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RESEARCH ARTICLE

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Heteroverticillium phytelephatis gen. et sp. nov. intercepted from nuts of *Phytelephas macrocarpa*, with an updated phylogenetic assessment of *Nectriaceae*

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ABSTRACT

An entry postal parcel with mature nuts of *Phytelephas macrocarpa* from Togo was inspected at Dalian Customs (China) in December 2021, and four strains were isolated from symptomatic tissues of the nuts. Based on morphological observations and molecular phylogenetic analyses, above strains were identified as a new species which is mainly characterised by the verticillately branching conidiophores. Based on multi-locus phylogenetic analyses, this new species forms a monophyletic clade closely related to *Corallomycetella, Paracremonium* and *Xenoacremonium* but could not be accommodated in any known genera of *Nectriaceae*. Thus, a new genus *Heteroverticillium* is established to accommodate this new species (*H. phytelephatis*). To our knowledge, this is the first time that Chinese customs have intercepted a new fungal genus. In addition, we provided an updated backbone tree for the generic relationships in *Nectriaceae*, which may largely assist future identification of nectriaceous fungi to genus level in quarantine inspections. Based on our analysis, *Varicosporellopsis* is likely a late synonym of *Paracremonium*.

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1. Introduction

The introduction of alien pathogens into a certain region may have profound negative effects on local native biota, ecological balance, human health and economic development (Capinha et al. 2015; Pyšek et al. 2020). With the growth of international trade, the risk of introducing invasive alien phytopathogens also increase (Zhao et al. 2021). Prevention the global spread of alien pathogens becomes an increasingly important concern for most countries. Alien pathogens often enter through cargo, passenger, conveyance, post, wood package and container, and the rate of pest interception is particularly high in parcels, as China is the world's largest carrier of parcels. The quarantine pest list of China currently includes 130 fungal species, of which 10 belong to the Ascomycetes family *Nectriaceae* (http://dzs.customs.gov.cn/dzs/2746776/3699554/index.html; accessed 9 April 2022). Besides, 175 species in family *Nectriaceae* (e.g. species from *Acremonium, Calonectria, Cylindrocladiella, Fusarium, Ilyonectria, Neocosmospora, Volutella*) have been listed as quarantine organisms in 52 countries (Zhao et al. 2021). *Nectriaceae* species thus receive high attention in the quarantine departments of different countries.

The family *Nectriaceae* includes a variety of important plant and human pathogens (Rossman 1996; Luo and Zhuang 2008; Chaverri et al. 2011; Lechat et al. 2015; Lombard et al. 2015), such as pathogens of Fusarium head blight (*Fusarium* spp.), pathogens of vascular wilts of many economically important crops (members of the *Fusarium oxysporum* species complex), and pathogens of sudden death syndrome of soybeans and root rot of many diverse hosts (*Neocosmospora* spp.) (O'Donnell et al. 2000a; Aoki et al. 2003; Qiu et al. 2012; Lombard et al. 2019; Maryani et al. 2019; Sandoval-Denis et al. 2019; Medeiros Araújo et al. 2020; Xu et al. 2021). Recent advances in the taxonomy of fungi following the one fungus = one name initiative and the implementation of DNA phylogeny in taxonomic revisions, resulted in many name changes, particularly those applying to subspecies, varieties and *formae speciales* (Wingfield

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et al. 2012). For example, the pathogen of banana Fusarium wilt (previously collectively called *F. oxysporum f. sp. cubense*) has recently been splited into nine *Fusarium* species based on morphological characteristics and phylogenetic inferences (Maryani et al. 2019). Despite the recent good advances in the systematics and phylogeny of *Nectriaceae* (Lombard et al. 2015; Crous et al. 2021a), the identification of Nectriaceous species remains a challenge to both plant pathologists and phytoquarantine staffs.

Phytelephas macrocarpa is mainly distributed in South America, commonly named as vegetable ivory (Smith 2015). The very hard seeds of this plant are used as a substitute for ivory and are used to make buttons, chess pieces and a variety of ornamental antiques (Smith 2015). Mature nuts of *Phytelephas macrocarpa* are recently increasingly imported to China through international freight transport or entry postal parcel. In December 2021, an entry postal parcel with mature nuts of *Phytelephas macrocarpa* from Togo was intercepted at China Customs (Dalian), and four fungal strains were isolated from the symptomatic tissues of mature nuts. Employing multi-locus phylogeny and morphological features, above strains were identified as a novel species belonging to *Nectriaceae* but could not be accommodated in any known genera. *Heteroverticillium phytelephatis* gen. et sp. nov. is thus described in this paper and its phylogenetic position is determined through our construction of a new backbone tree of *Nectriaceae*.

2. Materials and methods

2.1. Strains isolation

A total of four strains were isolated from the symptomatic tissues of the mature nuts of *Phytelephas macrocarpa* using single spore isolation (Zhang et al. 2013). The type specimens of new species described in this study were deposited in the Fungarium of Institute of Microbiology, Chinese Academy of Sciences, Beijing, China (HMAS), and the living ex-type cultures were deposited in the China General Microbiological Culture Collection Centre (CGMCC). All isolates examined in this study were also deposited in Lei Cai's personal culture collection (LC), housed at Institute of Microbiology, Chinese Academy of Sciences, Beijing, China. Taxonomic novelty descriptions and nomenclature were deposited in Fungal Names (Wang et al. 2023).

2.2. DNA extraction and amplification

Total genomic DNA was extracted from fresh fungal mycelia grown on PDA using the cetyltrimethyl ammonium bromide (CTAB) method (Porebski et al. 1997) and stored at −20 °C until use for polymerase chain reaction (PCR). PCR amplifications were performed in a reaction mixture consisting of 12.5 µL 2 × *Taq* PCR Master Mix (Vazyme Biotech Co., Ltd, Nanjing, China), 1 µL each of 10 µmol/L primers, 2 µL genomic DNA, adjusted to a final volume of 25 µL with distilled deionised water. Nine loci, including 28S large subunit (LSU) nrDNA, the internal transcribed spacer region and intervening 5.8S nrRNA gene (ITS), the large subunit of the ATP citrate lyase (*acl1*), the RNA polymerase II largest subunit (*rpb1*), RNA polymerase II second largest subunit (*rpb2*), β-tubulin (*tub2*), calmodulin (*CaM*), histone-3 (*H3*), and translation elongation factor 1-alpha (*tef1*) gene regions were amplified and sequenced, respectively. The PCR primer pairs and amplification conditions are listed in Table 1. The PCR products were visualised using 1% agarose electrophoresis gels. Sequencing was done by the Tianyi Huiyuan Company (Beijing, China) and SinoGenoMax Company (Beijing, China).

2.3. Phylogenetic analyses

Consensus sequences were obtained using MEGA v. 7 software (Kumar et al. 2016), and sequences for each locus were aligned using MAFFT v. 7.505 (Katoh and Standley 2013). Misalignments were corrected manually where necessary. Phylogenetic analyses were performed based on combined datasets, using Maximum-Likelihood (ML) and Bayesian Inference (BI) methods through the CIPRES Science Gateway portal (https://www.phylo.org/; Miller et al. 2012).

The ML analyses were carried out using RAxML-HPC v. 8.2.12 (Stamatakis 2014), with 1 000 replicates under the GTR+GAMMA model. The Bayesian analyses were carried out using MrBayes v. 3.2.7a (Huelsenbeck and Ronquist 2001; Ronquist and Huelsenbeck 2003), incorporating the best evolutionary models for each marker as determined by MrModelTest v. 2.4 (Nylander 2004). Bayesian analyses were computed with four simultaneous Markov Chain Monte Carlo chains for 20 M generations, and trees were sampled every 2 000 generations. The burn-in fraction was set to 0.25, after which the 50% majority rule consensus trees and posterior probability (PP) values were calculated.

Table 1. Primers used in this study, with originating loci, sequences programme and references.

Gene/DNA regions	Primers				PCR amplification procedures	References
Name	Abbreviation	Name	Direction	Sequence (5′→3′)		
28S large subunit of the rDNA	LSU	LR0R	Forward	ACCCGCTGAACTTAAGC	94 °C 90 s; 35 cycles of 94 °C 45 s, 57 °C 45 s, 72 °C 20 s; 72 °C 5 min; 10 °C soak	Rehner and Samuels (1994)
		LR5	Reverse	ATCCTGAGGGAAACTTC		Vilgalys and Hester (1990)
ATP citrate lyase	*acl1*	230up	Forward	AGCCCGATCAGCTCATCAAG	94 °C 90 s; 35 cycles of 94 °C 45 s, 57 °C 45 s, 72 °C 20 s; 72 °C 5 min; 10 °C soak	Gräfenhan et al. (2011)
		1220low	Reverse	CCTGGCAGCAAGATCVAGGAAGT		
Beta tubulin	*tub2*	T1	Forward	AACATGCGTGAGATTGTAAGT	95 °C 3 min; 35 cycles of 94 °C 30 s, 54 °C 45 s, 72 °C 15 s; 72 °C 10 min; 10 °C soak	O'Donnell and Cigelnik (1997)
		T2	Reverse	TAGTGACCCTTGGCCCAGTTG		
Calmodulin	*CaM*	CL1	Forward	GARTWCAAGGAGGCCTTCTC	95 °C 1 min; 35 cycles of 94 °C 30 s, 55 °C 30 s, 72 °C 15 s; 72 °C 10 min; 10 °C soak	O'Donnell et al. (2000b)
		CL2A	Reverse	TTTTTGCATCATGAGTTGGAC		
Histone	*H3*	H3-la	Forward	ACTAAGCAGACCGCCCGCAG	96 °C 2 min; 30 cycles of 92 °C 1 min, 60 °C 1 min, 72 °C 10 s; 72 °C 5 min; 10 °C soak	Roux et al. (2001)
		H3-lb	Reverse	GCGGGCGAGCTGGATGTCCTT		
Internal transcribed spacer region of the rDNA	ITS	ITS1	Forward	CCGTAGGTGAACCTGCGG	95 °C 5 min; 35 cycles of 95 °C 30 s, 52 °C 30 s, 72 °C 10 s; 72 °C 5 min; 10 °C soak	White et al. (1990)
		ITS4	Reverse	TCCTCCGCTTATTGATATGC		
RNA polymerase largest subunit	*rpb1*	F7	Forward	CRACACAGAAGAGTTTGAAGG	95 °C 5 min; 5 cycles of 95 °C 2 min, 58 °C 45 s, 72 °C 20 s; 5 cycles of 95 °C 2 min, 57 °C 45 s, 72 °C 20 s; 35 cycles of 95 °C 2 min, 56 °C 45 s, 72 °C 20 s; 72 °C 10 min; 10 °C soak	O'Donnell et al. (2010)
		G2R	Reverse	GTCATYTGDGTDGCDGGYTCDCC		
RNA polymerase second largest subunit	*rpb2*	5f2	Forward	GGGGWGAYCAGAAGAAGGC	94 °C 90 s; 35 cycles of 94 °C 45 s, 57 °C 45 s, 72 °C 20 s; 72 °C 5 min; 10 °C soak	Reeb et al. (2004) Liu et al. (1999)
		7cf	Forward	ATGGGYAARCAAGCYATGGG		
		7cr	Reverse	CCCATRGCTTGYTTRCCCAT		
		11ar	Reverse	GCRTGGATCTTRTCRTCSACC		
translation elongation factor 1-alpha	*tef1*	EF-1	Forward	ATGGGTAAGGARGACAAGAC	94 °C 90 s; 35 cycles of 94 °C 45 s, 55 °C 45 s, 72 °C 15 s; 72 °C 10 min; 10 °C soak	O'Donnell et al. (1998)
		EF-2	Reverse	GGARGTACCAGTSATCATG		

The clade supported with RAxML Bootstrap ≥70%, and the Bayesian PP ≥ 0.9 were marked on the tree (Figure 1). The tree was plotted using FigTree v. 1.4.2 (http://tree.bio.ed.ac.uk/software/figtree). All sequences and their alignments generated in this study were deposited in GenBank (Table 2) and TreeBASE (submission ID 30339), respectively.

2.4. Morphological observation

Obtained fungi were observed morphologically based on their macroscopic and microscopic features (Lombard et al. 2015). Plates were incubated for 7 days at 25 °C. Agar piece of approximately 5 × 5 mm was taken from the edge of colonies on synthetic nutrient-poor agar (SNA), and transferred onto different media for morphological observation. For macroscopic studies, potato dextrose agar (PDA), oatmeal agar (OA) and malt extract agar (MEA) media were used. The culture characteristics of the colony, including pigmentation and odour, were observed after 7 days of incubation in the dark on PDA, OA and MEA, respectively (Lombard et al. 2015). Colours were rated according to the colour charts (Kornerup and Wanscher 1978).

In the microscopic morphology study, SNA with sterile carnation leaves were used. Micromorphological characteristics, including conidiophores, phialides, and conidia, were observed after 7–14 days of incubation under a 12/12 h near-ultraviolet light/dark cycle at 25 °C (Lombard et al. 2015). Micromorphological characteristics were examined and photo-documented with water as mounting medium under a Nikon 80i microscope with differential interference contrast (DIC) optics, and a Nikon SMZ1500 dissecting microscope. For each species, 30 phialides and 50 conidia were randomly measured to calculate the mean value, standard deviation and minimum–maximum values. Descriptions and illustrations of taxonomic novelties were deposited in Fungal Names (Wang et al. 2023).

3. Results

3.1. Phylogenetic analysis

Employing 212 strains representing 169 species (five families), with *Stachybotrys chartarum* (CBS 129.13) and *Pseudoachroiostachys krabiense* (MFLUCC 16–0325) as outgroups, a high confidence phylogenetic tree was generated (Figure 1). The nine-locus alignment was 7497 bases in length including gaps. The best nucleotide substitution model for *acl1, CaM* and *tub2* loci was HKY + I + G, while GTR + I + G was selected for *H3*, ITS, LSU, *rpb1, rpb2* and *tef1*. The topology of multi-locus phylogenetic trees retrieved from ML and BI analyses were congruent. The results indicated that our new isolates formed a distinct clade in the *Nectriaceae* family but could not be included in any existing genera (Figure 1). Moreover, we provided a hitherto largest backbone tree of generic relationships in *Nectriaceae* based on phylogenetic analyses using existing sequence data from nine-locus (*acl1-CaM-H3*-ITS-LSU-*RPB1-RPB2-tef1-tub2*), and phylogenetic relationship of 63 accepted genera in this family were revealed (Figure 1). Most genera were monophyletic and supported by high bootstrap values. Our phylogenetic results showed that the ex-types of two *Varicosporellopsis* species, i.e. *V. aquatilis* and *V. americana* clustered in one clade together with 9 species of *Paracremonium*.

3.2. Taxonomy

New taxa

Heteroverticillium S.L. Han, L. Cai & P. Zhao, gen. nov. Figure 2.

Fungal name: FN 571491

Etymology: Heteros = ἕτερος in Greek, other; morphologically similar to but phylogenetically different from *Verticillium*.

Type species: *Heteroverticillium phytelephatis* S.L. Han, L. Cai & P. Zhao

Description: *Sexual morph*: not observed. *Asexual morph: Hyphae* hyaline, smooth-walled, septate, branched, with inconspicuously swollen septa. *Conidiophores* arising laterally from somatic hyphae, verticillately branching at 2–3 levels, with a terminal whorl of 1–5 phialides, and 1–2 lower nodes of 1–3 phialides, rarely with single phialides. *Phialides* monophialide, subulate, smooth- and thin-walled, periclinal thickening inconspicuous or absent. *Conidia* hyaline, smooth- and thin-walled, aseptate, ellipsoidal to slightly reniform.

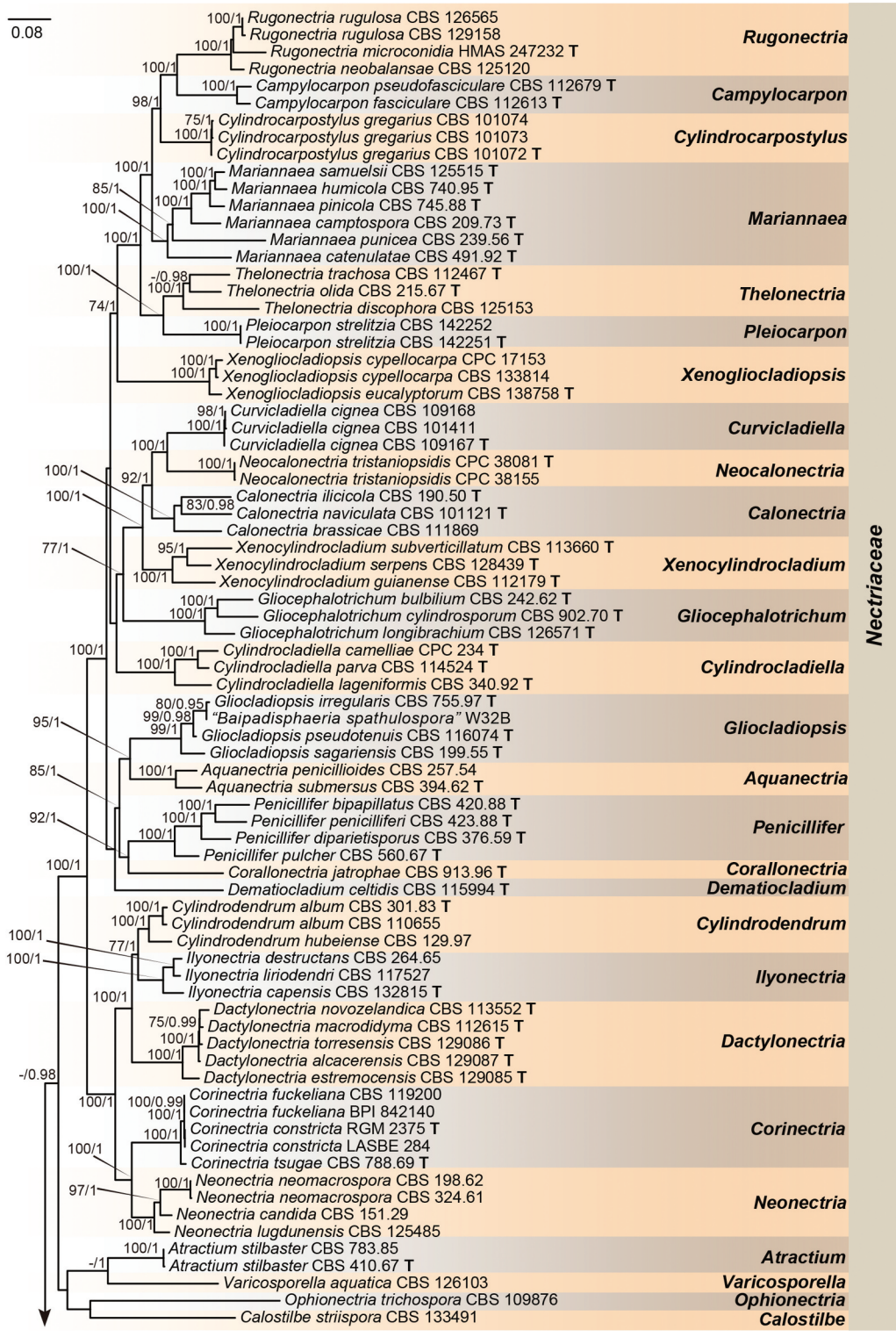

Figure 1. Phylogeny inferred based on the combined *acl1-CaM-H3*-ITS-LSU-*RPB1-RPB2-tef1-tub2* gene regions of species from *Nectriaceae*. *Stachybotrys chartarum* (CBS 129.13) and *Pseudoachroiostachys krabiense* (MFLUCC 16–0325) were used as outgroups. Strains isolated in this study were indicated in red colour. Strains of *Varicosporellopsis*, which is likely a late synonym of *Paracremonium* were indicated in green colour. The RAxML Bootstrap support values (ML-BS ≥ 70%) and Bayesian posterior probabilities (BI-PP ≥ 0.9) were displayed at the nodes (ML-BS/BI-PP). Ex-type, ex-epitype and ex-neotype strains were indicated in bold with T, ET, and NT, respectively. Strains need to be further identified were indicated with double quotation marks ("").

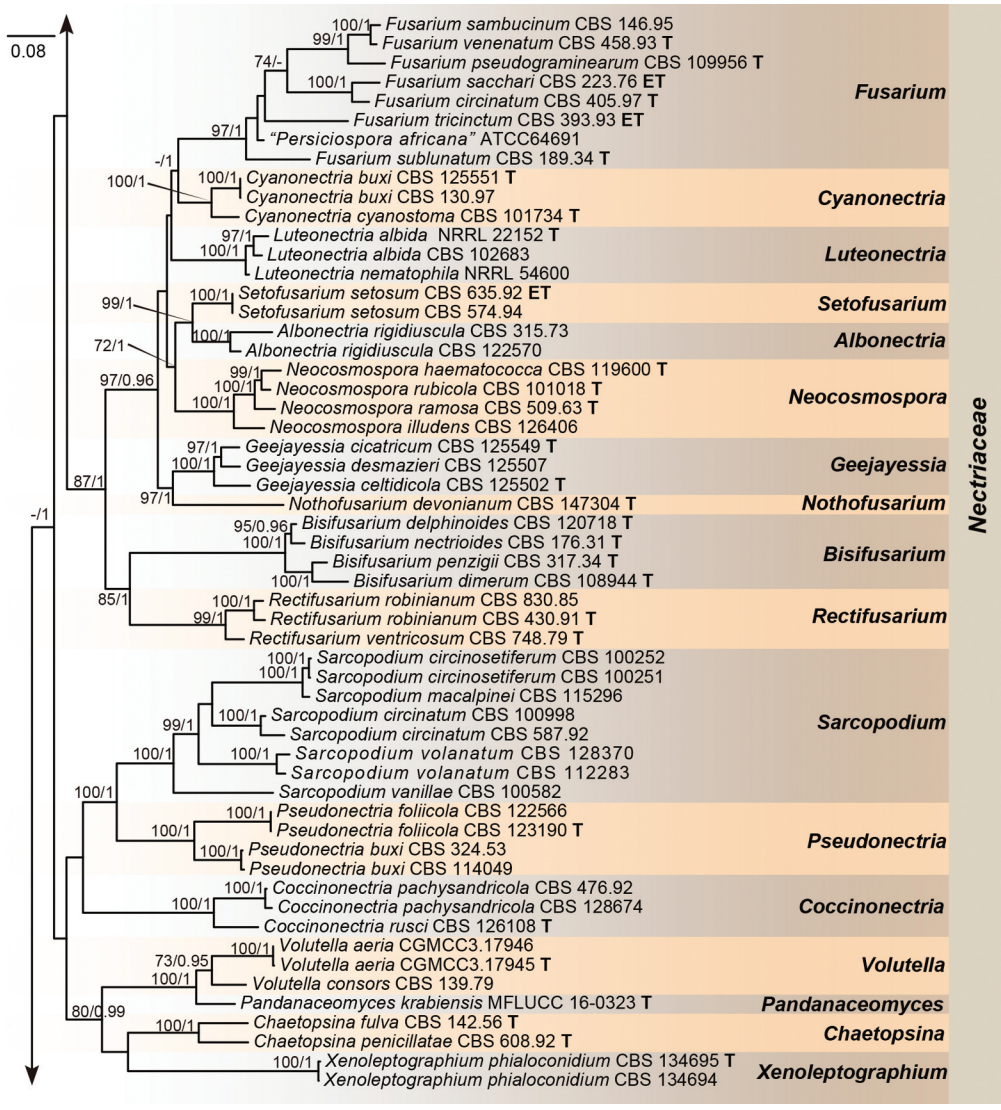

Figure 1. continued.

Heteroverticillium phytelephatis S.L. Han, L. Cai & P. Zhao, sp. nov. Figure 2

Fungal name: FN 571494

Etymology: Named after the host genus from which the type strain was isolated, *Phytelephas*.

Description: *Sexual morph*: not observed. *Asexual morph: Hyphae* 1.9–2.2 µm diam., hyaline, smooth-walled, septate, branched, with inconspicuously swollen septa. *Conidiophores* arises laterally from somatic hyphae, mostly 14.8–65.4 µm long, axis 1.7–2.9 µm wide, verticillately branching at 2–3 levels, with a terminal whorl of 1–5 phialides, and 1–2 lower nodes of 1–3 phialides, rarely with single phialides. *Phialides* monophialide, subulate, smooth- and thin-walled, periclinal thickening inconspicuous or absent, 11.7–39.1 × 1.2–2.3 µm (av. ± SD: 22.8 ± 1.9 × 2.1 ± 0.3 µm). *Conidia* hyaline, smooth- and thin-walled, aseptate, ellipsoidal to slightly reniform: 3.7–6.2 × 1.5–2.8 µm (av. ± SD: 4.4 ± 0.5 × 2.2 ± 0.3 µm). *Chlamydospores* not observed.

Culture characteristics: Colonies on PDA slow growing, reaching 23–27 mm diam. in 7 d after incubation at 25 °C in the dark, flat, with almost invisible aerial mycelium, wrinkled, margin entire, surface ivory; reverse white; odour absent. On OA reaching 31–38 mm diam. in 7 d after incubation 25 °C in the dark; flat, with sparse aerial mycelium, margin entire;

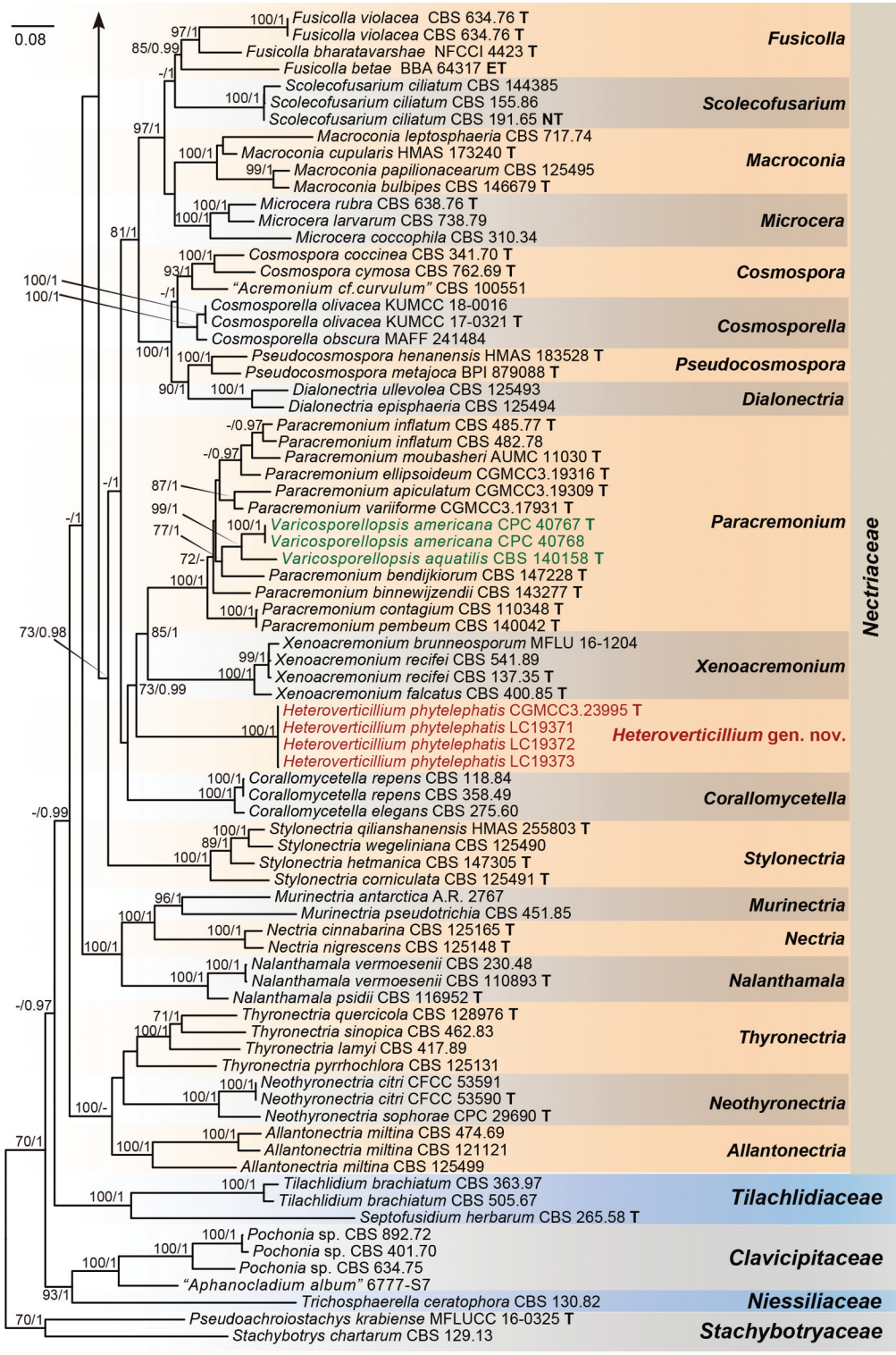

Figure 1. continued.

surface white; reverse cornsilk; odour absent. On MEA reaching 19–22 mm diam. in 7 d after incubation 25 °C in the dark; flat, with almost invisible aerial mycelium, margin entire; surface light beige; reverse beige; odour absent.

Material examined: TOGO, intercepted at China Customs (Dalian), infected nuts of *Phytelephas macrocarpa*, Dec. 2021, *X. Li*, HMAS 352429; TOGO, intercepted at China Customs (Dalian), isolated from infected nuts of *Phytelephas macrocarpa*, Dec. 2021,

X. Li (**holotype** HMAS 352423, dried culture; **ex-holotype living culture** CGMCC3.23995 = LC19374); *ibid*., LC19371; *ibid*., LC19372; *ibid*., LC19373.

Notes: The genus *Heteroverticillium* is phylogenetically allied to genera *Corallomycetella, Paracremonium* and *Xenoacremonium* (Figure 1). Morphologically, *Heteroverticillium* could be distinguished from these genera in the verticillately branching conidiophores, which is not observed in *Corallomycetella, Paracremonium* and *Xenoacremonium* (Lombard et al. 2015). *Heteroverticillium* also differs from *Corallomycetella, Paracremonium* and *Xenoacremonium* in lacking pigment production in culture, which is obvious in the later three.

4. Discussion

The growth of international trade, tourisms and post parcels in the past decades has facilitated the incidence of alien species invasion (Early et al. 2016). The number and frequency of intercepted quarantine species from post parcels are quickly accelerating, similar to those in cargo, passenger, conveyance, post, wood package and container (Lyu and Duan 2021). The Chinese customs has recently intercepted several alien insects, grass seeds and fungi from the post parcels (Yin and Ma 2004; Lin and Weng 2011; Ma et al. 2017; Wei 2019).

Based on the latest classification, four strains isolated from imported nuts of *Phytelephas macrocarpa*s in post parcels were identified to be representing a new genus in *Nectriaceae*. This is, to our knowledge, the first time a new fungal genus has been intercepted by Chinese Customs. The new genus *Heteroverticillium* is mainly characterised by verticillately branching conidiophores, closely related to *Corallomycetella, Paracremonium* and *Xenoacremonium* (*Nectriaceae*). Notably, these three genera contain mostly human and plant pathogenic fungi (Gams 1971; Lombard et al. 2015). While the pathogenicity of *Heteroverticillium phytelephatis* need to be further confirmed in future studies when fresh specimens of *Phytelephas macrocarpa*s were accessible.

Members of the family *Nectriaceae* are commonly found in various environments, and some are important plant or human pathogens (Lombard et al. 2015). Lombard et al. (2015) conducted hitherto most comprehensive morphological and molecular phylogenetic assessments of available type and authentic strains representing known genera in *Nectriaceae*, and their data have resolved most taxonomic discordances within the family *Nectriaceae*. Thereafter, 15 new genera within this family have been published (Crous et al. 2015, 2016, 2020, 2021a; Lechat and Fournier 2015, 2016; Aiello et al. 2017; González and Chaverri 2017; Huang et al. 2018; Hyde 2020). In this study, we updated the phylogenetic tree based on Lombard et al. (2015), with the addition of subsequently available data from 17 genera, which may greatly facilitate future identification of nectriaceous species in quarantine inspections. Several anamorph typified genera such as *Cyanochyta, Cyanophomella, Dacryoma*, and *Pleurocolla* were traditionally included in *Nectriaceae* but their phylogenetic relationships with other genera in *Nectriaceae* remain unclear due to the lack of molecular data. Compared with their original descriptions, our new genus could be well distinguishable from them by the verticillately branching conidiophores and the type of conidia (Höhnel von 1915, 1920; Petrak 1924; Samuels 1988).

Interestingly, the ex-types of two *Varicosporellopsis* species, i.e. *V. aquatilis* and *V. americana* proposed by Lechat and Fournier (2016) and Crous et al. (2021b) respectively, clustered within the *Paracremonium* clade (Figure 1), as also indicated in Crous et al. (2021b). Our phylogenentic analysis therefore indicated that the *Varicosporellopsis* is likely a late synonym of the anamorph typified genus *Paracremonium*. The genus *Paracremonium*, as circumscribed based on its type species *P. inflatum* (Lombard et al. 2015), could be distinguished from other acremonium-like genera by the formation of sterile coils (Lombard et al. 2015). However, none of the 9 subsequently described *Paracremonium* species produce sterile coils (Lynch et al. 2016; Crous et al. 2017, 2021b; Al-Bedak 2019; Zhang et al. 2020; DQ et al. 2021). The generic concept of *Paracremonium* might need to be updated with regard to the sterile coils, as well as the teleomorphic state observed in *V. aquatilis*.

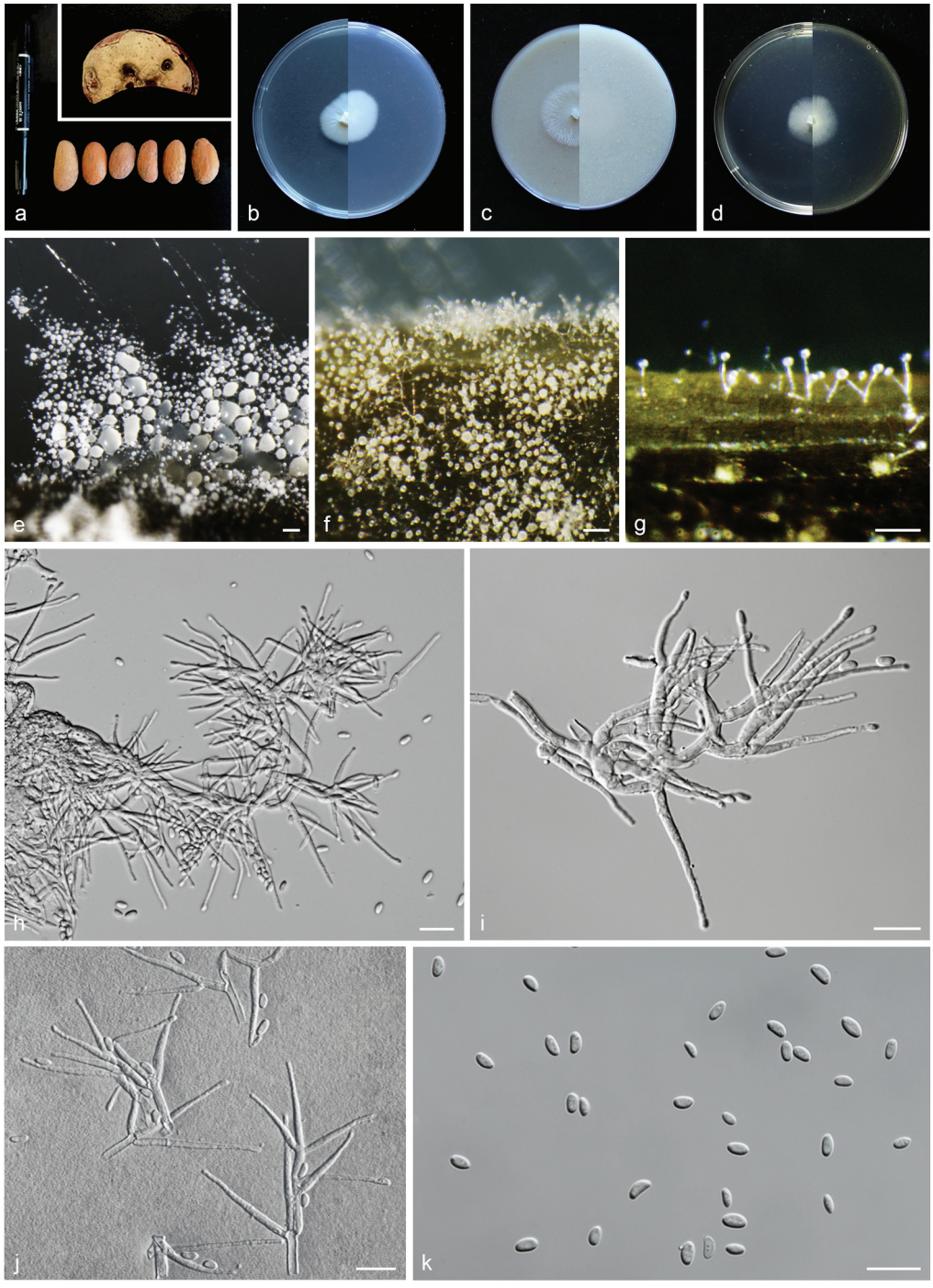

Figure 2. *Heteroverticillium phytelephatis* (CGMCC3.23995, ex-type culture). a: Disease symptoms on host plant. b: Front and reverse colony on PDA (7 d). c: Front and reverse colony on OA (7 d). d: Front and reverse colony on MEA (7 d). e-g: Aerial conidiophores. h-j: Conidiophores and phialides. k: Conidia. Scale bars: e-g = 50 µm; h-k = 10 µm.

Table 2. Strains analysed in this study, with information about host/substrate, location and GenBank accessions of sequences.

					GenBank accession numbers[3]								
Family	Species name[1]	Strain numbers[2]	Substrate	Location	*acl1*	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Clavicipitaceae	*Pochonia* sp.	CBS 401.70 = NRRL26536	*Myxomycete*	The Netherlands	KM231089	KM231439	KM231598	KM231843	AF339518	KM232276	KM232419	KM231980	KM232114
Clavicipitaceae	*Pochonia* sp.	CBS 892.72	*Arcyria* sp.	The Netherlands	KM231090	KM231440	KM231599	KM231844	KM231724	KM232277	KM232420	KM231981	KM232115
Clavicipitaceae	*Pochonia* sp.	CBS 634.75	*Myxomycete*	The Netherlands	KM231091	KM231441	–	KM231845	KM231725	KM232278	KM232421	KM231982	KM232116
Nectriaceae	*"Acremonium cf. curvulum"*	CBS 100551	*Olea europaea*	Italy	KM231057	KM231400	KM231552	KM231818	HQ232031	KM232244	KM232385	KM231949	KM232088
Nectriaceae	*"Aphanocladium album"*	6777-S7	–	–	–	–	–	KC008970	KC009230	–	–	–	–
Nectriaceae	*"Baipadisphaeria spathulospora"*	W32B	*Licuala longicalycata*	Sirindhorn peat swamp forest	–	–	–	–	HM134244	–	–	–	–
Nectriaceae	*Albonectria rigidiuscula*	CBS 122570 = GJS 01-170	Bark	Cameroon	HQ897896	KM231382	KM231533	HQ897815	KM231676	KM232228	HQ897760	KM231937	KM232070
Nectriaceae	*Albonectria rigidiuscula*	CBS 315.73 = ATCC24367 = IMI 137397	*Theobroma cacao*	Malaysia	KM231012	KM231383	KM231534	KM231809	KM231677	KM232229	KM232378	KM231938	KM232071
Nectriaceae	*Allantonectria miltina*	CBS 474.69 = MUCL14535	*Agave americana*	Spain	KM231080	KM231430	KM231592	KM231835	KM231716	KM232269	KM232408	KM231973	–
Nectriaceae	*Allantonectria miltina*	CBS 125499 = TG 2008-02	Yucca elata	USA	–	KM231432	–	KM231836	KM231717	KM232270	HQ897730	KM231974	KM232107
Nectriaceae	*Allantonectria miltina*	CBS 121121 = AR 4391	*Agave americana*	Italy	KM231081	KM231431	KM231593	HM484547	HM484572	HM484587	KM232409	HM484524	HM484609
Nectriaceae	*Aquanectria penicillioides*	CBS 257.54 = ATCC16261	*Acer* sp.	USA	KM230954	KM231275	–	KM231743	KM231613	KM232135	KM232299	KM231865	KM232000
Nectriaceae	*Aquanectria submersus*	CBS 394.62^T	Unknown	UK	HQ897845	–	KM231458	HQ897796	KM231612	KM232134	HQ897728	–	KM231999
Nectriaceae	*Atractium stilbaster*	CBS 410.67^T	Decaying bark	Germany	KM230990	KM231357	KM231509	KM231791	KM231654	KM232206	–	KM231920	KM232050
Nectriaceae	*Atractium stilbaster*	CBS 783.85 = KAS 385a	Stump	Sweden	KM230991	KM231358	KM231510	KM231792	KM231655	KM232207	–	KM231921	KM232051
Nectriaceae	*Bisifusarium delphinoides*	CBS 120718^T = CPC 13041	*Hoodia gordonii*	South Africa	KM230994	KM231363	KM231515	EU926229	KM231660	KM232210	–	EU926296	KM232056
Nectriaceae	*Bisifusarium dimerum*	CBS 108944^T = NRRL 36140	*Homo sapiens*	The Netherlands	KM230996	KM231365	KM231517	JQ434586	JQ434514	KM232212	KM232363	EU926334	EU926400
Nectriaceae	*Bisifusarium nectrioides*	CBS 176.31^T = NRRL 20689	Soil	Honduras	KM230993	KM231362	KM231514	EU926245	KM231659	KM232209	HQ897721	EU926312	KM232055
Nectriaceae	*Bisifusarium penzigii*	CBS 317.34^T = NRRL 22109	*Fagus sylvatica*	UK	KM230995	KM231364	KM231516	KM231795	KM231661	KM232211	KM232362	EU926324	EU926390
Nectriaceae	*Calonectria brassicae*	CBS 111869 = CPC2409 = PC 551197	*Argyreia sp.*	–	KM230965	GQ267382	DQ190720	GQ280576	GQ280698	KM232181	KM232308	FJ918567	AF232857
Nectriaceae	*Calonectria ilicicola*	CBS 190.50^T = CPC 2482 = IMI 299389	*Solanum tuberosum*	Java	KM230964	AY725764	AY725676	GQ280605	GQ280727	KM232180	KM232307	AY725726	AY725631
Nectriaceae	*Calonectria naviculata*	CBS 101121^T = CMW 30974	Leaf litter	Brazil	KM230966	GQ267399	GQ267252	GQ280600	GQ280722	KM232182	KM232309	GQ267317	GQ267211
Nectriaceae	*Calostilbe striispora*	CBS 133491	–	French Guiana	–	KM231355	–	KM231789	KM231653	KM232204	KM232361	KM231918	KM232048
Nectriaceae	*Campylocarpon fasciculare*	CBS 112613^T = CPC 3970	*Vitis* sp.	South Africa	KM231026	KM231297	JF735502	AY677301	HM364313	HM364331	KM232322	JF735691	AY677221
Nectriaceae	*Campylocarpon pseudofasciculare*	CBS 112679^T = CPC 5472	*Vitis vinifera*	South Africa	KM231027	KM231298	JF735503	AY677306	HM364314	HM364332	KM232323	JF735692	AY677214
Nectriaceae	*Chaetopsina fulva*	CBS 142.56^T = IMI 062199	*Cedrus deodara*	Italy	KM230977	KM231338	KM231495	KM231772	KM231637	KM232188	–	KM231902	KM232030
Nectriaceae	*Chaetopsina penicillatae*	CBS 608.92^T = GJS 77- 21 = ATCC 56205	*Beilschmiedia tawa*	New Zealand	HQ897847	–	–	HQ897798	KM231638	–	HQ897709	KM231903	KM232031
Nectriaceae	*Coccinonectria pachysandricola*	CBS 128674 = AR 4592	*Pachysandra terminalis*	USA	KM230981	KM231341	KM231499	JF832658	JF832715	JF832791	KM232351	JF832544	JF832909
Nectriaceae	*Coccinonectria pachysandricola*	CBS 476.92 = PD 92/1036	*Pachysandra terminalis*	The Netherlands	KM230980	–	KM231498	KM231775	KM231641	KM232191	–	KM231906	KM232034
Nectriaceae	*Coccinonectria rusci*	CBS 126108^T	*Ruscus aculeatus*	France	KM230978	KM231339	KM231496	KM231773	KM231639	KM232189	KM232349	KM231904	KM232032
Nectriaceae	*Corallomycetella elegans*	CBS 275.60	*Musa sapientum*	Zaire	–	–	KM231567	KM231828	KM231710	–	KM232393	KM231963	KM232100

(*Continued*)

Table 2. (Continued).

Family	Species name[1]	Strain numbers[2]	Substrate	Location	GenBank accession numbers[3]								
					acl1	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Corallomycetella repens*	CBS 358.49	*Carica papaya*	Java	KM231063	–	KM231565	KC479756	KM231708	KM232258	KM232391	KM231961	KC479785
Nectriaceae	*Corallomycetella repens*	CBS 118.84 = IMI101072	Soil	Sri Lanka	KM231064	–	KM231566	KC479755	KM231709	KM232259	KM232392	KM231962	KC479784
Nectriaceae	*Corallonectria jatrophae*	CBS 913.96^{T} = GJS 96-18	Unknown tree	Puerto Rico	KM230951	KM231273	KM231457	KC479758	KM231611	KM232132	KM232298	KM231863	KC479787
Nectriaceae	*Corinectria constricta*	LASBE 284 = SGO 167411	*Pinus radiata*	Chile	–	–	–	–	–	–	–	KY636411	KY636418
Nectriaceae	*Corinectria constricta*	RGM 2375^{T} = LASBE 330 = SGO 167415	*Pinus radiata*	Chile	–	–	–	–	–	–	–	–	KY636422
Nectriaceae	*Corinectria fuckeliana*	CBS 119200 = A.R. 4110 = IMI 871034	*Picea abies*	Austria	–	–	–	HM364293	HM364306	–	–	HM364344	HM352859
Nectriaceae	*Corinectria fuckeliana*	BPI 842140 = A.R. 3103	*Picea abies*	Austria	–	–	–	HM364291	–	–	–	HM364342	HM352857
Nectriaceae	*Corinectria tsugae*	CBS 788.69^{T}	*Tsuga heterophylla*	Canada	HQ897865	KM231316	KM231483	KM231763	HQ232146	KM232161	HQ897728	–	KM232020
Nectriaceae	*Cosmospora coccinea*	CBS 341.70^{T}	*Inonotus nodulosus*	Germany	HQ897913	KM231398	KM231550	HQ897827	KM231692	KM232242	HQ897777	KM231947	KM232086
Nectriaceae	*Cosmospora cymosa*	CBS 762.69^{T}	*Inonotus radiatus*	Germany	HQ897914	KM231399	KM231551	HQ897828	KM231693	KM232243	HQ897778	KM231948	KM232087
Nectriaceae	*Cosmosporella obscura*	MAFF 241484	–	–	–	–	–	KC291719	KC291788	–	–	–	KC291903
Nectriaceae	*Cosmosporella olivacea*	KUMCC 18-0016	–	–	–	–	–	MH087213	MH087215	–	–	–	MH087217
Nectriaceae	*Cosmosporella olivacea*	KUMCC 17-0321^{T}	dead wood	China	–	–	–	MH087212	MH087214	–	–	–	MH087216
Nectriaceae	*Curvicladiella cignea*	CBS 109167^{T} = CPC 1595 = MUCL 40269	Leaf litter	French Guiana	KM230969	KM231287	KM231461	AF220973	AY793431	KM232142	KM232311	KM231867	KM232002
Nectriaceae	*Curvicladiella cignea*	CBS 101411 = MUCL40268	Decaying seed	French Guiana	KM230967	KM231285	KM231459	KM231744	JQ666075	KM232141	KM232310	KM231866	KM232001
Nectriaceae	*Curvicladiella cignea*	CBS 109168 = CPC1594 = MUCL 40268	Decaying seed	French Guiana	KM230968	KM231286	KM231460	KM231745	JQ666074	KM232143	KM232312	KM231868	KM232003
Nectriaceae	*Cyanonectria buxi*	CBS 125551^{T} = HJS 1398	*Buxus sempervirens*	Slovenia	HM626630	–	–	HM626661	HM626673	–	HM626689	HM626648	–
Nectriaceae	*Cyanonectria buxi*	CBS 130.97	*Buxus sempervirens*	France	HM626622	KM231388	KM231539	KM231811	KM231679	KM232233	HM626690	HQ728150	KM232075
Nectriaceae	*Cyanonectria cyanostoma*	CBS 101734^{T} = GJS 98-127	*Buxus sempervirens*	France	HQ897895	KM231387	KM231538	FJ474076	HM626671	GQ506017	HQ897759	HM484535	HM484611
Nectriaceae	*Cylindrocarpostylus gregarius*	CBS 101073	*Pinus sylvestris*	Germany	KM231022	KM231293	KM231465	KM231748	JQ666083	–	KM232318	KM231871	KM232006
Nectriaceae	*Cylindrocarpostylus gregarius*	CBS 101074	*Picea abies*	Germany	KM231020	KM231291	–	KM231746	KM231614	–	KM232316	KM231869	KM232004
Nectriaceae	*Cylindrocarpostylus gregarius*	CBS 101072^{T}	*Hylurgops palliatus*	Germany	KM231021	KM231292	–	KM231747	JQ666084	KM232144	KM232317	KM231870	KM232005
Nectriaceae	*Cylindrocladiella camelliae*	CPC 234T = PPRI 3990 = IMI 346845	*Eucalyptus grandis*	South Africa	KM230959	KM231280	AY793509	AF220952	JN099249	KM232139	KM232304	JN099087	AY793471
Nectriaceae	*Cylindrocladiella lageniformis*	CBS 340.92^{T} = PPRI 4449 = UFV 115	*Eucalyptus* sp.	Brazil	KM230958	KM231279	AY793520	AF220959	JN099165	JN989491	KM232303	JN099003	AY793481
Nectriaceae	*Cylindrocladiella parva*	CBS 114524^{T} = ATCC 28272 = CPC 2370	*Telopea speciosissima*	New Zealand	KM230960	KM231281	AY793526	AF220964	JN099171	KM232140	–	JN099009	AY793486
Nectriaceae	*Cylindrodendrum album*	CBS 301.83^{T} = ATCC 46842 = IMI 255534	*Fucus distichus*	Canada	KM231046	KM231322	KM231484	KM231764	KM231626	KM232162	KM232339	KM231889	KM232021
Nectriaceae	*Cylindrodendrum album*	CBS 110655	Soil	The Netherland	KM231047	KM231323	KM231485	KM231765	KM231627	KM232163	KM232340	KM231890	KM232022
Nectriaceae	*Cylindrodendrum hubeiense*	CBS 129.97	*Viscum album*	France	KM231048	KM231324	KM231486	KM231766	KM231628	KM232164	KM232341	KM231891	KM232023
Nectriaceae	*Dactylonectria alcacerensis*	CBS 129087^{T} = CPC 19172	*Vitis vinifera*	Portugal	KM231054	KM231330	JF735630	JF735333	KM231629	KM232176	–	JF735819	AM419111
Nectriaceae	*Dactylonectria estremocensis*	CBS 129085^{T} = CPC 19170	*Vitis vinifera*	Portugal	KM231052	KM231328	JF735617	JF735320	KM231630	KM232174	KM232345	JF735807	JF735448

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Table 2. (Continued).

					GenBank accession numbers[3]								
Family	Species name[1]	Strain numbers[2]	Substrate	Location	*acl1*	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Dactylonectria macrodidyma*	CBS 112615^{T} = CPC 3976	*Vitis vinifera*	South Africa	KM231055	KM231331	JF735647	AY677290	HM364315	HM364333	JF268710	JF268750	AY677233
Nectriaceae	*Dactylonectria novozelandica*	CBS 113552^{T} = CPC 5713	*Vitis vinifera*	New Zealand	KM231053	KM231329	JF735633	JF735334	–	KM232175	KM232346	JF735822	AY677237
Nectriaceae	*Dactylonectria torresensis*	CBS 129086^{T} = CPC 19171	*Vitis vinifera*	Portugal	KM231056	KM231332	JF735681	JF735362	KM231631	KM232177	KM232347	JF735870	JF735492
Nectriaceae	*Dematiocladium celtidis*	CBS 115994^{T}	*Celtis tala*	Argentina	KM230952	KM231274	–	AY793430	AY793438	KM232133	–	KM231864	–
Nectriaceae	*Dialonectria episphaeria*	CBS 125494 = TG 2006-11	Unknown Ascomycete	Canada	HQ897892	KM231404	KM231556	HQ897811	KM231697	KM232248	HQ897756	KM231953	KM232092
Nectriaceae	*Dialonectria ullevolea*	CBS 125493 = TG 2007-56	Unknown Ascomycete	USA	HQ897918	KM231403	KM231555	KM231821	KM231696	KM232247	HQ897782	KM231952	KM232091
Nectriaceae	*Fusarium circinatum*	CBS 405.97^{T} = BBA 69720 = DAOM 225113 = MRC 7541 = NRRL 25331	*Pinus radiata*	USA	KM231017	KM231393	KM231544	U61677	MH874260	–	JX171623	KM231943	KM232080
Nectriaceae	*Fusarium pseudograminearum*	CBS 109956^{T} = NRRL 28062	*Hordeum vulgare*	Australia	–	–	–	DQ459871	DQ459871	JX171524	JX171637	AF212468	–
Nectriaceae	*Fusarium sacchari*	CBS 223.76^{ET} = BBA 63340 = DAOM 225138 = IMI 202881 = NRRL 13999	*Saccharum officinarum*	India	–	AF158331	–	–	–	JX171466	JX171580	AF160278	U34414
Nectriaceae	*Fusarium sambucinum*	CBS 146.95 = BBA64226	*Solanum tuberosum*	UK	KM231015	KM231391	KM231542	KM231813	KM231682	KM232235	KM232381	KM231941	KM232078
Nectriaceae	*Fusarium sublunatum*	CBS 189.34^{T} = BBA 62431 = NRRL 13384	Soil	Costa Rica	HQ897916	KM231389	KM231540	HQ897830	KM231680	–	KM232380	–	KM232076
Nectriaceae	*Fusarium tricinctum*	CBS 393.93^{ET} = BBA 64485 = NRRL 25481	Winter wheat culm base	Germany	–	–	–	HM068317	HM068317	JX171516	JX171629	AB674263	–
Nectriaceae	*Fusarium venenatum*	CBS 458.93^{T} = BBA 64537 = NRRL 26228	Winter wheat	Austria	KM231016	KM231392	KM231543	KM231814	KM231683	KM232236	KM232382	KM231942	KM232079
Nectriaceae	*Fusicolla betae*	BBA 64317^{ET}	*Triticum aestivum*	Germany	HQ897917	–	–	MH855265	MH866717	–	HQ897781	–	–
Nectriaceae	*Fusicolla bharatavarshae*	NFCCI 4423^{T}	*Avicennia marina*	India	–	–	–	MK152510	MK152511	–	MK157022	–	MK376462
Nectriaceae	*Fusicolla violacea*	CBS 634.76^{T} = BBA 62461 = NRRL 20896	*Quadraspidiotus perniciosus*	Iran	KM231059	KM231407	KM231558	KM231824	KM231700	KM232251	HQ897696	KM231956	KM232095
Nectriaceae	*Fusicolla violacea*	CBS 634.76^{T} = BBA 62461 = NRRL 20896	*Quadraspidiotus perniciosus*	Iran	–	–	–	KM231824	U88112	PENDING	HQ897696	KM231956	KM232095
Nectriaceae	*Geejayessia celtidicola*	CBS 125502^{T} = TG 2008-32	*Celtis occidentalis*	Canada	HM626625	KM231386	KM231537	HM626657	HM626669	KM232232	HM626685	HM626638	KM232074
Nectriaceae	*Geejayessia cicatricum*	CBS 125549^{T} = HJS 1372	*Buxus sempervirens*	Slovenia	HM626636	KM231385	KM231536	KM231810	KM231678	KM232231	HM626679	HM626643	KM232073
Nectriaceae	*Geejayessia desmazieri*	CBS 125507 = TG 2007-87	*Buxus sempervirens*	Spain	HM626633	KM231384	KM231535	HM626651	HM626663	KM232230	HM626675	HQ728146	KM232072
Nectriaceae	*Gliocephalotrichum bulbilium*	CBS 242.62^{T} = ATCC 22228 = IFO 9325 = IMI 096357 = MUCL 18575 = NRRL 2899 = QM 9007	Soil	USA	KM230962	KM231283	KF513326	MH858145	AY489732	AY489664	EF469114	KM231892	DQ377831
Nectriaceae	*Gliocephalotrichum cylindrosporum*	CBS 902.70^{T} = ATCC 22229 = IFO 9326 = IMI 155704 = MUCL 18576 = QM 9009	Soil	Thailand	KM230963	KM231284	KF513353	DQ366705	JQ666077	KM232179	KM232306	KF513408	DQ377841
Nectriaceae	*Gliocephalotrichum longibrachium*	CBS 126571^{T} = MUCL 46693	Leaf litter	French Guiana	KM230961	KM231282	KF513367	DQ278422	KM231686	KM232178	KM232305	KF513435	DQ377835
Nectriaceae	*Gliocladiopsis irregularis*	CBS 755.97^{T} = CPC 718	Soil	Indonesia	KM230957	KM231278	JQ666023	AF220977	JQ666082	KM232138	KM232302	KF513449	JQ666133
Nectriaceae	*Gliocladiopsis pseudotenuis*	CBS 116074^{T} = CPC 706	Soil	China	KM230956	KM231277	JQ666030	AF220981	JQ666080	KM232137	KM232301	JQ666099	JQ666140

(*Continued*)

Table 2. (Continued).

Family	Species name[1]	Strain numbers[2]	Substrate	Location	GenBank accession numbers[3]								
					acl1	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Gliocladiopsis sagariensis*	CBS 199.55^{T}	Soil	India	KM230955	KM231276	JQ666031	JQ666063	JQ666078	KM232136	KM232300	JQ666106	JQ666141
Nectriaceae	***Heterovertiсillium phytelephatis***	LC19371	*Phytelephas macrocarpa*	Togo	**OQ779138**	**OQ779142**	**OQ779146**	**OQ780394**	**OQ780398**	**OQ779150**	**OQ779154**	**OQ779158**	**OQ779162**
Nectriaceae	***Heterovertiсillium phytelephatis***	LC19372	*Phytelephas macrocarpa*	Togo	**OQ779139**	**OQ779144**	**OQ779148**	**OQ780395**	**OQ780399**	**OQ779151**	**OQ779155**	**OQ779160**	**OQ779163**
Nectriaceae	***Heterovertiсillium phytelephatis***	LC19373	*Phytelephas macrocarpa*	Togo	**OQ779140**	**OQ779143**	**OQ779147**	**OQ780396**	**OQ780400**	**OQ779153**	**OQ779156**	**OQ779159**	**OQ779165**
Nectriaceae	***Heterovertiсillium phytelephatis***	CGMCC3.23995^{T} = LC19374	*Phytelephas macrocarpa*	Togo	**OQ779141**	**OQ779145**	**OQ779149**	**OQ780397**	**OQ780401**	**OQ779152**	**OQ779157**	**OQ779161**	**OQ779164**
Nectriaceae	*Ilyonectria capensis*	CBS 132815^{T}	*Protea* sp.	South Africa	–	KM231319	JX231135	JX231151	KM515908	KM232171	KM232336	JX231119	JX231103
Nectriaceae	*Ilyonectria destructans*	CBS 264.65	*Cyclamen persicum*	Sweden	–	KM231317	JF735506	AY677273	KM515927	KM232169	KM232334	JF735695	AY677256
Nectriaceae	*Ilyonectria liriodendri*	CBS 117527	*Vitis vinifera*	Portugal	–	KM231318	JF735509	DQ178165	KM515922	KM232170	KM232335	JF735698	DQ178172
Nectriaceae	*Luteonectria albida*	CBS 102683 = GJS 99-73 = GJS 8522A	Tree bark	Costa Rica	–	–	–	MW827615	MH874402	–	MW834016	MW834283	–
Nectriaceae	*Luteonectria albida*	NRRL 22152^{T} = NRRL 13950	Woody stem bark	Jamaica	–	–	–	–	–	JX171492	JX171605	–	–
Nectriaceae	*Luteonectria nematophila*	NRRL 54600	Unknown	Germany	–	–	–	–	–	JX171552	JX171664	–	–
Nectriaceae	*Macroconia bulbipes*	CBS 146679^{T} = CPC 37138	*Erica* sp. associated with *Dimerosporiopsis engleriana*	South Africa	MW834046	MW834115	–	NR_173436	NG_076704	MW834202	MW834018	–	MW834310
Nectriaceae	*Macroconia cupularis*	HMAS 173240^{T}	*Stylodothis* sp.	China	–	–	–	EF121864	EF121870	–	–	–	–
Nectriaceae	*Macroconia leptosphaeria*	CBS 717.74	Stroma of *Pyrenomycete*	France	KM231062	KM231414	KM231564	KM231827	KM231707	KM232257	KM232390	JF735695	KM232099
Nectriaceae	*Macroconia papilionacearum*	CBS 125495 = DAOM 238119 = TG 2007-03	*Black ascomycete* on *Fabaceae*	USA	HQ897912	KM231411	KM231561	HQ897826	KM231704	KM232254	HQ897776	KM231958	KM232096
Nectriaceae	*Mariannaea camptospora*	CBS 209.73^{T} = IMI 186965	Soil	The Netherlands	KM231032	KM231303	KM231473	AY624202	–	KM232147	KM232326	KM231875	AY624245
Nectriaceae	*Mariannaea catenulatae*	CBS 491.92^{T} = ATCC 56204	Wood	Venezuela	KM231030	KM231301	KM231471	KM231752	KM231617	KM232150	–	KM231877	KM232009
Nectriaceae	*Mariannaea humicola*	CBS 740.95^{T} = CCT 4534	Soil	Brazil	KM231034	KM231305	KM231475	KM231755	KM231619	KM232153	KM232328	KM231880	KM232012
Nectriaceae	*Mariannaea pinicola*	CBS 745.88^{T} = CTR 71- 199	*Pinus* sp.	Venezuela	KM231033	KM231304	KM231474	KM231754	AY554242	KM232152	KM232327	KM231879	KM232011
Nectriaceae	*Mariannaea punicea*	CBS 239.56^{T}	Soil	Zaire	KM231028	KM231299	KM231469	AY624201	JF415981	KM232148	JF416001	KM231876	AY624244
Nectriaceae	*Mariannaea samuelsii*	CBS 125515^{T} = DAOM 235814 = KAS 1307	Soil	Guatamala	HQ897888	KM231308	KM231478	HQ843767	HQ843766	KM232156	HQ897752	KM231883	KM232015
Nectriaceae	*Microcera coccophila*	CBS 310.34 = NRRL 13962	*Scale insect*	Italy	HQ897843	KM231410	KM231560	HQ897794	KM231703	–	HQ897705	JF740692	–
Nectriaceae	*Microcera larvarum*	CBS 738.79 = BBA 62239 = MUCL 19033 = NRRL 20473	*Quadrapidiotus perniciosus*	Iran	KM231060	KM231408	KM231559	KM231825	KM231701	KM232252	KM232387	KM231957	–
Nectriaceae	*Microcera rubra*	CBS 638.76^{T} = BBA 62460 = NRRL 20475	*Quadrapidiotus perniciosus*	Iran	HQ897903	KM231409	–	HQ897820	KM231702	KM232253	HQ897767	JF740696	EU860019
Nectriaceae	*Murinectria antarctica*	A.R. 2767	–	–	–	–	–	HM484556	HM484560	HM484575	–	HM484516	HM484601
Nectriaceae	*Murinectria pseudotrichia*	CBS 451.85	–	–	MH936731.1	MH936837.1	MH936801.1	MH892586	GQ506000.1	GQ506030.1	MH936692.1	–	–
Nectriaceae	*Nalanthamala psidii*	CBS 116952^{T} = AR 4095	*Psidium guajava*	Taiwan	KM231073	KM231423	KM231576	AY864836	AY864837	KM232268	KM232401	KM231972	AY864838
Nectriaceae	*Nalanthamala vermoesenii*	CBS 110893^{T} = MUCL 9504	*Areca* sp.	–	KM231072	KM231422	KM231575	AY554214	AY554246	KM232267	KM232400	KM231971	AY554233

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Table 2. (Continued).

Family	Species name[1]	Strain numbers[2]	Substrate	Location	GenBank accession numbers[3]								
					acl1	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Nalanthamala vermoesenii*	CBS 230.48 = ATCC 10522 = IMI 040231 = MUCL 7584 = NRRL 1752	*Citrus medica*	Spain	KM231071	KM231421	KM231574	AY554212	AY554263	KM232266	KM232399	KM231970	AY554231
Nectriaceae	*Nectria cinnabarina*	CBS 125165^T = AR 4477 = CLL 7152	*Aesculus* sp.	France	KM231074	KM231424	KM231577	HM484548	HM484562	HM484577	KM232402	HM484527	HM484606
Nectriaceae	*Nectria nigrescens*	CBS 125148^T = AR 4211	Wood	USA	KM231075	KM231425	KM231578	HM484707	HM484720	HM484781	KM232403	HM484672	HM484806
Nectriaceae	*Neocalonectria tristaniopsidis*	CPC 38155 = CBS 146805	leaves of *Tristaniopsis collina*	Australia	–	MW173098	MW173107	MW175334	MW175374	–	MW173110	MW173119	MW173131
Nectriaceae	*Neocalonectria tristaniopsidis*	CPC 38081 = CBS 146800^T	leaves of *Tristaniopsis collina (Myrtaceae)*	Australia	–	MW173097	MW173106	MW175333	MW175373	–	MW173109	MW173118	MW173130
Nectriaceae	*Neocosmospora haematococca*	CBS 119600^T = GJS 02- 90	Dying tree	Sri Lanka	KM230999	KM231369	KM231521	KM231797	KM231664	KM232216	–	KM231926	KM232059
Nectriaceae	*Neocosmospora illudens*	CBS 126406 = GJS 85-67	Bark	New Zealand	KM231008	KM231378	KM231529	JF832660	JF832762	JF832837	KM232373	KM231934	JF832841
Nectriaceae	*Neocosmospora ramosa*	CBS 509.63^T = IMUR 410 = MUCL 8050	Air	Brazil	KM231004	KM231374	KM231525	KM231802	KM231669	KM232221	KM232369	KM231930	KM232064
Nectriaceae	*Neocosmospora rubicola*	CBS 101018^T	*Rubus idaeus*	Italy	KM231002	KM231372	KM231524	KM231800	KM231667	KM232219	KM232367	KM231928	KM232062
Nectriaceae	*Neonectria candida*	CBS 151.29 = IMI 113894 = MUCL 28083	*Malus sylvestris*	UK	KM231044	KM231315	JF735602	AY677291	HM042436	KM232168	DQ789792	DQ789723	DQ789863
Nectriaceae	*Neonectria lugdunensis*	CBS 125485 = DAOM 235831 = TG 2008-07	*Populus fremontii*	USA	HQ897867	KM231314	KM231482	KM231762	KM231625	KM232160	HQ897731	KM231887	KM232019
Nectriaceae	*Neonectria neomacrospora*	CBS 198.62 = BBA 9628 = IMI 113890	*Abies concolor*	Germany	KM231041	KM231312	KM231481	AJ009255	HM364316	KM232167	DQ789795	JF735788	DQ789866
Nectriaceae	*Neonectria neomacrospora*	CBS 324.61 = DSM 62489	*Abies concolor*	The Netherlands	KM231042	KM231313	JF735599	JF735312	HM364318	HM364335	DQ789803	KM231888	DQ789875
Nectriaceae	*Neothyronectria citri*	CFCC 53591	*Citrus maxima cv. Shatian*	China	–	–	–	MK861081	MK861072	–	–	MK902789	MK902798
Nectriaceae	*Neothyronectria citri*	CFCC 53590^T	*Citrus maxima cv. Shatian*	China	–	–	–	MK861080	MK861071	–	–	MK902788	MK902797
Nectriaceae	*Neothyronectria sophorae*	CPC 29690^T = CBS 142094	*Sophora microphylla*	New Zealand	–	–	–	KY173470	KY173559	–	–	–	KY173619
Nectriaceae	*Nothofusarium devonianum*	CBS 147304^T = NRRL 22134	*Ruscus aculeatus*	United Kingdom	–	–	–	MW827632	MW827673	–	JX171603	MW834291	–
Nectriaceae	*Ophionectria trichospora*	CBS 109876 = GJS 01-155	–	Cameroon	–	KM231442	–	–	AF543790	AY489669	DQ522457	–	DQ522520
Nectriaceae	*Pandanaceomyces krabiensis*	MFLUCC 16-0323^T	*Pandanus* sp.	Thailand	–	–	–	MH388355	MH376729	–	–	–	–
Nectriaceae	*Paracremonium apiculatum*	CGMCC3.19309^T	–	–	–	–	–	MK329123	MK329028	–	–	MK336058	MK336136
Nectriaceae	*Paracremonium bendijkiorum*	CBS 147228^T	–	–	–	–	–	MW883436	MW883828	–	MW890068	MW890111	MW890139
Nectriaceae	*Paracremonium binnewijzendii*	CBS 143277^T	–	–	–	–	–	MG250173	MG250174	–	–	–	MG254816
Nectriaceae	*Paracremonium contagium*	CBS 110348^T = UAMH 10141	*Homo sapiens*	Canada	KM231067	KM231417	KM231570	KM231831	HQ232118	KM232262	KM232396	KM231966	KM232103
Nectriaceae	*Paracremonium ellipsoideum*	CGMCC3.19316^T	–	–	–	–	–	MK329125	MK329030	–	–	MK336060	MK336138
Nectriaceae	*Paracremonium inflatum*	CBS 482.78	Soil	Colombia	KM231066	KM231416	KM231569	KM231830	KM231711	KM232261	KM232395	KM231965	KM232102
Nectriaceae	*Paracremonium inflatum*	CBS 485.77^T = CDC 77-043179	*Homo sapiens*	India	KM231065	KM231415	KM231568	KM231829	HQ232113	KM232260	KM232394	KM231964	KM232101

(*Continued*)

Table 2. (Continued).

Family	Species name[1]	Strain numbers[2]	Substrate	Location	GenBank accession numbers[3]								
					acl1	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Paracremonium moubasheri*	AUMC 11030^{T}	–	–	–	–	–	KX384655	–	–	–	–	–
Nectriaceae	*Paracremonium pembeum*	CBS 140042^{T}	–	–	KT936332	KT936374	–	–	–	–	KT936353	–	KU053066
Nectriaceae	*Paracremonium variiforme*	CGMCC3.17931^{T}	–	–	–	–	–	KU746691	KU746737	–	KY883246	KX855237	KU746783
Nectriaceae	*Penicillifer bipapillatus*	CBS 420.88^{T}	Bark	Venezuela	KM230948	KM231270	KM231454	KM231740	KM231608	KM232129	KM232295	KM231860	KM231996
Nectriaceae	*Penicillifer diparietisporus*	CBS 376.59^{T} = ATCC 13214 = IMI 100713 = QM 7720	Soil	USA	KM230949	KM231271	KM231455	KM231741	KM231609	KM232130	KM232296	KM231861	KM231997
Nectriaceae	*Penicillifer penicilliferi*	CBS 423.88^{T} = GJS 87- 48B	Unknown	Guyana	KM230947	KM231269	KM231453	KM231739	KM231607	KM232128	KM232294	KM231859	KM231995
Nectriaceae	*Penicillifer pulcher*	CBS 560.67^{T} = ATCC 18931 = MUCL 11607	Soil	The Netherlands	KM230950	KM231272	KM231456	KM231742	KM231610	KM232131	KM232297	KM231862	KM231998
Nectriaceae	*"Persiciospora africana"*	ATCC64691	–	–	–	–	–	–	AY015631	–	–	–	–
Nectriaceae	*Pleiocarpon strelitzia*	CBS 142252 = ST20	*Strelitzia reginae*	Italy	–	–	KY304635	KY304663	KY304688	–	KY304713	KY304741	KY304769
Nectriaceae	*Pleiocarpon strelitzia*	CBS 142251^{T} = ST1 = CPC 27628	*Strelitzia reginae*	Italy	–	–	KY304616	KY304644	KY304672	–	KY304697	KY304722	KY304750
Nectriaceae	*Pseudocosmospora henanensis*	HMAS 183528^{T}	–	–	–	–	–	GU075856	GU075863	–	–	–	HM054103
Nectriaceae	*Pseudocosmospora metajoca*	BPI 879088 T = A.R. 4576	*Eutypa* sp.	New Zealand	–	–	–	NR_155633	NG_059485	KC291886	–	–	KC291923
Nectriaceae	*Pseudonectria buxi*	CBS 324.53	*Buxus sempervirens*	The Netherlands	KM230984	KM231344	KM231502	KM231778	KM231644	KM232194	KM232353	KM231909	KM232037
Nectriaceae	*Pseudonectria buxi*	CBS 114049 = AR 2716	*Buxus sempervirens*	Spain	KM230985	KM231345	KM231503	KM231779	U17416	AY489670	KM232354	KM231910	KM232038
Nectriaceae	*Pseudonectria foliicola*	CBS 123190^{T} = CPC 15385	*Buxus sempervirens*	New Zealand	KM230982	KM231342	KM231500	KM231776	KM231642	KM232192	KM232352	KM231907	KM232035
Nectriaceae	*Pseudonectria foliicola*	CBS 122566 = AR 2709	*Buxus sempervirens*	USA	KM230983	KM231343	KM231501	KM231777	KM231643	KM232193	–	KM231908	KM232036
Nectriaceae	*Rectifusarium robinianum*	CBS 430.91^{T} = NRRL 25729	*Robinia pseudoacacia*	Germany	HQ897907	KM231360	KM231512	KM231794	KM231657	–	HQ897771	KM231923	KM232053
Nectriaceae	*Rectifusarium robinianum*	CBS 830.85 = BBA 64246 = NRRL 13953	*Solanum tuberosum*	Germany	KM230992	KM231359	KM231511	KM231793	KM231656	–	JX171575	KM231922	KM232052
Nectriaceae	*Rectifusarium ventricosum*	CBS 748.79^{T} = BBA 62452 = NRRL 20846 = NRRL 22113	Soil	Germany	HQ897897	KM231361	KM231513	HQ897816	KM231658	KM232208	HQ897761	KM231924	KM232054
Nectriaceae	*Rugonectria microconidia*	HMAS 247232^{T}	Mossy bark	China	–	–	–	MF669050	MF669052	MF669056	–	–	–
Nectriaceae	*Rugonectria neobalansae*	CBS 125120 = GJS 85-219	Dead tree	Indonesia	KM231023	KM231294	KM231466	KM231750	HM364322	KM232146	KM232321	KM231874	HM352869
Nectriaceae	*Rugonectria rugulosa*	CBS 126565 = GJS 09-1245	Dead tree	Venezuela	KM231024	KM231296	KM231468	KM231749	KM231615	KM232145	KM232320	KM231873	KM232007
Nectriaceae	*Rugonectria rugulosa*	CBS 129158	–	USA	KM231025	KM231295	KM231467	JF832661	JF832761	JF832836	KM232319	KM231872	JF832911
Nectriaceae	*Sarcopodium circinatum*	CBS 587.92 = CCT 5383	Soil	Costa Rica	–	KM231353	–	KM231787	KM231651	KM232202	KM232360	JF832545	KM232046
Nectriaceae	*Sarcopodium circinatum*	CBS 100998 = INIFAT C98/9	Leaf litter	Brazil	–	KM231352	KM231507	KM231786	KM231650	KM232201	KM232359	KM231917	KM232045
Nectriaceae	*Sarcopodium circinosetiferum*	CBS 100252 = FMR 6355	Soil	Argentina	KM230987	KM231347	KM231589	KM231781	KM231645	KM232196	KM232355	KM231912	KM232040
Nectriaceae	*Sarcopodium circinosetiferum*	CBS 100251 = FMR 6354	Soil	Argentina	KM230988	KM231348	KM231590	KM231782	KM231646	KM232197	KM232356	KM231913	KM232041
Nectriaceae	*Sarcopodium flavolanatum*	CBS 128370	Decaying wood	China	KM230989	KM231350	KM231505	KM231784	KM231648	KM232199	KM232357	KM231915	KM232043
Nectriaceae	*Sarcopodium flavolanatum*	CBS 112283	*Theobroma gileri*	Ecuador	–	KM231351	KM231506	KM231785	KM231649	KM232200	KM232358	KM231916	KM232044
Nectriaceae	*Sarcopodium macalpinei*	CBS 115296 = HKUCC 8395	*Viburnum odoratissimum*	Hong Kong	–	KM231349	KM231591	KM231783	KM231647	KM232198	–	KM231914	KM232042
Nectriaceae	*Sarcopodium vanillae*	CBS 100582 = PD 98/8/ 459-1	*Anthurium* sp.	Ecuador	KM230986	KM231346	KM231504	KM231780	HQ232174	KM232195	–	KM231911	KM232039
Nectriaceae	*Scolecofusarium ciliatum*	CBS 144385 = IHEM 2989	*Fagus sylvatica*	Belgium	–	–	–	KJ125591	KJ126479	–	KP835472	MW834297	–

(*Continued*)

Table 2. (Continued).

Family	Species name[1]	Strain numbers[2]	Substrate	Location	GenBank accession numbers[3]								
					acl1	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Scolecofusarium ciliatum*	CBS 191.65^{NT} = ATCC 16068 = ATCC 24137 = BBA9661 = DSM 62172 = IMI 112499 = NRRL 2043	*Fagus sylvatica*	Germany	–	–	–	MW827636	MW827677	–	MW834035	MW834296	–
Nectriaceae	*Scolecofusarium ciliatum*	CBS 155.86 = NRRL 22284	Hordeum vulgare mouldy grain, associated with scale insect	Denmar	–	–	–	MW827635	MW827676	–	MW834034	MW834295	–
Nectriaceae	*Setofusarium setosum*	CBS 574.94 = BBA 65063	Unknown	French Guian	–	–	–	MW827633	MW827674	–	MW834033	MW834293	–
Nectriaceae	*Setofusarium setosum*	CBS 635.92^{ET} = GJS 88-12 = NRRL 36526	Tree bark	French Guian	–	–	–	MW827634	MW827675	–	JX171651	MW834294	–
Nectriaceae	*Stylonectria corniculata*	CBS 125491^{T}	Unidentified ascomycete on *Carpinus* sp.	Germany	HQ897915	–	–	HQ897829	KM231691	–	HQ897779	KM231946	–
Nectriaceae	*Stylonectria hetmanica*	CBS 147305^{T} = CPC 38725	*Diaporthe* sp. on *Frangula alnus*	Ukraine	MW834104	–	–	NR_173440	–	–	MW834036	–	–
Nectriaceae	*Stylonectria qilianshanensis*	HMAS 255803^{T}	Unknown ascomycete on *Picea asperata*	China	MT087289	–	–	–	–	–	MT087288	–	–
Nectriaceae	*Stylonectria wegeliniana*	CBS 125490 = TG 2009-03	*Hapalycystis bicaudata*	Austria	HQ897890	KM231396	KM231548	KM231817	KM231690	KM232240	HQ897754	KM231945	KM232084
Nectriaceae	*Thelonectria discophora*	CBS 125153 = AR 4324	*Pinus radiata*	New Zealand	KM231049	KM231327	KM231489	HM364294	HM364307	HM364326	KM232344	KM231897	HM352860
Nectriaceae	*Thelonectria olida*	CBS 215.67^{T} = ATCC 16548 = DSM 62520 = IMI116873	*Asparagus officinalis*	Germany	KM231050	KM231325	KM231487	AY677293	HM364317	HM364334	KM232342	HM364345	KM232024
Nectriaceae	*Thelonectria trachosa*	CBS 112467^{T} = GJS 92-45 = IMI 352560	Bark	Scotland	KM231051	KM231326	KM231488	AY677297	HM364312	HM364339	KM232343	KM231896	AY677258
Nectriaceae	*Thyronectria lamyi*	CBS 417.89	*Berberis vulgaris*	Germany	KM231083	KM231434	KM231597	KM231837	KM231718	JF832830	KM232413	JF832580	KM232108
Nectriaceae	*Thyronectria pyrrhochlora*	CBS 125131 = AR 2786	*Acer campestre*	Austria	–	–	KM231594	HM484545	HM484570	HM484584	KM232410	HM484519	HM484598
Nectriaceae	*Thyronectria quercicola*	CBS 128976^{T} = AR 3805	*Quercus ilex*	Spain	–	KM231433	KM231595	JF832624	JF832743	JF832831	KM232411	JF832581	JF832880
Nectriaceae	*Thyronectria sinopica*	CBS 462.83	*Hedera helix*	The Netherlands	KM231082	–	KM231596	HM484542	GQ506001	GQ506031	KM232412	HM484531	HM484595
Nectriaceae	*Varicosporella aquatica*	CBS 126103	*Populus* sp.	France	–	–	–	KP192669	KP192671	–	–	–	–
Nectriaceae	*Varicosporellopsis americana*	CPC 40767^{T} = CBS 148257	sludge in water reservoir	USA	–	–	–	OK664739	OK663778	–	–	–	OK651211
Nectriaceae	*Varicosporellopsis americana*	CPC 40768 = CBS 148258	sludge in water reservoir	USA	–	–	–	OK664740	OK663779	–	–	–	OK651212
Nectriaceae	*Varicosporellopsis aquatilis*	CBS 140158^{T}	submerged wood of *Sambucus nigra*	France	–	–	–	KU233187	KU233189	–	–	–	–
Nectriaceae	*Volutella aeria*	CGMCC3.17946	Air	China	–	–	–	KU746707	KU746753	–	–	KX855254	KU746800
Nectriaceae	*Volutella aeria*	CGMCC3.17945^{T}	Air	China	–	–	–	KU746708	KU746754	–	–	KX855253	KU746799
Nectriaceae	*Volutella consors*	CBS 139.79 = PD 78/836	Decaying *orchid bulb*	The Netherlands	HQ897853	KM231334	KM231491	KM231768	KM231633	KM232184	HQ897715	KM231899	KM232026
Nectriaceae	*Xenoacremonium brunneosporum*	MFLU 16-1204	–	–	–	–	–	MN047107	MN017873	–	MN077080	MN077075	–

(*Continued*)

Table 2. (Continued).

					GenBank accession numbers[3]								
Family	Species name[1]	Strain numbers[2]	Substrate	Location	*acl1*	*CaM*	*H3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Nectriaceae	*Xenoacremonium falcatus*	CBS 400.85^{T}	*Pinus radiata*	New Zealand	KM231068	KM231418	KM231571	KM231832	HQ232025	KM232263	–	KM231967	KM232104
Nectriaceae	*Xenoacremonium recifei*	CBS 137.35^{T} = IHEM4405 = MUCL 9696	*Homo sapiens*	Brazil	KM231069	KM231419	KM231572	KM231833	HQ232106	KM232264	KM232397	KM231968	KM232105
Nectriaceae	*Xenoacremonium recifei*	CBS 541.89	Soil	Brazil	KM231070	KM231420	KM231573	KM231834	HQ232114	KM232265	KM232398	KM231969	KM232106
Nectriaceae	*Xenocylindrocladium guianense*	CBS 112179^{T} = CPC3496 = MUCL 41975	Plant litter	French Guiana	KM230971	KM231289	KM231463	AF317348	JQ666073	KM232166	KM232314	KM231895	AF320197
Nectriaceae	*Xenocylindrocladium serpens*	CBS 128439^{T} = MUCL39315	Bark	Ecuador	KM230972	KM231290	KM231464	AF220982	KM231688	KM232165	–	KM231894	AF320196
Nectriaceae	*Xenocylindrocladium subverticillatum*	CBS 113660^{T} = CPC 3397 = MUCL 41834	Plant litter	Singapore	KM230970	KM231288	KM231462	AF317347	KM231687	–	KM232313	KM231893	AF320196
Nectriaceae	*Xenogliocladiopsis cypellocarpa*	CBS 133814 = CPC19417	*Eucalyptus cypellocarpa*	Australia	KM231039	KM231310	KM231479	KM231760	KM231623	KM232158	KM232332	KM231885	KM232017
Nectriaceae	*Xenogliocladiopsis cypellocarpa*	CPC 17153	*Eucalyptus* sp.	Australia	KM231040	KM231311	KM231480	KM231761	KM231624	KM232159	KM232333	KM231886	KM232018
Nectriaceae	*Xenogliocladiopsis eucalyptorum*	CBS 138758^{T} = CPC16271	*Eucalyptus* sp.	South Africa	KM231038	KM231309	–	KM231759	KM231622	KM232157	KM232331	KM231884	KM232016
Nectriaceae	*Xenoleptographium phialoconidium*	CBS 134695^{T}(ex-isotype) = CMW 37140	the exposed xylem tissues of *Gmelina arborea*	Indonesia	–	–	–	–	KT164791	–	KT164795	KT164797	KT164793
Nectriaceae	*Xenoleptographium phialoconidium*	CBS 134694 = CMW 37146 (ex-holotype)	the exposed xylem tissues of *Gmelina arborea*	Indonesia	–	–	–	–	KT164792	–	KT164796	KT164798	KT164794
Niessiliaceae	*Trichosphaerella ceratophora*	CBS 130.82	*Carpinus betulus*	Switzerland	KM231093	KM231443	KM231586	KM231847	KM231727	KM232280	KM232423	KM231983	KM232117
Stachybotryaceae	*Pseudoachroiostachys krabiense*	MFLUCC 16-0325^{T}	*Pandanus* sp.	Thailand	–	–	–	MH388362	MH376736	–	–	–	–
Stachybotryaceae	*Stachybotrys chartarum*	CBS 129.13	–	–	–	KM231452	KM231588	KM231858	KM231738	KM232293	KM232434	KM231994	KM232127
Tilachlidiaceae	*Septofusidium herbarum*	CBS 265.58^{T} = IMI 053581	*Urtica dioica*	UK	KM231088	KM231438	KM231585	KM231842	KM231723	KM232275	KM232418	KM231979	KM232113
Tilachlidiaceae	*Tilachlidium brachiatum*	CBS 505.67	*Hypholoma fasciculare*	Poland	KM231085	KM231436	–	KM231839	KM231720	KM232272	KM232415	KM231976	KM232110
Tilachlidiaceae	*Tilachlidium brachiatum*	CBS 363.97	*Agaricus* sp.	France	KM231084	KM231435	KM231583	KM231838	KM231719	KM232271	KM232414	KM231975	KM232109

[1] The new species names are in bold.
[2] ^{T} = ex-type; ^{ET} = ex-epitype; ^{NT} = ex-neotype.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Aiello D, Polizzi G, Crous PW, Lombard L. 2017. *Pleiocarpon* gen. nov. and a new species of *Ilyonectria* causing basal rot of *Strelitzia reginae* in Italy. IMA Fungus. 8(1):65–76. doi:10.5598/imafungus.2017.08.01.05.

Al-Bedak OA. 2019. *Paracremonium moubasheri*, a new species from an alkaline sediment of Lake Hamra in Wadi-El-Natron, Egypt with a key to the accepted species. Stud Fungi. 4:216–222.

Aoki T, O'Donnell K, Homma Y, Lattanzi AR. 2003. Sudden-death syndrome of soybean is caused by two morphologically and phylogenetically distinct species within the *Fusarium solani* species complex—*f. virguliforme* in North America and F. tucumaniae in South America. Mycologia. 95(4):660–684. doi:10.1080/15572536.2004.11833070.

Capinha C, Essl F, Seebens H, Moser D, Pereira HM. 2015. The dispersal of alien species redefines biogeography in the Anthropocene. Science. 348(6240):1248–1251. doi:10.1126/science.aaa8913.

Chaverri P, Salgado C, Hirooka Y, Rossman AY, Samuels GJ. 2011. Delimitation of *Neonectria* and *Cylindrocarpon* (*Nectriaceae, Hypocreales, Ascomycota*) and related genera with *Cylindrocarpon*-like anamorphs. Stud Mycol. 68:57–78.

Crous PW, Cowan DA, Maggs-Kolling G, Yilmaz N, Larsson E, Angelini C, Brandrud TE, Dearnaley JDW, Dima B, Dovana F, et al. 2020. Fungal planet description sheets: 1112–1181. Persoonia. 45(1):251–409. doi:10.3767/persoonia.2020.45.10

Crous PW, Lombard L, Sandoval-Denis M, Seifert KA, Schroers HJ, Chaverri P, Gene J, Guarro J, Hirooka Y, Bensch K, et al. 2021a. *Fusarium*: more than a node or a foot-shaped basal cell. Stud Mycol. 98:1–184.

Crous PW, Osieck ER, Ž J, Boers J, Van Iperen AL, Starink-Willemse M, Dima B, Balashov S, Bulgakov TS, Johnston PR, et al. 2021b. Fungal planet description sheets: 1284–1382. Persoonia. 47(1):178–374. doi:10.3767/persoonia.2021.47.06

Crous PW, Wingfield MJ, Burgess TI, Carnegie AJ, Hardy GESJ, Smith D, Summerell BA, Cano-Lira JF, Guarro J, Houbraken J, et al. 2017. Fungal planet description sheets: 625–715. Persoonia. 39:270–467. doi:10.3767/persoonia.2017.39.11.

Crous PW, Wingfield MJ, Burgess TI, Hardy GESJ, Crane C, Barrett S, Cano-Lira JF, Le Roux JJ, Thangavel R, Guarro J, et al. 2016. Fungal Planet description sheets: 469-557. Persoonia - Molecular Phylogeny and Evolution of Fungi. 37(1):218–403. doi:10.3767/003158516X694499

Crous PW, Wingfield MJ, Le Roux JJ, Richardson DM, Strasberg D, Shivas RG, Alvarado P, Edwards J, Moreno G, Sharma R, et al. 2015. Fungal Planet description sheets: 371–399. Persoonia. 35(1):264–327. doi:10.3767/003158515X690269

Mng DQ, Luo LY, He XX, Wang MS, Fang WX, Chen SF, Chen WH, Han YF, Liang ZQ. 2021. *Paracremonium lepidopterorum*, a new insect-associated fungus. Phytotaxa. 524:85–91. doi:10.11646/phytotaxa.524.2.2.

Early R, Bradley BA, Dukes JS, Lawler JJ, Olden JD, Blumenthal DM, Gonzalez P, Grosholz ED, Ibanez I, Miller LP, et al. 2016. Global threats from invasive alien species in the twenty-first century and national response capacities. Nat Commun. 7(1):12485. doi:10.1038/ncomms12485

Gams W. 1971. Cephalosporium-artige schimmelpilze (Hyphomycetes). Stuttgart (Germany): Gustav Fischer Verlag.

González CD, Chaverri P. 2017. *Corinectria*, a new genus to accommodate *Neonectria fuckeliana* and *C. constricta* sp. nov. from *Pinus radiata* in Chile. Mycol Prog. 16(11–12):1015–1027. doi:10.1007/s11557-017-1343-8.

Gräfenhan T, Schroers HJ, Nirenberg HI, Seifert KA. 2011. An overview of the taxonomy, phylogeny, and typification of nectriaceous fungi in *Cosmospora, Acremonium, Fusarium, Stilbella*, and *Volutella*. Stud Mycol. 68:79–113. doi:10.3114/sim.2011.68.04.

Höhnel von F. 1915. Fragmente zur Mykologie (XVII. Mitteilung, Nr. 876 bis 943). Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Math.-naturw. Klasse Abt I. 124:49–159.

Höhnel von F. 1920. Fungi imperfecti. Beiträge zur Kenntnis derselben Hedwigia. 60:56–89.

Huang SK, Jeewon R, Hyde KD, Bhat DJ, Wen TC. 2018. Novel Taxa within Nectriaceae: cosmosporella gen. nov. and Aquanectria sp. nov. from Freshwater Habitats in China. Crypto Mycol. 39(2):169–192. doi:10.7872/crym/v39.iss2.2018.169.

Huelsenbeck JP, Ronquist F. 2001. MrBayes: bayesian inference of phylogeny. Bioinformatics. 17(8):754–755. doi:10.1093/bioinformatics/17.8.754.

Hyde KD. 2020. Refined families of *Sordariomycetes*. Mycosphere. 11(1):305–1059. doi:10.5943/mycosphere/11/1/7.

Katoh K, Standley DM. 2013. MAFFT multiple sequence alignment software version 7: improvements in performance and usability. Mol Biol Evol. 30(4):772–780. doi:10.1093/molbev/mst010.

Kornerup A, Wanscher JH. 1978. Methuen handbook of colour. In: 3rd edn. London: Eyre Methuen.

Kumar S, Stecher G, Tamura K. 2016. MEGA7: molecular evolutionary genetics analysis version 7.0 for bigger datasets. Mol Biol Evol. 33(7):1870–1874. doi:10.1093/molbev/msw054.

Lechat C, Fournier J. 2015. *Varicosporella*, a new aquatic genus in *Nectriaceae* from France. Ascomyceteorg. 7:1–8.

Lechat C, Fournier J. 2016. *Varicosporellopsis*, a new aquatic genus from South of France. Ascomyceteorg. 8:96–100.

Lechat C, Fournier J, Nordén B. 2015. *Stylonectria norvegica* (*Nectriaceae)*, a new species from Norway. Ascomyceteorg. 7:220–224.

Lin YW, Weng RQ. 2011. *Rhynchophorus ferrugineus* (Oliver) was intercepted from inbound parcels at Fujian Port. Plant Quar. 25:24.

Liu YJ, Whelen S, Hall BD. 1999. Phylogenetic relationships among ascomycetes: evidence from an RNA polymerse II subunit. Mol Biol Evol. 16(12):1799–1808. doi:10.1093/oxfordjournals.molbev.a026092.

Lombard L, Sandoval-Denis M, Lamprecht SC, Crous PW. 2019. Epitypification of *Fusarium oxysporum* – clearing the taxonomic chaos. Persoonia. 43(1):1–47. doi:10.3767/persoonia.2019.43.01.

Lombard L, van der Merwe NA, Groenewald JZ, Crous PW. 2015. Generic concepts in *Nectriaceae*. Stud Mycol. 80 (1):189–245. doi:10.1016/j.simyco.2014.12.002.

Luo J, Zhuang WY. 2008. Two new species of *Cosmospora* (*Nectriaceae, Hypocreales*) from China. Fungal Divers. 31:83–93.

Lynch SC, Twizeyimana M, Mayorquin JS, Wang DH, Na F, Kayim M, Kasson MT, Thu PQ, Bateman C, Rugman-Jones P, et al. 2016. Identification, pathogenicity and abundance of Paracremonium pembeum sp. nov. and Graphium euwallaceae sp. nov.—two newly discovered mycangial associates of the polyphagous shot hole borer (*Euwallacea* sp.) in California. Mycologia. 108(2):313–329. doi:10.3852/15-063

Lyu Y, Duan WJ. 2021. The current status and suggestions of interception of quarantine fungi at China ports from 2017 to 2019. Plant Quar. 35:70–76.

Maryani N, Lombard L, Poerba YS, Subandiyah S, Crous PW, Kema GHJ. 2019. Phylogeny and genetic diversity of the banana *Fusarium* wilt pathogen *Fusarium oxysporum* f. sp. *cubense* in the Indonesian centre of origin. Stud Mycol. 92:155–194.

Ma GD, Zhang MZ, Chen WJ. 2017. First interception of *Diaporthe phaseolorum* at national postal inspection ports. Plant Quar. 21:38.

Medeiros Araújo MB, Moreira GM, Nascimento LV, GdA N, SRdC N, Pfenning LH, Ambrósio M. 2020. Fusarium rot of melon is caused by several Fusarium species. Plant Pathol. 70(3):712–721. doi:10.1111/ppa.13328.

Miller MA, Pfeiffer W, Schwartz T 2012. The CIPRES science gateway: enabling high-impact science for phylogenetics researchers with limited resources. In: proceedings of the 1st conference of the extreme science and engineering discovery environment: bridging from the extreme to the campus and beyond. Association for Computing Machinery, USA: 1–8.

Nylander JAA. 2004. MrModeltest v2. Program distributed by the author. Evolutionary Biology Centre. Sweden: Uppsala University.

O'Donnell K, Cigelnik E. 1997. Two Divergent Intragenomic rDNA ITS2 Types within a Monophyletic Lineage of the Fungus*Fusarium*Are Nonorthologous. Mol Phylogenet Evol. 7(1):103–116. doi:10.1006/mpev.1996.0376.

O'Donnell K, Kistlerr HC, Cigelnik E, Ploetz RC. 1998. Multiple evolutionary origins of the fungus causing Panama disease of banana: concordant evidence from nuclear and mitochondrial gene genealogies. Proc Natl Acad Sci USA. 95 (5):2044–2049. doi:10.1073/pnas.95.5.2044.

O'Donnell K, Kistler HC, Tacke BK, Casper HH. 2000a. Gene genealogies reveal global phylogeographic structure and reproductive isolation among lineages of *Fusarium graminearum*, the fungus causing wheat scab. Proc Natl Acad Sci USA. 97(14):7905–7910. doi:10.1073/pnas.130193297.

O'Donnell K, Nirenberg H, Aoki T, Cigelnik E. 2000b. A multigene phylogeny of the *Gibberella fujikuroi* species complex: detection of additional phylogenetically distinct species. Mycoscience. 41(1):61–78. doi:10.1007/BF02464387.

O'Donnell K, Sutton DA, Rinaldi MG, Sarver BA, Balajee SA, Schroers HJ, Summerbell RC, Robert VA, Crous PW, Zhang N, et al. 2010. Internet-accessible DNA sequence database for identifying fusaria from human and animal infections. J Clin Microbiol. 48(10):3708–3718. doi:10.1128/JCM.00989-10

Petrak F. 1924. Mykologische Notizen. VII Ann Mycol. 22:1–182.

Porebski S, Bailey LG, Baum BR. 1997. Modification of a CTAB DNA extraction protocol for plants containing high polysaccharide and polyphenol components. Plant Mol Biol Rep. 15 (1):8–15. doi:10.1007/BF02772108.

Pyšek P, Hulme PE, Simberloff D, Bacher S, Blackburn TM, Carlton JT, Dawson W, Essl F, Foxcroft LC, Genovesi P, et al. 2020. Scientists' warning on invasive alien species. Biol Rev Camb Philos Soc. 95:1511–1534.

Qiu MH, Zhang RF, Xue C, Zhang SS, Li SQ, Zhang N, Shen QR. 2012. Application of bio-organic fertilizer can control *Fusarium* wilt of cucumber plants by regulating microbial community of rhizosphere soil. Biol Fertil Soils. 48:807–816.

Reeb V, Lutzoni F, Roux C. 2004. Contribution of RPB2 to multilocus phylogenetic studies of the *Euascomycetes* (*Pezizomycotina*, Fungi) with special emphasis on the lichen-forming *Acarosporaceae* and evolution of polyspory. Mol Phylogenet Evol. 32(3):1036–1060. doi:10.1016/j.ympev.2004.04.012.

Rehner SA, Samuels GJ. 1994. Taxonomy and phylogeny of *Gliocladium* analysed from nuclear large subunit ribosomal DNA sequences. Mycol Res. 98(6):625–634. doi:10.1016/S0953-7562(09)80409-7.

Ronquist F, Huelsenbeck JP. 2003. MrBayes 3: bayesian phylogenetic inference under mixed models. Bioinformatics. 19 (12):1572–1574. doi:10.1093/bioinformatics/btg180.

Rossman A. 1996. Morphological and molecular perspectives on systematics of the *Hypocreales*. Mycologia. 88(1):1–19. doi:10.1080/00275514.1996.12026620.

Roux J, Steenkamp ET, Marasas WFO, Wingfield MJ, Wingfield BD. 2001. Characterization of *Fusarium graminearum* from Acacia and Eucalyptus using β-tubulin and histone gene sequences. Mycologia. 93(4):704–711. doi:10.1080/00275514.2001.12063201.

Samuels GJ. 1988. Species of *Nectria* (*Ascomycetes, Hypocreales*) having orange perithecia and colorless, striate ascospores. Brittonia. 40:306–331.

Sandoval-Denis M, Lombard L, Crous PW. 2019. Back to the roots: a reappraisal of *Neocosmospora*. Persoonia. 43(1):90–185. doi:10.3767/persoonia.2019.43.04.

Smith N. 2015. *Phytelephas macrocarpa*. In: palms and people in the Amazon. Geobotany studies. doi:10.1007/978-3-319-05509-1_53

Stamatakis A. 2014. RAxML version 8: a tool for phylogenetic analysis and post-analysis of large phylogenies. Bioinformatics 30:1312–1313.

Vilgalys R, Hester M. 1990. Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. J Bacteriol. 172(8):4238–4246. doi:10.1128/jb.172.8.4238-4246.1990.

Wang F, Wang K, Cai L, Zhao M, Kirk PM, Fan G, Sun Q, Li B, Wang S, Yu Z, et al. 2023. Fungal names: a comprehensive nomenclatural repository and knowledge base for fungal taxonomy. Nucleic Acids Res. 51(D1):708–716. doi:10.1093/nar/gkac926

Wei WC. 2019. First interception of live cockroach with pyomonas aeruginosa nucleic acid in Nanning. China Inspection and Quarantine. Z1:13.

White TJ, Bruns T, Lee S, Taylor J. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. PCR Protocols: A Guide to Methods and Applications. 18:315–322.

Wingfield MJ, De Beer ZW, Slippers B, Wingfield BD, Groenewald JZ, Lombard L, Crous PW. 2012. One fungus, one name promotes progressive plant pathology. Mol Plant Pathol. 13:604–613.

Xu F, Liu W, Song Y, Zhou Y, Xu X, Yang G, Wang J, Zhang J, Liu L. 2021. The distribution of *Fusarium graminearum* and *Fusarium asiaticum* causing fusarium head blight of wheat in relation to climate and cropping system. Plant Dis. 105:2830–2835.

Yin LP, Ma GY 2004. Strengthen the firewall for entry quarantine of international postal parcels. International Business. 007. https://kns.cnki.net/kcms/detail/detail.aspx?FileName=GJSB200412270074&DbName=CCND2004.

Zhang K, Su YY, Cai L. 2013. An optimized protocol of single spore isolation for fungi. Crypto Mycol. 34:349–356.

Zhang ZF, Zhou SY, Eurwilaichitr L, Ingsriswang S, Raza M, Chen Q, Zhao P, Liu F, Cai L. 2020. Culturable mycobiota from Karst caves in China II, with descriptions of 33 new species. Fungal Divers. 106:29–136.

Zhao P, Duan WJ, Liu F, Zhou X, Fan GM, Ma ZY, Cai L. 2021. Construction and application of reference databases for plant quarantine fungi in China. Acta Microbiol Sinica. 61:3806–3819.