr.) Wanas., Wijayaw. & K.D. Hyde, comb. nov. MycoBank MB821948;Facesoffungi number: FoF 03536. 

Basionym: Sphaeria elongata Fr., Observationes mycologicae 1: 175. 1815. 

Synonyms: Cucurbitaria elongata (Fr.) Grev., Scott. crypt. fl.: pl. 195. 1826. 

Gibberidea elongata (Fr.) Kunte, Revisio generum plantarum 3: 481. 1898. 

Note: See Mirza (1968) for further details on Camarosporidiella elongata (= Cucurbitaria elongata).

Camarosporidiella eufemiana Wanas., Camporesi & K.D. Hyde, sp. nov. MycoBank MB821949; Facesoffungi number: FoF 03537. Fig. 10.

Etymology: eufemiana, due to its occurrence in Santa Eufemia, Italy.

Saprobic on dead branches of Cytisus sp. Asexual morph: Undetermined. Sexual morph: Ascomata 350–400 μm high, 450–550 μm diam (x = 376.8 × 496.4 μm, n = 10), black, semi-erumpent to superficial, solitary or gregarious, globose, ostiolate. Ostiole short papillate central, slightly sunken, minute and inconspicuous at the surface, smooth, with ostioral canal filled with hyaline to brown cells. Peridium 40–50 μm wide at the base, 40–70 μm wide in sides, thick, comprising 6–8 layers, with heavily pigmented outer layer, thick-walled, comprising blackish to dark brown elongated cells of textura angularis, cells towards the inside lighter, with inner layer composed 2–3 layers, hyaline, flattened, thin-walled cells of textura angularis. Hamathecium comprising numerous, 2.5–3.5 μm (n = 30) wide, filamentous, branched, septate, pseudoparasaphyses. Asci 130–150 × 14–15 μm (x = 142.4 × 14.5 μm, n = 20), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, rounded at apex with a minute ocular chamber. Ascospores 20–25 × 10–12 μm (x = 21.9 × 10.3 μm, n = 30), overlapping uniseriate or sometimes biseriate, muriform, mostly ellipsoid, 3–5-transversely septate, with one longitudinal septum, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming brown at maturity, asymmetrical, upper part wider than lower part, conical and narrowly rounded at the ends, not surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 3 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin creamy to pale brown centre and dirty white towards the margin after 6 wk, reverse iron, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Material examined: Italy, Forlī-Cesena [FC], Premilcuore, Santa Eufemia, on dead aerial branches of Cytisus sp. (Fabaceae), 3 Jan. 2014, E. Camporesi ITI621 (MFLU 16-0182, holotype, ex-type culture MFLUCC 17-0207 = CBS 143116).

Notes: Camarosporidiella eufemiana morphologically resembles other sexual members in this genus having similar asci and ascospore shapes. In the phylogenetic analyses, Ca. eufemiana groups as a sister taxon to Ca. elongata but with no statistical support (Subclade A4, Fig. 1). However, Ca. eufemiana is different from Ca. elongata in having longer asci (140–225 μm, Mirza 1968) with a long pedicle, while Ca. eufemiana has comparatively shorter asci (130–150 μm) with a short pedicle. Camarosporidiella laburni (= Cucurbitaria laburni) and Cucurbitaria spartii are also reported from Cytisus sp. (Mirza 1968). Camarosporidiella laburni (Subclade A3, Fig. 1) is phylogenetically distinct from Ca. eufemiana in this study. There is no molecular data available for Cucurbitaria spartii and its relationship to Camarosporidiella eufemiana cannot be resolved. However, Ca. eufemiana has shorter asci (130–150 μm) than Cucurbitaria spartii (150–240 μm, Mirza 1968).

Camarosporidiella halimodendri Wanas., Bulgakov & K.D. Hyde, sp. nov. MycoBank MB821950; Facesoffungi number: FoF 03538. Fig. 11.

Etymology: Named after the host genus from which it was collected, Halimodendron.

Saprobic or weakly pathogenic on dead branches of Halimodendron halodendron. Asexual morph: Conidiomata pycnidal, 500–600 μm diam (x = 480.4 × 496.7 μm, n = 10), solitary or gregarious, black, immersed, sometimes scattered beneath the host periderm or on decorcicated wood, fully or partly erumpent, unicellular, with a papillate ostiolate. Ostiole 100–200 μm long, 80–120 μm diam (x = 169.2 × 93.4 μm, n = 6), central, long, smooth, sometimes ostioral canal filled with hyaline or pale brown cells. Pycnidial wall multi-layered, 25–35 μm wide at the base, 35–45 μm wide in sides, thick, comprising 5–6 layers, outer layer heavily pigmented, thick-walled, comprising blackish to dark reddish-brown cells of textura angularis, cells towards the inside lighter, inner layer composed of 1–2 layers, hyaline, thin-walled cells of textura angularis. Conidiophores reduced to conidiogenous cells. Macroconidiogenous cells enteroblastic, anellidic, doliiform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. Macroconidia 16–25 × 8–12 μm (x = 21.5 × 10.7 μm; n = 40), oblong, straight to slightly curved, rounded at both ends, sometimes narrowly rounded ends, 4–6-transverse septate, with 1–2 longitudinal septa, with 2–4 oblique septa, muriform, smooth-walled, brown to dark brown. Microconidiogenous cells intermingled with macroconidiogenous cells, hyaline, discrete, enteroblastic with percurrent annellidic, ampulliform to subcylinndric. Microconidia 4.5–7.5 × 3.5–4.5 μm (x = 6.5 × 3.9 μm; n = 25), hyaline, round to oblong or ellipsoid, with a few small guttules. Sexual morph: Undetermined.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, white, reverse cream-grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Materials examined: Russia, Rostov Region, Rostov-on-Don city, Botanical garden of Southern Federal University, Systematic Arboretum, 47,2360559° N, 39,655591° E; on dying twigs and shrubs Halimodendron halodendron (Fabaceae), 8 May 2013, T.S. Bulgakov T-018 (MFLU 17-0463, ex-paratype culture, MFLUCC 14-0905); Rostov Region, Shakhly city, near Grushinovsky pond, stony steppe, 47.7237362° N, 39,2551937° E; on dead twigs of Caragana frutex (Fabaceae), 18 May 2014, T.S. Bulgakov T-050, MFLU 17-0469, living culture MFLUCC 14-0907 = CBS 143118.
Notes: Camarosporium halimi (12–16 × 9–13 μm, 2–3 transverse septa) has also been found on Halimodendron halodendron from Iran (Farr & Rossman 2017), but it has smaller conidia with fewer transverse septa (Saccardo 1906) compared to Camarosporidiella halimodendri (8–25 × 8–12 μm, 4–6 transverse septa). In this study, we refer six strains to Ca. halimodendri (Subclade A11, Fig. 1), which group together with 81 % ML, 74 % MP, 0.98 PP statistical support and share similar morphologies.

Camarosporidiella eufemiana Wanas., Camporesi & K.D. Hyde, sp. nov. MycoBank MB821951; Facesoffungi number: FoF 03539. Fig. 10.

Etymology: italica, due to its occurrence in Italy.

Saprobic on dead branches of Coronilla emerus. Asexual morph: Undetermined. Sexual morph: Ascomata 400–450 μm high, 550–600 μm diam (x = 436.2 × 457.8 μm, n = 10), black, immersed to semi-erumpent, solitary or gregarious, globose, with an ostiole comprising greenish grey setae. Ostiole 60–90 μm long, 30–45 μm diam (x = 76.2 × 36.4 μm, n = 6) central, short, slightly sunken, minute and inconspicuous on the surface, smooth, ostiolar canal filled with hyaline to brown cells. Peridium 20–30 μm wide at the base, 40–50 μm wide in sides, thick, comprising 5–8 layers, outer layer heavily pigmented, thick-
Fig. 11. Camarosporidiella halimodendri (MFLU 17-0463, holotype). A. Conidiomata on host surface. B. Vertical section through conidioma. C, D. Microconidia. E, F. Conidiogenous cells. G–L. Macroconidia. Scale bars: A = 500 μm; B = 100 μm; C = 50 μm; D–F = 10 μm; G = 20 μm; H–L = 10 μm.
walled, comprising blackish to dark brown elongated cells of textura angularis, cells towards the inside lighter, inner layer composed of 2–3 layers, hyaline, flattened, thin-walled cells of textura angularis. Hamathecium comprising numerous, 3.5–4.5 μm (n = 40) wide, filamentous, branched, septate, pseudoparaphyses. Asci 150–180 × 15–20 μm (Χ = 164.7 × 18.4 μm, n = 30), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, apex rounded with a minute ocular chamber. Ascospores 30–35 × 12–14 μm (Χ = 32.9 × 12.8 μm, n = 50), overlapping uniseriate or sometimes overlapping biseriate, mummiform, mostly ellipsoidal, 6–8-transversely septate, with 2–3 longitudinal septa, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming brown at maturity, asymmetrical, upper part wider than lower part, slightly paler ends, conical and narrowly rounded at the ends, not surrounded by a mucilaginous sheath.

**Colonies on PDA:** Slow growing, reaching 3 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin greenish grey after 6 wk, reverse greenish grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin.

**Material examined:** Italy, Forti-Cesena [FC], Bagno di Romagna, Valgianna, on dead aerial twigs of Coronilla emerus (Fabaceae), 19 May 2013, E. Camporesi IT1283 (MFLU 16-0139, holotype, ex-type culture MFLUCC 13-0547).

**Notes:** Cucurbitaria coronillae, Cu. elongata and Cu. emeri are also recorded on Coronilla emerus (Munk 1957, Mirza 1968). These three species morphologically resemble Camarosporidiella italica with respect to their ascomata, peridium, ascus and ascospore characters. Cucurbitaria emerus is different from Ca. italica in having diplodia-like uniseriate conidia. Cucurbitaria coronillae differs from Ca. italica in having much longer ascospores (>30 μm) with 2–3 longitudinal septa while Cu. coronillae has comparatively shorter ascospores (<27 μm) with one longitudinal septum. Cucurbitaria elongata differs from Ca. italica in having a prominently thicker peridium (100–180 μm) while Ca. italica has a peridium up to 50 μm wide.

**Camarosporidiella laburni** (Pers.) Wanas., Bulgakov, Camporesi & K.D. Hyde comb. nov. MycoBank MB821952; Faceoffungi number: FoF 03540. Figs 13, 14.

Synonym: Sphaeria laburni Pers., Observ. mycol. 1: 68. 1796.

**Gilberea laburni** (Pers.) Kuntze, Revisio generum plantarum 3: 481. 1898.

**Camarosporium laburni** Sacc. & Roum., Michelia 2: 630. 1882.

Saprobic on woody branches. Asexual morph: Conidiomata pycnidial, 300–350 μm high, 300–400 μm diam (Χ = 338.2 × 326.1 μm, n = 10), solitary to gregarious, black, immersed, unilocular, with an appallate ostiole. Pycnidial wall multi-layered, 20–30 μm wide at the base, 40–50 μm wide in sides, thick, comprising 4–7 layers, outer layer heavily pigmented, thick-walled, comprising blackish to dark brown cells of textura angularis, cells towards the inside lighter, inner layer composed of 2–3 layers, hyaline, thin-walled cells of textura angularis. Conidiophores reduced to conidiogenous cells. Conidiogenous cells enteroblastic, anellidic, doliform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. Conidia 20–30 × 8–11 μm (Χ = 26.1 × 9.7 μm; n = 30), oblong, straight to slightly curved, rounded at both ends, 4–5-transversely septate, with 1–2 longitudinal septa, mummiform, smooth-walled, initially hyaline, becoming blackish brown at maturity. Sexual morph: Ascomata 400–550 μm high, 500–600 μm diam (Χ = 462.4 × 559.9 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, uniloculate, with an ostiole. Ostiole central, short, slightly sunken, minute and inconspicuous at the surface, smooth, ostoliar canal filled with hyaline cells. Peridium 40–60 μm wide at the base, 90–120 μm wide in sides, thick, comprising 10–12 layers, outermost layer heavily pigmented, thin-walled, comprising blackish to dark brown amorphous layer, middle layer heavily pigmented, thick-walled, comprising blackish to dark brown loosely packed cells of textura angularis, inner layer composed of 3–4 layers, reddish brown to hyaline, cells towards the inside lighter, flattened, thick-walled cells of textura angularis. Hamathecium comprising numerous, 2.5–3 μm (n = 40) wide, filamentous, branched septate, pseudoparaphyses. Asci 160–190 × 12–16 μm (Χ = 176.3 × 14.8 μm, n = 40), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, apex rounded with a minute ocular chamber. Ascospores 27–32 × 10–12 μm (Χ = 30.4 × 11.1 μm, n = 50), overlapping uniseriate, mummiform, mostly ellipsoidal, 6–7-transversely septate, with 1–2 longitudinal septa, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming pale brown at maturity, asymmetrical, slightly paler ends, conical and narrowly rounded at the ends, not surrounded by a mucilaginous sheath.

**Colonies on PDA:** Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, greenish grey after 6 wk, reverse greenish grey, flat on the surface, without aerial mycelium.

**Materials examined:** Italy, Forti-Cesena, Fiumicello di Premilcuore, on dead aerial branches of Laburnum anagyroides, 1 Jan. 2012, E. Camporesi, IT83, MFLU 16-0094, living culture MFLUCC 14-0885; Rostov, Rostov-on-Don city, Botanical garden of Southern Federal University, Systematic Arboretum, 47.235073° N, 39.655591° E on dead twigs of Laburnum anagyroides (Fabaceae), 5 Mar. 2014, T.S. Bulgakov T-003, MFLU 17-0451, living culture MFLUCC 14-0885; Rostov-on-Don city, Botanical Garden of Southern Federal University, Systematic Arboretum, 47.235073° N, 39.654168° E, on Laburnum anagyroides, 30 May 2015, T.S. Bulgakov T-811, MFLU 15-2954, living culture MFLUCC 17-0704 = CBS 143122; on Laburnum sp., 28 May 2015, T.S. Bulgakov T-838, MFLU 15-2981, living culture MFLUCC 17-0709; Republic of Crimea, Feodosia city Municipality, Tepe-Oba ridge, artificial forest, 44.010872° N, 35.3841327° E, on dead branches of Laburnum anagyroides, 23 Jun. 2016, T.S. Bulgakov CR029 (MFLU 17-1434, living culture MFLUCC 17-0751 = CBS 143120) ibid. CR032 (MFLU 17-1435, living culture MFLUCC 17-0752).

**Notes:** Camarosporidiella laburni (= Cucurbitaria laburni) was introduced by De Notaris (1862) for a collection from Italy. Our collection is also from Italy, which fits with the original description of *Cm. laburni* (De Notaris 1862) and the description of *Mirza* (1968). A comprehensive comparison of *Cm. laburni* with other species is given by Green (1931) and Mirza (1968), which is clearly different from the remaining described species in *Cucurbitaria*. By considering the continent, host and morphological evidence, we introduce DNA-based molecular data for *Cm. laburni* as *Ca. laburni*. Furthermore, in this study the strains (MFLUCC 14-0885, 17-0704, 17-0752, 17-0709, 17-0751, from conidia) cluster together with *C. laburni* (Subclade A3, Fig. 1) and we consider them belong to this species as the asexual
Camarosporidiella clematidis clusters in a subclade sister to Ca. laburni, but morphologically differs from Ca. laburni in having smaller conidia (10–17 × 7–9 μm) while Ca. laburni has comparatively larger conidia (20–30 × 8–11 μm).

Camarosporidiella laburnicola (R.H. Perera et al.) Wanas. & K.D. Hyde, comb. nov. MycoBank MB821953; Facesoffungi number: FoF 03541.
Basionym: Camarosporium laburnicola R.H. Perera et al., Fungal Diversity 83: 97. 2017.

Illustrations: See Tibpromma et al. (2017).

Notes: Camarosporidiella laburnica (Subclade A3, Fig. 1) was isolated from Laburnum anagyroides and is morphologically similar to Ca. arezzoensis, Ca. elongatum and Ca. uniseriatum. However, Ca. laburnica differs from these taxa in having smaller asci and ascospores with different numbers of longitudinal and transverse septa (Tibpromma et al. 2017). Camarosporidiella laburnica is nested in between Ca. laburni and Ca. clematidis, but this relationship is not supported (> 60 ML & MP and > 0.95 PP, Clade A3, Fig. 1). Camarosporidiella laburnica is morphologically similar to Ca. laburni in ascomata, asci and ascospore characters. However, Camarosporidiella laburni...
differs from *Ca. laburnicola* in having much larger asci (160–190 × 12–16 μm) and ascospores (27–32 × 10–12 μm) while *Ca. laburnicola* has comparatively smaller asci (125–150 × 9–11 μm) and ascospores (15–21 × 6–8 μm).

*Camarosporidiella mackenziei* Wanas., Bulgakov & K.D. Hyde \*sp. nov.\* MycoBank MB821954; Facesoffungi number: FoF 03542. Fig. 15.

**Etymology:** In honour of Dr. Eric Hugh Charles Mckenzie for his immense contribution to mycology.

*Necrotrophic* on dying branches of *Caragana arborescens*. 

**Asexual morph:** Conidiomata pycnidial, 450–550 μm high, 500–600 μm diam \((\bar{x} = 408.4 \times 569.5 \, \mu m; \, n = 10)\), solitary or gregarious, black, immersed to semi-erumpent, unilocular, with a papillate ostiolate. Ostiole 120–160 μm long, 80–90 μm diam \((\bar{x} = 140.1 \times 66.7 \, \mu m; \, n = 10)\), central, long, smooth, sometimes ostiolar canal filled with hyaline or pale brown cells. *Pycnidal wall* multi-layered, 40–50 μm wide at the base, 40–55 μm wide in sides, thick, comprising 4–6 layers, outer layer heavily pigmented, thick-walled, comprising blackish to dark reddish-brown cells of *textura angularis*, cells towards the inside lighter, inner layer composed of 1–2 layers, hyaline, thin-walled cells of *textura angularis*. Conidiophores reduced to conidiogenous cells. *Macroconidiogenous cells* enteroblastic, annellidic, doliform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. *Macroconidia* 17–25 × 9–13 μm \((\bar{x} = 19.6 \times 11.1 \, \mu m; \, n = 50)\), oblong, straight to slightly curved, rounded at both ends, sometimes narrowly rounded ends, 3–4-transversely septate, with 1–2 longitudinal septa, muriform, smooth-walled, brown to dark brown. *Microconidiogenous cells* intermingled with macroconidiogenous cells, hyaline, integrated, enteroblastic with percurrent annellidic, ampulliform to
subcylindrical. Microconidia 6.5–8 × 4–6 μm (X = 7.6 × 4.5 μm; n = 20), hyaline, round to oblong or ellipsoidal, with small guttules. Sexual morph: Undetermined.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, greenish grey, reverse greenish grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Materials examined: Russia, Rostov Region, Oktyabrsky district, natural sanctuary (Persianovskaya preserved steppe), shelterbelt artificial forest, 47,5036056° N, 40,1545572° E, on dying twigs and shrubs of Caragana arborescens (Fabaceae), 26 Apr. 2014, T.S. Bulgakov T-001 (MFLU 17-0449, holotype, ex-type culture, MFLUCC 14-0883 = CBS 143123); ibid. T-011 (MFLU 17-0457, paratype, ex-paratype culture, MFLUCC 14-0893 = CBS 143124). ibid. 47,2350724° N, 39,6541643° E, 28 May 2015, T-810, MFLU 15-2953, paratype, ex-paratype living culture MFLUCC 17-0703.

Notes: Camarosporidiella caraganica has also been collected from Caragana spp. and resembles Ca. mackenziei in conidial dimensions (13–26 × 6–13 μm; Liu et al. 2015) and shape. However, they are phylogenetically apart (Subclades A7 and A12 respectively, Fig. 1).

The affiliation of Ca. mackenziei with Camarosporidiella sp. (CPC 25960, CPC 25962) cannot be compared as no details are available for these isolations (Subclade A12, Fig. 1). All the three strains of C. mackenziei in Subclade A12 (Fig. 1) are from the same locality and host. There are slight differences in their DNA sequence data and there could be a probability that they constitute a species complex. Perhaps more collections from different regions/hosts can further clarify their taxonomy in future studies. We reiterate, however, that morphologically they are similar and hence we consider them as one species.
Camarosporidiella melnikii Wanas., Bulgakov & K.D. Hyde, sp. nov. MycoBank MB821955; Facesoffungi number: FoF 03543. Fig. 16.

Etymology: In honour of Vadim Alexandrovich Mel’nik (March 16, 1937 – April 10, 2017) for his immense contribution to mycology.

Necrotrophic on dying branches of Caragana frutex. Asexual morph: Conidiomata pycnidial, 350–550 μm high, 300–500 μm diam (μ = 457.7 × 393.1 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, ostiolate. Ostiole central, short, slightly sunken, minute, inconspicuous on surface, smooth, with ostiolar canal filled with hyaline cells. Ostiole 120–180 × 100 μm long, 70–90 μm diam (μ = 150.1 × 82.7 μm, n = 10), central, long, smooth, sometimes ostiolar canal filled with hyaline or pale brown cells. Pycnidial wall multi-layered, 40–50 μm wide at the base, 40–75 μm wide in sides, thick, comprising 4–8 layers, outer layer heavily pigmented, thick-walled, comprising blackish to dark reddish-brown cells of textura angularis, cells towards the inside lighter, inner layer composed of 2–4 layers, hyaline, thin-walled cells of textura angularis. Conidiophores reduced to conidiogenous cells. Macroconidiogenous cells enteroblastic, annelidic, doliform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. Macroconidia 11–16 × 5–6 μm (μ = 13.3 × 5.5 μm; n = 50), oblong, straight, rounded at both ends, sometimes narrowly rounded ends, 2–3-transversely septate, without longitudinal septa, smooth-walled, initially hyaline, becoming brown to dark brown at maturity. Microconidiogenous cells intermingled with macroconidiogenous cells, hyaline, integrated, enteroblastic with persistent annelidic, ampulliform to subcylindrical. Microconidia 7–12 × 4–7 μm (μ = 9.6 × μm; n = 20), hyaline, round to oblong or ellipsoidal, with small guttules. Sexual morph: Undetermined.

Colony on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin dirty white after 6 wk, reverse creamy, flat on the surface, without aerial mycelium.

Material examined: Russia, Rostov region, Shakhty city, Cotton Fabric urban microdistrict, Grushevka steppe slopes near Grushevsky Pond, 47, 723148° N, 40, 255065° E, on dead aerial branches of Caragana frutex (Fabaceae), 12 May 2015, T.S. Bulagkov T-318, MFLU 15-2022, holotype, ex-type living culture MFLUCC 17-0684.

Notes: Camarosporidiella melnikii is an independent taxon (sister to Ca. caraganaicola isolates) and segregates from others with high statistical support (Subclade A7, Fig. 1). Ca. melnikii has smaller conidia (11–16 × 5–6 μm) without longitudinal septa, while Camarosporidiella caraganaica has comparatively larger conidia (13–26 × 6–13 μm; Liu et al. 2015) with longitudinal septa. Camarosporidiella melnikii also resembles Ca. celtidis in having 2–3-transversely septate conidia, without longitudinal septa, but phylogeny herein supports their distinction (Subclades A7 and A5 respectively, Fig. 1).

Camarosporidiella mirabellensis Wanas., Camporesi & K.D. Hyde, sp. nov. MycoBank MB821956; Facesoffungi number: FoF 03544. Fig. 17.

Etymology: mirabellensis, due to its occurrence in Monte Mirabello, Italy.

Saprobic on woody branches. Asexual morph: Undetermined. Sexual morph: Ascomata 300–350 μm diam, 500–550 μm diam (μ = 323.9 × 523.3 μm, n = 10), black, immersed to semi-erumpent, solitary or gregarious, broadly oblong, cupulate when dry. Peridium 50–80 μm wide at the base, 60–90 μm wide in sides, thick, comprising 8–10 layers, outer layer heavily pigmented, thick-walled, comprising blackish to dark brown elongated cells of textura angularis, cells towards the inside lighter, inner layer composed of 2–3 layers, hyaline, flattened, thin-walled cells of textura angularis. Hamathecium comprising numerous, 1.5–2 μm (n = 30) wide, filamentous, branched, septate, pseudoparaphyses. Asci 140–170 × 12–16 μm (μ = 158.8 × 13.7 μm, n = 30), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, apex rounded with a minute ocular chamber. Ascospores 22–27 × 9–11 μm (μ = 24.8 × 9.9 μm, n = 40), overlapping uniseriate or sometimes overlapping biseriate, muriform, mostly ellipsoidal, 3–5-transversely septate, with 1–2 longitudinal septa, deeply constricted at the middle septum, slightly constricted at the remaining septa, initially hyaline, becoming brown at maturity, asymmetrical, slightly paler ends, conical and narrowed at the ends, not surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 3 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin dirty white after 6 wk, reverse creamy, flat on the surface, without aerial mycelium.

Material examined: Italy, Forli-Cesena [FC], Predappio, Monte Mirabello, on dead aerial branches of Robinia pseudoacacia (Fabaceae), 3 Oct. 2014, E. Camporesi IT 2139 (MFLU 16-0228, holotype).

Notes: Unfortunately, we could not manage to maintain a living culture as subsequent attempts to subculture failed, and hence a living culture is unavailable. Camarosporidiella elongata and Ca. sparti have also been reported on Robinia pseudoacacia and morphologically resemble our new collection of Ca. mirabellensis in their ascomata, peridium, asci and ascospore characteristics (Mirza 1968). However, Ca. mirabellensis differs from Ca. elongata and Ca. sparti in having ascospores with fewer transverse septa (< 5). In multi-gene phylogenetic analyses, Ca. mirabellensis, Ca. eufemiana and Ca. premicurensis are more closely related (Subclade A4, Fig. 1). We must point out that despite not having sufficient phylogenetic differences, we consider them morphologically different in terms of spore shape, structure and seption. While Ca. mirabellensis has pointed ends and more than one longitudinal septum, Ca. eufemiana has much more rounded ends with one longitudinal septum. Camarosporidiella premicurensis, on the other hand, has larger asci, and more transverse septa. Therefore, we introduce Ca. mirabellensis as a novel species in order to minimize taxonomic ambiguity of Camarosporidiella.

Camarosporidiella moricola (Chethana et al.) Wanas. & K.D. Hyde, comb. nov. MycoBank MB821957; Facesoffungi number: FoF 03545.

Basionym: Camarosporium moricola Chethana et al., Fungal Diversity 83: 101. 2017.

Illustrations: See Tibpromma et al. (2017).
Materials examined: Russia, Rostov Region, Shakhty city, railroad artificial forest near Kazyonny pond, 47.7532324° N, 40.208931° E, on Morus alba (Moraceae), 26 Feb. 2014, T.S. Bulgakov T-004, MFLU 17-0452, living culture MFLUCC 14-0886; ibid. Rostov-on-Don city, Botanical garden of Southern Federal University, Higher Park, underwood, 47.2336592° N, 39.6593893° E, 26 Mar. 2014, T.S. Bulgakov T-015, MFLU 17-0461, living culture MFLUCC 14-0898; ibid. Shakhty city, Atyukhta River valley, Volchya Balka, 47.7122088° N, 40.1836753° E, 5 Jul. 2015, T.S. Bulgakov T-232, MFLU 15-1936; ibid. Shakhty city, Cotton Fabric urban microdistrict, Grushevky steppe slopes near Grushevsky Pond, 47.7234186° N, 40.255065° E, 30 Apr. 2015, T.S. Bulgakov T-265, MFLU 15-1969, living culture MFLUCC 17-0680; ibid. 14 May 2015, T.S. Bulgakov T-371, MFLU 15-2075, living culture MFLUCC 17-

Fig. 16. Camarosporidiella melnikii (MFLU 17-2022, holotype). A, B. Conidiomata on host surface. C. Vertical section through conidiomata. D, E. Conidiogenous cells forming conidia. F. Macro- and micro-conidia. G–L. Macroconidia. Scale bars: A = 500 μm; B = 200 μm; C = 100 μm; D–E = 5 μm; F = 10 μm; G–L = 5 μm.
Notes: Tibpromma et al. (2017) introduced Camarosporidiella moricola (= Camarosporium moricola) with three isolates, which were collected from Morus alba in Russia. In this study, we add another 12 strains to Camarosporidiella moricola (Subclade A1, Fig. 1) which were also collected from Morus alba in Russia. See more details in Tibpromma et al. (2017).
Camarosporidiella premicurensis Wanas., Camporesi & K.D. Hyde. sp. nov. MycoBank MB821958; Facesoffungi number: FoF 03546. Fig. 18.

Etymology: premicurensis, due to its occurrence in Premicurea, Italy.

Saprobic on Cytisus sp. Asexual morph: Undetermined. Sexual morph: Ascoma: Ascomata 400–450 μm high, 500–600 μm diam (x = 442.1 × 531.7 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, uniloculate, with an apapillate ostiole. Ostiole central, short, slightly sunken, minute and inconspicuous at the surface, smooth, ostiolar canal filled with hyaline cells. Peridium 30–50 μm wide at the base, 60–90 μm wide in sides, thick, comprising 8–15 layers, outermost layer heavily pigmented, thin-walled, comprising blackish to dark brown amorphous layer, middle layer heavily pigmented, thick-walled, comprising blackish to dark brown loosely packed cells of textura angularis, inner layer composed of 3–4 layers, reddish brown to brown, hyaline, cells towards the inside lighter, flattened, thick-walled cells of textura angularis. Hamathecium comprising numerous, 2.5–3.5 μm (n = 40) wide, filamentous, branched septate, pseudoparaphyses. Asci 160–210 × 14–16 μm (x = 181.1 × 15 μm, n = 40), 8-spored, bitunicate, fissituniculate, cylindrical, short-pedicellate, apex rounded with a minute ocular chamber. Ascospores 22–27 × 10–12 μm (x = 24.7 × 10.9 μm, n = 50), overlapping uniseriate, mostly ellipsoidal, 5–7-transversely septate, with 1–2 longitudinal septa, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming pale brown at maturity, asymmetrical, slightly paler, conical and narrowly rounded at the ends, not surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, creamy after 6 wk, reverse greenish grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Material examined: Italy, Forti-Cesena [FC], Premicurea, Fantiella, on dead aerial twigs of Cytisus sp. (Fabaceae), 28 Jun. 2014, E. Camporesi, IT1681 (MFLU 16-0185, holotype, ex-type culture MFLUCC 14-0839 = CBS 143127).

Notes: Camarosporidiella laburni has also been collected from the same host genus, Cytisus (Farr & Rossman 2017) and morphologically resembles Ca. premicurensis in having similar ascomata, peridium, ascis and ascospore characters. However, Ca. laburni has longer ascospores (> 27 μm) and a thicker peridium (> 100 μm), while Ca. premicurensis has comparatively shorter ascospores (< 27 μm) and thinner peridium (> 90 μm). Camarosporidiella premicurensis (Subclade A4, Fig. 1) is also phylogenetically distant from Ca. laburni and the latter appears to be more closely related to Ca. laburnicolor and Ca. clamatidis (Subclade A3, Fig. 1).

Camarosporidiella robindicolor (Wijayaw. et al.) Wijayaw., Wanas. & K.D. Hyde. comb. nov. MycoBank MB821959; Facesoffungi number: FoF 03547.

Basionym: Camarosporium robindicolor Wijayaw. et al., Phytotaxa 183: 21. 2014.

Synonym: Camarosporium aureum Norphanphon et al., Fungal Diversity 72: 153. 2015.

Illustrations: See Wijayawardane et al. (2014a) and Liu et al. (2015).

Additional material examined: Russia, Rostov Region, Kransoulsinsky District, Donskoye forestry, artificial forest, 47° 362125°1 N, 40° 231375°7 E, on dead twigs of Gleditsia triacanthos (Fabaceae), 21 May 2013, T.S. Bulgakov T-042, MFLU 17-0486, living culture MFLUCC 14-0906 = CBS 141330; Rostov Region, Rostov-on-Don city, Botanical garden of Southern Federal University, Higher Park, 47° 235283°7 N, 39° 6490788° E, on dead twigs of Gleditsia triacanthos, 14 May 2013, T.S. Bulgakov T-010, MFLU 17-0456, living culture MFLUCC 14-0892 = CBS 143128; Rostov Region, Shakhty city, Atyukhta river valley, railroad artificial forest, 47° 713120°9 N, 40° 181603°0 E, on Robinia neomexicana (Fabaceae), 14 Mar. 2014, T.S. Bulgakov T-012, MFLU 17-0458, living culture MFLUCC 14-0894 = CBS 143129; Rostov-on-Don city, Botanical garden of Southern Federal University, Higher Park, 47° 2389405°5 N, 39° 6484137° E, on Robinia pseudoacacia (Fabaceae), 8 May 2014, T.S. Bulgakov T-053, MFLU 17-0471, living culture MFLUCC 14-0909 = CBS 143131; Shakhty city, 20th anniversary of Red Army microdistrict, Solyonaya Balka, 47° 7104113° N, 340° 2627254° E, on Robinia pseudoacacia, 21 May 2013, T.S. Bulgakov T-403, MFLU 15-2104, living culture MFLUCC 17-0688, ibid., on Robinia sp., 21 May 2016, T.S. Bulgakov T-1303, MFLU 16-1997, living culture MFLUCC 17-0688 = CBS 143132; ibid., on Robinia sp., 5 Jun. 2016, T.S. Bulgakov DL004, MFLU 16-2300, living culture MFLUCC 17-0733.

Notes: All strains of Camarosporidiella robindicolor (including the strain of Ca. aureum, MFLUCC 14-0620) cluster together with significant statistical support of 97 % for ML, 98 % for MP and 1.00 for PP (Clade A2, Fig. 1). Morphological comparison reveals identical morphs and our phylogeny strongly supports an association of Ca. aureum with other strains of Ca. robindicolor. Therefore, it would be taxonomically correct to treat them as conspecific. We herein synonymise Camarosporium aureum under Ca. robindicolor. See Liu et al. (2015) for more details on Camarosporium aureum.

Camarosporidiella schulzeri Wanas., Bulgakov & K.D. Hyde. sp. nov. MycoBank MB821960; Facesoffungi number: FoF 03548. Fig. 19.

Etymology: Named after Stephan V.M. Schulzer, who introduced the genus Camarosporium.

Necrotrophic on dying branches of Elaeagnus angustifolia. Asexual morph: Conidiomata pycnidial, 370–420 μm high, 380–460 μm diam (x = 366.4 × 420.7 μm, n = 10), solitary or gregarious, black, immersed or partly erumpent, unilocular, ostiolate. Ostiole 50–80 μm long, 50–70 μm diam (x = 67.2 × 60.4 μm, n = 6), central, long, smooth, sometimes ostiolar canal filled with hyaline or pale brown cells. Pycnidial wall multi-layered, 15–25 μm wide at the base, 25–35 μm wide in sides, thick, comprising 4–5 layers, with heavily pigmented outer layer, thick-walled, comprising blackish to dark reddish-brown cells of textura angularis, with lighter cells towards the inside, with inner layer composed of 1–2 layers, hyaline, thin-walled cells of textura angularis. Conidiophores reduced to conidiogenous cells. Macroconidiogenous cells enteroblastic, annelidic, doliform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidial wall. Macroconidia 15–21 × 8–12 μm (x = 18.9 × 10.1 μm, n = 40), oblong, straight to slightly curved, rounded at both ends, 2–3-transversely septate, with one longitudinal septum, muriform, smooth-walled, brown to dark brown. Microconidiogenous cells intermingled with macroconidiogenous cells, hyaline, integrated,
Fig. 18. Camarosporidiella premilcurensis (MFLU 16-0185, holotype). A. Appearance of ascomata on host substrate. B. Section of ascoma. C. Close-up of ostiole. D. Peridium. E. Pseudoparaphyses. F–H. Asci. I–N. Ascospores. Scale bars: B = 100 μm; C, D = 50 μm; E = 5 μm; F–H = 20 μm; I–N = 10 μm.
enteroblastic, annellidic, ampulliform to subcylindrical. Microconidia 4.5–6.5 \times 4.5–5.5 \mu m (x = 5.9 \times 4.9 \mu m; n = 25), hyaline, round to oblong or ellipsoidal, with a few small guttules. Sexual morph: Undetermined. Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, white, reverse cream-grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled. Materials examined: Russia, Rostov Region, Rostov-on-Don city, Botanical garden of Southern Federal University, Higher Park, underwood, 47.2365559° N, 39.655591° E, on Elaeagnus angustifolia (Fabaceae), 26 Mar. 2014, T.S. Bulgakov T-014 (MFLU 17-0460, holotype, ex-type culture, MFLUCC 14-0897 = CBS 143133); Oktyabrsky district, south of Persianovsky settlement, Balka Khoruli (Khoruli gully), 47.5036926° N, 40.1241732° E, on Gleditsia triacanthos, 28 Apr. 2015, T.S. Bulgakov T-205, MFLU 15-1909; ibid., on Robinia sp., 14 Mar. 2016, T.S. Bulgakov T-1305, MFLU 16-1599, living culture MFLUCC 17-0722; ibid., on Robinia sp., 24 Mar. 2016, T.S. Bulgakov T-1370, MFLU 16-1664, living culture MFLUCC 17-0722. Notes: The holotype of Camarospordiniella schulzeri was collected from Elaeagnus angustifolia, and Camarosporium caraganae (conidia 14–22 × 9–12 \mu m), Ca. elaeagnicola (21–23 × 8–10 \mu m), Camarospordiniella elaeagnicola (18–25 × 9–13 \mu m) and Ca. arezzoesis (22–30 × 8–10 \mu m).
have also been reported from *Elaeagnus* (Farr & Rossman 2017, this study). *Camarosporiella elaeagnicola* and *Ca. arezzoensis* are also positioned in different subclades (Subclades A6 and A8 respectively, Fig. 1) and this provides additional support to justify their species status. The relationship between *Camarosporium caraganae* and *Ca. elaeagnicola* with *Camarosporiella schulzeri* cannot be investigated due to lack of molecular data for *Camarosporium caraganae* and *Ca. elaeagnicola*.

**Camarosporiella spartii** (Trail) Wijayaw., Wanas. & K.D. Hyde, *comb. nov*. MycoBank MB821961; Facesoffungi number: FoF 03549.

*Basionym*: *Camarosporium spartii* Trail, Scott. Natural., N.S. 3 (”9”): 222. 1888.

**Illustrations**: See Wijayawardane et al. (2014a).

**Note**: This species is located basal in Subclade A4 (Fig. 1).

**Coniothyriaceae** W.B. Cooke, Revista de Biol. 12: 289. 1983 (“1980–1983”).

**Type genus**: *Coniothyrum* Corda.

**Staurosphaeria** Rabenh., Bot. Ztg. 16(40): 303. 1858. MycoBank MB5186; Facesoffungi number: FoF 03550.

**Synonym**: *Hazlinszkyomyces* Crous & R.K. Schumach, IMA Fungus 8: 143. 2017.

**Necrotrophic** or saprobic on dead branches. **Asexual morph**: *Conidiomata* solitary, globose, dark brown, immersed, erumpent, globose, with central ostiole; ostiolar canal filled with hyaline cells; conidiomatal wall of 6–8 layers of dark brown texture angularis. *Conidiophores* reduced to conidiogenous cells lining the inner cavity. **Macroconidiogenous cells** hyaline, smooth, doliiform, proliferating percurrently at apex. **Macroconidia** solitary, ellipsoid, smooth, red-brown, with central transverse septum, becoming murriformly septate. **Microconidiogenous cells** intermingled with macroconidial cells, hyaline, integrated, proliferating percurrently at apex, subcylindrical. **Microconidia** hyaline, globose to ellipsoid, smooth, aseptate. **Sexual morph**: cucurbitaria-like. *Ascomata* black, superficial to semi-immersed, gregarious, confluent, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, black, ostiolate. **Ostiole** central, short. **Peridium** composed of blackish to dark brown cells of texture angularis, cells towards the inside lighter, composed of thin-walled cells of texture angularis. **Hamathecum** comprising numerous, branched septate, pseudoparaphyses. **Asci** 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate. **Ascospores** overlapping uniseriate, muriform, mostly ellipsoidal, 4–6-transversely septate, with 1–2 vertical septa, constricted at middle septum, initially hyaline, becoming brown at maturity, slightly paler, conical and narrow at the ends.

**Type species**: *Staurosphaeria lycii* Rabenh.

**Staurosphaeria lycii** Rabenh., Bot. Ztg. 16(40): 303. 1858. Facesoffungi number: FoF 03551. Figs 20, 21.

**Necrotrophic** on dead branches of *Lycium barbarum*. **Asexual morph**: *Conidiomata* pyxidioid, 500–600 μm high, 500–650 μm diam (x = 570.4 × 567.5 μm, n = 10), solitary, black, immersed or partly erumpent, unilocular, ostiolate. **Ostiole** 150–200 μm long, 200–250 μm diam (x = 170.2 × 235.4 μm, n = 6), central, long, smooth, ostiolar canal filled with hyaline cells. **Pycnidial wall** multi-layered, 20–25 μm wide at the base, 25–30 μm wide in sides, thick, comprising 4–5 layers, with heavily pigmented outer layer, thick-walled, comprising blackish to dark reddish-brown cells of texture angularis, with lighter cells towards the inside, with inner layer composed of 1–2 layers, hyaline, thin-walled cells of texture angularis. **Conidiophores** reduced to conidiogenous cells. **Macroconidiogenous cells** enteroblastic, anellidic, doliiform, integrated, solitary, hyaline, smooth-walled, and formed from the inner layer of pycnidium wall. **Macroconidia** 11–16 × 9–11 μm (x = 13.1 × 10.1 μm; n = 40), globose to oblong, rounded at both ends, 1–2-transversely septate, with one longitudinal septum, muriform, smooth-walled, brown to dark brown. **Microconidiogenous cells** intermingled with macroconidiogenous cells, hyaline, integrated, enteroblastic, anellidic, ampulliform to sub-cylindrical. **Microconidia** 3.5–6.5 × 3.5–4.5 μm (x = 5.1 × 4 μm; n = 25), hyaline, round to oblong or ellipsoidal, with a few small guttules. **Sexual morph**: Undetermined.

**Colonies on PDA**: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, white, reverse creamy grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

**Material examined**: Germany. Dresden, on dry branches of *Lycium barbarum* (lectotype designated here, Rabenh., Rottzchii Herb. Viv. Mycol., Ed. nov., Ser. Primia, Cent. VIII, No. 736, in HAL). Russia, Rostov Region, Shakhtry city; coal heap of former coal mine “Proletarian district” 47.7104113° N, 40.2827254° E; on dying and dead twigs of *Lycium barbarum* (Solanaeaceae), 21 May 2015, T.S. Bulgakov T-289 (MFLU 15-1993, epitype designated here, MBT377706, ex-type culture, MFLUCC 17-0210 = CBS 143140); ibid., T-418 (MFLU 15-2122, living culture MFLUCC 17-0211 = CBS 143141).

**Notes**: The type species has very characteristic red-brown conidia, developing a transverse septum, and later vertical septa, dividing the conidium into four compartments. It is distinct from *Camarosporium s. str.* in that conidia in the latter are unevenly pigmented (pale brown at ends), and multi-septate, lacking a microconidial morph as observed in conidiomata of *Staurosphaeria*. It was in the past assumed that *Staurosphaeria* and *Karstenula* (*Didymosphaeraceae*) are congeneric. However, the type species, *K. rhodostoma*, has been linked to the asexual morph *Microdiplodia frangulae* (Constantinescu 1993), so the generic synonymy with *Staurosphaeria* seems rather unlikely.

**Other accepted species**

**Staurosphaeria aloes** (Crous & M.J. Wingf.) Crous, Wanans. & K.D. Hyde, *comb. nov*. MycoBank MB821962; Facesoffungi number: FoF 03552.

*Basionym*: *Camarosporium aloes* Crous & M.J. Wingf., Persoonia 31: 247. 2013.

**Synonym**: *Hazlinszkyomyces aloes* (Crous & M.J. Wingf.) Crous, IMA Fungus 8: 143. 2017.

**Illustrations and material examined**: See Crous et al. (2013).

**Staurosphaeria aptrootii** (Crous & M.J. Wingf.) Crous, Wanans. & K.D. Hyde, *comb. nov*. MycoBank MB821963; Facesoffungi number: FoF 03553.
Basionym: Hazslinzskyomyces aptrootii Crous, IMA Fungus 8: 143. 2017.

Illustrations and material examined: See Crous & Groenewald (2017).

Staurosphaeria lyciicola (Crous & R.K. Schumach.) Crous, Wanas. & K.D. Hyde, nom. nov. MycoBank MB821964; Facesoffungi number: FoF 03554.

Basionym: Hazslinzskyomyces lycii Crous & R.K. Schumach., IMA Fungus 8: 144. 2017.

Illustrations and material examined: See Crous & Groenewald (2017).

Staurosphaeria rhamnicola Wanas., Gafforov & K.D. Hyde, sp. nov. MycoBank MB821965; Facesoffungi number: FoF 03555.

Fig. 22.

Etymology: Named after the host genus from which it was collected, Rhamnus.

Saprobic on dead branches of Rhamnus sp. Asexual morph: Undetermined. Sexual morph: Ascomata 200–400 μm high, 250–350 μm diam (x = 320.4 × 296.8 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, sometimes scattered beneath the host periderm or on decorticated wood, fully or partly erumpent, globose, uniloculate, with an ostiole. Ostiole central, short, slightly sunken, minute and inconspicuous at the surface, smooth, ostiolar canal filled with hyaline cells. Peridium 25–40 μm wide at the base, 30–50 μm wide in sides, thick, comprising 8–12 layers, outermost layer heavily pigmented, thin-walled, comprising blackish to dark brown amorphous layer, middle layer heavily pigmented, thick-walled, comprising blackish to dark brown loosely packed cells of textura angularis, inner layer composed of 3–4 layers, reddish brown to hyaline, cells towards the inside lighter, flattened, thick-walled cells of textura angularis. Hamathecium comprising numerous, 2.5–3 μm (n = 40) wide, filamentous, branched septate, pseudoparaphyses. Asci 170–200 × 16–22 μm (x = 186.2 × 18.4 μm, n = 40), 8-spored, bitunicate, fissitunicate, cylindrical, short-pedicellate, apex rounded with a minute ocular chamber. Ascospores 26–32 × 12–14 μm (x = 30.4 × 13.1 μm, n = 50), overlapping uniseriate, muriform, mostly ellipsoidal, 5–6-transversely septate, with 1–2 longitudinal septa, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming pale brown at maturity, asymmetrical, slightly paler ends, conical and narrowly rounded at the ends, not surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, creamy after 6 wk, reverse iron, flat on the surface, with aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Material examined: Uzbekistan, Surxondaryo Province, Sherobod District, Oqtosh village on dead twigs of Rhamnus sp. (Rhamnaceae), 12 May 2016, Y. Gafforov, YG-S4-4D (TASM 6102, holotype); ibid., (MFLU 17-0183, isotype, ex-isotype culture MFLUCC 17-0814) ibid., YG-S4-5 (TASM 6101 = MFLU 17-0182, paratype, ex-paratype culture, MFLUCC 17-0813).

Notes: Staurosphaeria rhamnicola morphologically resembles Camarosporidiella arezzoensis, Ca. eufemiana, Ca. italica, Ca. laburni, Ca. mirabellensis, Ca. premilcurensis and Neocucurbitaria acerina in having similar ascomata, peridium, asci and ascospore characters. However, they are phylogenetically distant from Staurosphaeria rhamnicola (Clade B, Fig. 1).

Neocamarosporiaceae Wanas., Wijayaw., Crous & K.D. Hyde, fam. nov. MycoBank MB821966; Facesoffungi number: FoF 03556.

Etymology: Referring to the name of the type genus.

Saprobic on leaves and wood. Asexual morph: Conidiomata immersed, becoming erumpent, globose, brown to black,
Fig. 21. Staurosphaeria lycii (MFLU 15-1993, epitype). A–C. Conidiomata on host surface. D. Vertical section through conidioma. E, F. Microconidiogenous cells and microconidia. G, H. Macroconidiogenous cells. I–N. Macro conidia. Scale bars: A = 1 mm, B = 500 μm; C, D = 100 μm; E–N = 5 μm.
ostiolate. Ostiole papillate, central. Conidiomata wall composed of thin-walled, brown cells of textura angularis. Conidiophores reduced to conidiogenous cells. Conidiogenous cells proliferating several times percurrently near apex, ampulliform to doliiform, separate, hyaline, smooth-walled. Conidia solitary, initially hyaline, aseptate, developing initially a central septum and then becoming muriform, variable from globose to obovoid to ellipsoid, golden brown, finely roughened, thick-walled. Sexual morph: Ascomata superficial to semi-immersed, confluent, gregarious, fully or partly erumpent, globose, with an apopillate ostiole.

Fig. 22. Staurosphaeria rhamnicola (TASM 6102, holotype). A, B. Appearance of ascomata on host substrate. C. Section of ascoma. D. Peridium. E. Pseudoparaphyses. F–I. Asci. J–O. Ascospores. Scale bars: C = 100 μm; D, F–I = 20 μm, E, J–O = 10 μm.
Ostiole central, short, erect or slightly sunken, smooth, ostiolar canal filled with hyaline cells. Peridium thin, comprising blackish to brown loosely packed cells of textura angularis. Hamathecium comprising numerous, filamentous, branched septate, pseudo-paraphyses. Ascii 8-spored, bitunicate, fissitunicate, cylindrical-clavate to cylindrical, pedicellate, rounded at apex, with a minute ocular chamber. Ascospores uniseriately overlapping, muri-form, mostly ellipsoidal, 5–7-transversely septate, with 1–2 longitudinal septa, deeply constricted at middle septum, slightly constricted at remaining septa, initially hyaline, becoming pale brown at maturity, rounded at both ends, surrounded by a mucilaginous sheath.

Type genus: Neocamarosporium Crous & M.J. Wingf.

Notes: Ariyawansa et al. (2015c) and Wijayawardene et al. (2016) treated Neocamarosporium as a genus in Pleosporaceae, but in our analyses four Neocamarosporium species, three new camarosporium-like taxa and a pleospora-like taxon also group with Coniothyrium obiones, Dimorphosphorica tragani, N. chersinae, N. chichastianum, N. goegapense, Pleospora chenopodii, P. halimoniae, P. calvescens, P. betae and Phoma betae (which represent phoma-like and ascochyta-like assexual morphs fide de Gruyter et al. 2012) and reside in a distinct clade (Clade D, Fig. 1) in Pleosporaceae with high bootstrap support (95 % and 79 % in ML and MP analyses respectively) and high PP value (1.00). This clade (Clade D) is distinct from Pleosporaceae sensu stricto which comprises Pleospora sensu stricto (= Stempylhum, see Woudenberg et al. 2017), the type genus. Therefore, Neocamarosporiaceae fam. nov. is introduced for Clade D based on morphology and multi-gene phylogeny.

The family Neocamarosporiaceae is somewhat similar to the Pleosporaceae, but differs in several respects. The characteristics of the ascomatal wall are distinctly different from each other. Pleosporaceae species have a thick peridium with several hyaline and pigmented cell layers, while Neocamarosporiaceae species have a thin peridium with only 2–3 pigmented cell layers and lack hyaline cell layers.

Ariyawansa et al. (2015c) mentioned that the asexual morphs of Pleosporaceae can be coelomycetous or hyphomycetous. Apart from Neocamarosporium (ascochyta-like, camarosporium-like and phoma-like) no other Pleosporaceae species produce a coelomycetous asexual morph. Therefore, it would appear that hyphomycetous assexual morphs are specific to Pleosporaceae. Therefore, by considering the sexual morph and assexual morph differences together with molecular support obtained herein with Neocamarosporiaceae in clade D, we believe that it would taxonomically be more appropriate to establish a new family to accommodate these species in Pleosporaceae.

It is interesting to note that the species which were collected from marine to saline habitats, and produce muriform conidia, i.e. Neocamarosporium chersinae, N. chichastianum and N. salicornicola cluster together as a subclade in clade D (Fig. 1), but could not be segregated from Dimorphosphorica tragani and Coniothyrium obiones based on our phylogenetic analyses. However, DNA sequence data of Coniothyrium obiones (CBS 453.68) analysed herein is an unverified sequence as it is not from the type material. Given that the relationship between the Coniothyrium obiones and other taxa is undetermined, we keep CBS 453.68 as “Coniothyrium obiones” for now. Dimorphosphorica tragani is different to other taxa in Neocamarosporium in conidial morphology and habitat. Consequently, it would be appropriate to retain Dimorphosphorica as a separate genus in Neocamarosporiaceae. Furthermore, some of the Neocamarosporium spp. (e.g. N. chichastianum) have only ITS sequence data and it would be wise to consider or evaluate the utility of several other genes such as large subunit nrDNA (28S, LSU), small subunit nrDNA (18S, SSU), or translation elongation factor alpha 1 (tefl-α) to further elucidate phylogenetic relationships among this clade of fungi with more fresh collections.

Neocamarosporium Crous & M.J. Wingf., Persoonia 32: 273. 2014. emend.

Saprobic on leaves and wood. Asexual morph: See Crous et al. (2014b). Sexual morph: Ascomata superficial to semi-immersed, confluent, gregarious, fully or partly erumpent, globose, with an applanate ostiole. Ostiole central, short, erect or slightly sunken, smooth, ostiolar canal filled with hyaline cells. Peridium thin, comprising blackish to brown loosely packed cells of textura angularis. Hamathecium comprising numerous, filamentous, branched septate, pseudoparaphyses. Ascii 8-spored, bitunicate, fissitunicate, cylindrical-clavate to cylindrical, pedicellate, apex rounded with a minute ocular chamber. Ascospores uniseriately overlapping, muri-form, mostly ellipsoidal, 5–7-transversely septate, with 1–2-longitudinal septa, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming pale brown at maturity, rounded at both ends, surrounded by a mucilaginous sheath.

Type species: Neocamarosporium goegapense Crous & M.J. Wingf.

Notes: The genus Neocamarosporium was introduced by Crous et al. (2014b) based on Neocamarosporium goegapense from South Africa, which is morphologically similar to the genus Camarosporium with its pycnidial conidiomata, hyaline, percurrently proliferating conidiogenous cells, and brown, muriform conidia (Crous et al. 2014b). Currently there are 25 strains that cluster in Neocamarosporium, representing 11 species (in this study). Also, a further three strains which was introduced by Grum-Grahimaylo et al. (2016) and six strains which were collected from marine to saline habitats in Iran, group here as Neocamarosporium sp. In this study, we introduce Neocamarosporium korfii, N. lamiacearum (first sexual record), N. salicornicola and N. salisola as new species in Neocamarosporium.

Accepted species in Neocamarosporium

Neocamarosporium betae (Berl.) Ariyawansa & K.D. Hyde, Fungal Diversity 71: 119. 2015.

Basionym: Pyrenophora echinella var. betae Berl.: 208. 1888.

Synonyms: Phoma betae A.B. Frank, Z. Rübenzucker-Ind.: 905. 1892.

Pleospora betae Björk., Botaniska Notiser 1944: 218. 1944.

Neocamarosporium calvescens (Fr. ex Desm.) Ariyaw. & K.D. Hyde, Fungal Diversity 71: 120. 2015.
Basionym: Sphaeria calvescens Fr., Sclerum. Suec.: no. 401. 1822.
Synonyms: Pleospora calvescens (Fr. ex Desm.) Tul. & C. Tul., Selecta Fungorum Carpodologia, Tomus Secundus. Xylariei - Valsei - Sphaeriei 2: 266. 1863.

Neocamarosporium chernsinae Crous, IMA Fungus 8: 146. 2017.
Illustrations and material examined: See Crous & Groenewald (2017).

Neocamarosporium goegapense Crous & M.J. Wingf., Persoonia 32: 273. 2014.
Illustrations and material examined: See Crous et al. (2014b).

Neocamarosporium obiones (Jaap) Wanans. & K.D. Hyde, comb. nov. MycoBank MB821968; Facesoffungi number: FoF 03558.
Basionym: Diplodina obiones Jaap, Verh. bot. Ver. Prov. Brandenb. 47: 96. 1905.
Synonyms: Ascomyces obiones (Jaap) P.K. Buchanan, Mycol. Pap. 156: 28. 1987. Pleospora halimiones Gruyter & Verkley, Stud. Mycol. 75: 25. 2012.

Neocamarosporium korfi Wanans., E.B.G. Jones & K.D. Hyde, sp. nov. MycoBank MB821969; Facesoffungi number: FoF 03559. Fig. 23.

Etymology: In honour of Prof. Richard Paul "Dick" Korfi (May 28, 1925 – August 20, 2016) for his immense contribution to mycology.

Saprobic on dead stems of Lamiaceae sp. Asexual morph: Conidiomata pycnidial, 130–200 μm high, 160–220 μm diam (x = 161.7 × 178.9 μm, n = 10), solitary or gregarious, black, superficial, unicellular. Ostiole inconspicuous. Pycnidial wall 12–20 μm wide, comprising 3–5 layers, outer layer heavily pigmented, thick-walled, comprising dark brown cells of textura angularis, cells towards the inside lighter, inner layer comprising 2–3 layers, hyaline, thin-walled cells of textura angularis. Conidiophores reduced to conidiogenous cells. Conidiogenous cells enteroblastic, annelidic, doliform, integrated, solitary, hyaline, smooth-walled, and originated from the inner layer of pycnidial wall. Conidia 12–18 × 8–10 μm (x = 14.3 × 9.4 μm; n = 30), oblong, straight to slightly curved, rounded at both ends, 1–3-transversely separte, with 1–2 longitudinal septa, muriform, smooth-walled, dark brown, guttulate. Sexual morph: Undetermined.

Colonies on PDA: Slow growing, reaching 3 cm diam after 3 wk at 16 °C, powdery, circular, smooth margin, greenish brown, reverse dark brown.

Material examined: Russia, Republic of Crimea, Feodosia city Municipality, Karadag State Nature Reserve, 44.9145837°N, 35, 2052527°E, on dead branches of Bassia prostrata (Amaranthaceae), 23 Jun. 2016. T.S. Bulgakov CR006 (MFLU 17-1436 holotype, ex-type culture MFLUCC 17-0745 = CBS 143135).

Notes: Based on the multi-gene phylogenetic analyses (Fig. 1), our strain of Neocamarosporium korfi segregates from N. lamiacearum, but this subclade is not supported in the phylogenetic analyses (Clade D, Fig. 1). Neocamarosporium korfi is morphologically similar to N. salsolae and N. salicorniicola in conidiomatal characteristics and conidial shape. However, these species are phylogenetically distinct (Clade D, Fig. 1). Thus, in this paper we introduce N. korfi as a new species in Neocamarosporium.

Neocamarosporium lamiacearum Dayar., E.B.G. Jones & K.D. Hyde, sp. nov. MycoBank MB821970; Facesoffungi number: FoF 03560. Fig. 24.

Etymology: Named after the host family from which it was collected, Lamiaceae.

Saprobic on dead stems of Lamiaceae sp. Asexual morph: Ascomata 200–250 μm high, 180–250 μm diam (x = 232.1 × 217.4 μm, n = 10), black, superficial to semi-immersed, confluent, gregarious, cupulate when dry, globose, uniloculate, with an apapillate ostiole. Ostiole, 40–60 μm long, 40–60 μm diam, central, short, slightly sunken, minute and inconspicuous at the surface, smooth, ostioral canal filled with hyaline cells. Peridium 10–15 μm wide at the base, 10–20 μm wide in sides, thin, comprising 2–3 layers, reddish brown to brown, cells towards the inside lighter, flattened, thin-walled cells of textura angularis. Hamathecium comprising numerous, 2.5–3 μm (n = 40) wide, filamentous, branched, septate, pseudoparaphyses. Ascii 100–120 × 14–17 μm (x = 105.5 × 15 μm, n = 40), 8-spored, bitunicate, fissitunicate, cylindrical-clavate to cylindrical, pedicellate (10–20 μm long), apex rounded with a minute ocular chamber. Ascospores 14–20 × 8–11 μm (x = 15.9 × 9.4 μm, n = 50), overlapping uniseriate, muriform, mostly ellipsoidal, with 3–4-transversely separte, with one longitudinal septum, deeply constricted at the middle septum, slightly constricted at remaining septa, initially hyaline, becoming pale brown at maturity, upper part wider than lower part, slightly paler, rounded at both ends, conical at lower end, surrounded by a mucilaginous sheath.

Colonies on PDA: Slow growing, reaching 2 cm diam after 4 wk at 16 °C, later with dense mycelium, circular, rough margin, white, reverse cream-grey, flat on the surface, without aerial mycelium. Hyphae septate, branched, hyaline, thin-walled.

Materials examined: Russia, Rostov Region, Krasnosulinsky district, Donskoye forestry, 47.8547249°N, 40.2318907°E, steppe in gully, on dead stems of Lamiaiceae plant (perhaps, Manduca peregrinum or Pholmis herba-venti spsp. pungens), 28 Jun. 2015, T.S. Bulgakov T-846 (MFLU 15-2899, holotype, ex-type culture MFLUCC 16-0560 = CBS 143136); Russia, Republic of Crimea, Feodosia city Municipality, salt-march near Baraqol salty lake, 44.996382°N, 35, 2431965°E, on dead branches of Bassia salsolae (Amaranthaceae), 23 Jun. 2016, T.S. Bulgakov CR026 (MFLU 17-1437, paratype, ex-paratype culture, MFLUCC 17-0790 = CBS 143137).

Notes: Neocamarosporium lamiacearum is morphologically somewhat similar to taxa in Pleosporaceae in having cylindrical-clavate to cylindrical ascii and muriform ascospores. However, the characteristics of the ascomatal wall in Neocamarosporium CAMAROSPORIUM AND ALLIED GENERA
lamiacearum are noticeably different from Pleosporaceae taxa. Pleosporaceae species have a thick peridium with several hyaline and pigmented cell layers, while Neocamarosporiaceae lamiacearum has a thin peridium with only 2–3 pigmented cell layers and lack hyaline cell layers.

Neocamarosporium salicorniicola Dayarathne, E.B.G. Jones & K.D. Hyde, sp. nov. MycoBank MB821971; Facesoffungi number: FoF 03561. Fig. 25.

Etymology: Named after the host genus from which it was collected, Salicornia.

Saprobic on dead stems of Salicornia sp. Asexual morph: Conidiomata pycnidial, 75–110 μm high, 80–96 μm diam (x = 94.4 × 88 μm, n = 10), solitary or gregarious, black, superficial, unilocular. Ostiole inconspicuous. Pycnidial wall 7–11 μm wide, comprising 3–4 layers, outer layer heavily pigmented, thick-walled, comprising dark brown cells of textura angularis, cells towards the inside lighter, inner layer comprising 2–3 layers, hyaline, thin-walled cells of textura angularis. Conidiophores reduced to conidiogenous cells. Conidiogenous cells enteroblastic, annelidic, doliform, integrated, solitary, hyaline, smooth-walled, and originated from the inner layer of pycnidium wall. Conidia 8–12 × 4–6 μm (x = 10.5 × 4.8 μm; n = 30), oblong, straight to slightly curved, rounded at both ends, 1–3-transversely septate, with one longitudinal septum, muriform, smooth-walled, dark brown, guttulate. Sexual morph: Undetermined.

Colonies on PDA: Slow growing, reaching 3 cm diam after 3 wk at 16 °C, powdery, circular, smooth margin, ash, reverse yellowish at margins and black at the middle.

Material examined: Thailand, Phetchaburi Province, Cha-Am, Chao Samran, on dead stem of Salicornia sp. (Amaranthaceae), 28 Jul. 2015, M. Dayarathne CHAM025 (MFLU 15-0957, holotype, ex-type culture MFLUCC 15-0957).
Fig. 24. Neocamarosporium lamiacearum (MFLU 15-2989, holotype). A, B. Appearance of ascomata on host substrate. C. Section of ascoma. D. Peridium. E. Pseudo-paraphyses. F–H. Asci. I–L. Ascospores. Scale bars: A, B = 200 μm; C = 100 μm; D, E = 10 μm; F–H = 20 μm; I–L = 10 μm.
**Notes:** Based on the multi-gene phylogenetic analyses (Fig. 1), our strain of *N. salicornicola* shares a sister relationship to *N. jorjanensis* and to *Dimorphosporicola tragani* but with no support (Clade D, Fig. 1). In this paper, we introduce *Neocamarosporium salicornicola* as a new species in *Neocamarosporium*, based on its comparatively smaller and distinct dark, guttulate conidia, and its phylogenetic position.

*Neocamarosporium salicornicola* Wanas., Gafforov & K.D. Hyde, sp. nov. MycoBank MB821972; Facesoffungi number: FoF 03562. Fig. 26.

**Etymology:** Named after the host genus from which it was collected, *Salsola*.

Saprobic on dead stems of *Salsola* sp. Asexual morph: *Conidiomata* pycnidial, 120–150 μm high, 80–110 μm diam (X = 137.5 × 99.5 μm, n = 10), solitary or gregarious, black, superficial, unilocular. Ostiole inconspicuous. *Pycnidial wall* 6–10 μm wide, comprising 3–4 layers, outer layer heavily pigmented, thick-walled, comprising dark brown cells of *textura angularis*, cells towards the inside lighter, inner layer comprising 2–3 layers, hyaline, thin-walled cells of *textura angularis*. Conidiophores reduced to conidiogenous cells. Conidiogenous cells enteroblastic, annellidic, doliform, integrated, solitary, hyaline, smooth-walled, and originated from the inner layer of pycnidium wall. *Conidia* 18–25 × 12–20 μm (X = 21.9 × 16.9 μm; n = 30), oblong, straight to slightly curved, rounded at both ends, 1–3-transversely septate, with 1–3 longitudinal septa, muniform, smooth-walled, dark brown. *Sexual morph:* Undetermined.

**Colonies on PDA:** Slow growing, reaching 3 cm diam after 3 wk at 16 °C, circular, smooth margin, dark green, reverse blackish green.

**Materials examined:** *Uzbekistan*, Surxondaryo Province, Sherobod District, Oqtoosh village on dead stem of *Salsola* sp. (Amaranthaceae), 12 May 2016, Y. Gafforov YG-S6 (TASM 6100, holotype); YG-S6-1 (TASM 6099 = MFLU 17-0191, isotype, ex-isotype culture MFLUCC 17-0827) ibid., YG-S6-1 (TASM 6099 = MFLU 17-0191, paratype, ex-paratype culture, MFLUCC 17-0828).

**Notes:** Based on the multi-gene phylogenetic analyses (Fig. 1), our strains of *Neocamarosporium salicornicola* cluster in a subclade sister to *N. goegapense* with significant statistical support (Clade D, Fig. 1).

**Another accepted genus**

*Dimorphosporicola* Crous, Fungal Biology 120: 1412.

**Type species:** *Dimorphosporicola tragani* Crous.

*Dimorphosporicola tragani* Crous, Fungal Biology 120: 1413.

**Illustrations and material examined:** See Crous & Groenewald (2016).

**Notes:** *Dimorphosporicola* was described by Crous & Groenewald (2017) to accommodate *D. tragani*, which is morphologically similar to *Coleophoma* species. But *D. tragani* is distinct from *Coleophoma* by having percurrently proliferate conidiogenous cells, and having dimorphic conidia. *Dimorphosporicola* and *Neocamarosporium* are different to each other in macro-conidial morphology.

**DISCUSSION**

Our phylogenetic results indicate that camarosporium-like species which were treated as *Camarosporium* in previous papers (viz. *Camarosporium arezzoensis*, *Cm. aborescentis*, *Cm. caraganiola*, *Cm. elaeagnellum*, *Cm. elongata*, *Cm. clematidis*, *Cm. laburni*, *Cm. robianica* and *Cm. aureum fide* Wijayawardene et al. 2014a, c, Liu et al. 2015, Tibpromma et al. 2016, Thambugala et al. 2016) are well positioned within the *Pleosporineae* and phylogenetically distinct from other genera. These species, which has been our focal group, constitute a strongly supported monophyletic lineage with 75 newly collected strains (Clade A). In contrast, *Cm. quaternatum* (CPC 23216, CPC 31081 & CPC 31518), the type species of *Camarosporium*, and other camarosporium-like taxa group in separate clades (Clade A, B, C and D, Fig. 1).

To discuss tree output (Fig. 1), we divided the taxa in the phylogram into 4 clades (A–D), and ingroup taxa in Clade A into 12 subclades (A1–A12). Generally, *Camarosporidiella* clustered separately from the rest with high support (Clade A, Fig. 1). All species in Clade A are distinct from other camarosporium-like taxa in *Pleosporineae*. Clade A comprises new strains and several other species were transferred to the new genus, *Camarosporidiella* (Fig. 1). With regards to conidial morphology, *Camarosporidiella* resembles *Camarosporium sensu stricto* and other camarosporium-like genera (Crous et al. 2014b, 2015a, b, Wijayawardene et al. 2014c, 2015, 2016) but is phylogenetically distinct. *Camarosporidiella arezzoensis*, *Ca. aborescentis*, *Ca. caraganiola*, *Ca. celtidis*, *Ca. eufemiana*, *Ca. elongata*, *Ca. italicca*, *Ca. laburni*, *Ca. mirabellensis* and *Ca. prenicularens* represent the sexual morph of the genus. Thus, the holomorph of the genus comprises a camarosporium-like asexual morph and cucurbitaria-like sexual morph. With the addition of new specimens and species, updated morphological characterisation, DNA sequence data analyses with strong support, and the monophyletic status of *Camarosporidiella* species, a new family, *Camarosporidiellaeae* is established herein to circumscribe *Camarosporidiella*.

Clade B comprises two new collections which are morphologically similar to *Staurosphearia lycii* and three other species i.e. *Hazzlinszykomyces lycii*, *H. aptroobii* and *H. aloeis in Coniothyriaceae* with significant statistical support. By giving precedence to the oldest name, the genus *Staurosphearia* is resurrected to accommodate this group. Clade C (Fig. 1), which comprises the type species of *Camarosporium*, is retained as *Camarosporium sensu stricto* and *Camarosporomyces flavigenus*. As in Wijayawardene et al. (2014b) and Crous & Groenewald (2017), *Camarosporium sensu stricto* groups with *Coniothyriaceae*, which comprises *Coniothyrium sensu stricto* and phoma-like species (de Gruyter et al. 2012). Recent studies reported that some camarosporium-like genera (such as *Pseudocamarosporium* and *Paracamarosporium*) have broader generic concepts (Crous et al. 2015a, b), Wijayawardene et al. (2014c) introduced *Pseudocamarosporium* and *Paracamarosporium* to accommodate camarosporium-like taxa that reside in *Didymosphaeraceae*. Crous et al. (2015b) showed that several coniothyrium-like species group with *Pseudocamarosporium* and
Paracamarosporium in their phylogenetic study. Hence, both Pseudocamarosporium and Paracamarosporium exhibit camarosporium-like or coniothyrium-like conidial morphologies. Further phylogenetic investigations with broader taxon sampling of Camarosporium sensu stricto and Coniothyrium sensu stricto are warranted to better understand both the Camarosporium and Coniothyrium generic concepts.

Neocamarosporium goegapense and 10 other Neocamarosporium species cluster in a strongly supported clade (Clade D, Fig. 1). Based on morphology of the sexual and asexual morphs and multi-gene phylogeny, Neocamarosporiaceae was introduced. Previous studies and our results in this study demonstrate that naming of camarosporium-like taxa based only on morphology is inaccurate and hence there is a need to carry

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**Fig. 25. Neocamarosporium salicorniicola (MFLU 15-0957, holotype).** A. Appearance of conidiomata on Salicornia sp. B. Vertical section of conidioma. C. Developing stages of conidia on conidiogenous cells. D–K. Conidia. Scale bars: B = 50 μm; C = 20 μm; D–K = 5 μm.
out DNA sequence-based studies. Wijayawardene et al. (2016) discussed the importance of re-collecting, and epitypyfing of camarosporium-like taxa as currently it has more than 500 epithets in Index Fungorum (2017), and very few of these taxa are presently known from culture.

ACKNOWLEDGEMENTS

We thank the technical staff of Center of Excellence in Fungal Research, Sorram Sukpisit, Wilawan Punyaboon and Thatsanee Luangharn for their invaluable assistance. We are also grateful to Milan C. Samarakoon, Danushka Tennakoon, Indunil C. Senanayake, Asha J. Dissanayake, Qing Tian, Chuan-Gen Lin for their valuable assistance with the culture work, DNA isolation, amplification and sequencing. Dhanushka Wanasinghe is thankful to Hiram Ariyawansa for his valuable suggestions. Chayanard Phukhamsakda would like to thank Royal Golden Jubilee Ph. D. Program under Thailand Research Fund, for the award of a scholarship no. PHD0020/2557 to study towards a PhD. Alan JL Phillips acknowledges the support from Biosystems and Integrative Sciences Institute (BioISI, FCT/UID/ Multi/04046/2013). R. Jeewon is grateful to University of Mauritius & Mae Fah Luang University for enabling research collaboration. K.D. Hyde thanks to National Research Council of Thailand (Mae Fah Luang University) for grants “Biodiversity, phylogeny and role of fungal endophytes of Pandanaceae” (Grant No: 592010200112) and Thailand Research Fund (TRF) grant no RSA5980088 entitled “Biodiversity, phylogeny and role of fungal endophytes on above parts of Rhizophora apiculata and Nypa fruticans”. National Research Council of Thailand (Mae Fah Luang University) grant no 60201000201 entitled “Diseases of mangrove trees and maintenance of good forestry practice”. Samantha C. Karunarathna thanks to Yunnan Provincial Department of Human Resources and Social Security funded postdoctoral project (number 179122), Kevin D. Hyde also thanks to the Chinese Academy of Sciences, project number 2013T2S0030, for the award of Visiting Professorship for Senior International Scientists at Kunming Institute of Botany. Y.S. Gafforov acknowledges the support from Committee for...
coordination science and technology development under the Cabinet of Ministers of Uzbekistan (Project No. P3-2014-0830174425).

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