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Fusarium and allied genera from China: species diversity and distribution

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Key words

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Abstract The genus *Fusarium* includes numerous important plant and human pathogens, as well as many industrially and commercially important species. During our investigation of fungal diversity in China, a total of 356 fusarioid isolates were obtained and identified from diverse diseased and healthy plants, or different environmental habitats, i.e., air, carbonatite, compost, faeces, soil and water, representing hitherto one of the most intensive sampling and identification efforts of fusarioid taxa in China. Combining morphology, multi-locus phylogeny and ecological preference, these isolates were identified as 72 species of *Fusarium* and allied genera, i.e., *Bisifusarium* (1), *Fusarium* (60), and *Neocosmospora* (11). A seven-locus dataset, comprising the 5.8S nuclear ribosomal RNA gene with the two flanking internal transcribed spacer (ITS) regions, the intergenic spacer region of the rDNA (IGS), partial translation elongation factor 1-alpha (*tef1*), partial calmodulin (*cam*), partial RNA polymerase largest subunit (*rpb1*), partial RNA polymerase second largest subunit (*rpb2*) gene regions, and partial β-tubulin (*tub2*), were sequenced and employed in phylogenetic analyses. A genus-level phylogenetic tree was constructed using combined *tef1*, *rpb1*, and *rpb2* sequences, which confirmed the presence of four fusarioid genera among the isolates studied. Further phylogenetic analyses of two allied genera (*Bisifusarium* and *Neocosmospora*) and nine species complexes of *Fusarium* were separately conducted employing different multi-locus datasets, to determine relationships among closely related species. Twelve novel species were identified and described in this paper. The *F. babinda* species complex is herein renamed as the *F. falsibabinda* species complex, including descriptions of new species. Sixteen species were reported as new records from China.

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INTRODUCTION

Fusarium and allied genera comprise a large number of destructive pathogens and mycotoxigenic fungi, threatening plant, animal, and human health, as well as food security (O'Donnell et al. 2013). Fusarioid species cause many notable plant diseases, such as Fusarium head blight or scab of cereals by members of the *F. graminearum* species complex (O'Donnell et al. 2000a, Cuomo et al. 2007), sudden death syndrome of soybeans (Aoki et al. 2005) and root rot of many diverse hosts (Coleman et al. 2009, Sandoval-Denis et al. 2018a) by members of *Neocosmospora* (Lombard et al. 2015, Sandoval-Denis et al. 2019), ear rot of maize by members of the *F. fujikuroi* species complex (Desjardins et al. 2002), and vascular wilts of many economically important crops by members of the *F. oxysporum* species complex (O'Donnell et al. 1998b, Skovgaard et al. 2001, Van der Does et al. 2008, Lombard et al. 2019a, Maryani et al. 2019a). Species within this complex are also well-known for their ability to produce a range of secondary metabolites, including some notorious mycotoxins produced by *Fusarium* spp. in cereals (Marasas et al. 1984, O'Donnell et al. 2018).

Since the establishment of *Fusarium* (Link 1809), the taxonomic framework of this genus has undergone several significant changes. Link (1809) determined the primary morphological character of *Fusarium* to be the distinctive canoe- or banana-shaped conidia. Wollenweber & Reinking (1935) surveyed the morphology of macro- and microconidia, and the presence of chlamydospores, sclerotia and sporodochia, and suggested that *Fusarium* should be divided into 16 morphological sections, including 65 species and 77 varieties and forms. In the next several decades, this system has largely influenced subsequent taxonomic studies. Despite the impact of this system, other several controversial viewpoints persisted. Snyder & Hansen (1940, 1941, 1945, 1954) reduced the number of species to nine with a number of formae speciales, and highlighted the importance of morphological observations based on cultures derived from single-spore isolates. Gordon (1944, 1952, 1954a, b, 1956a, b, 1959, 1960) developed a pragmatic approach that combined sexual morph morphology, incorporating some thoughts from Wollenweber & Reinking (1935) and Snyder & Hansen (1940, 1941, 1945, 1954), which accepted 26 species in the genus. Booth (1971) introduced the morphology of the conidio-

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genous cells as a species-level diagnostic character. Nelson et al. (1983) provided a detailed morphological identification manual for *Fusarium*. Nevertheless, the species identification in *Fusarium*, based on morphology was still confusing, because of the variable phenotypes in culture, intricate or too vague descriptions of species among different studies, and the historically complicated subspecies level ranks (Leslie & Summerell 2006, Lombard et al. 2019a, b, Wang et al. 2019).

During the last three decades, phylogenetic inference played an increasingly important role in *Fusarium* taxonomy (Lombard et al. 2019a, b). Many morphological sections in the system of Wollenweber & Reinking (1935), e.g., sections *Discolor* and *Elegans*, proved to be polyphyletic based on *rpb1-rpb2* analyses (O'Donnell et al. 2013). Debates about the generic boundary of *Fusarium* also led to disagreement among taxonomists. Gräfenhan et al. (2011) and Schroers et al. (2011) introduced several genera in the basal *Fusarium* clade in the *Nectriaceae*, and indicated that several monophyletic clusters in the terminal *Fusarium* clade corresponded to other genera, including *Neocosmospora*. However, Geiser et al. (2013) insisted on a broader definition of *Fusarium*, to avoid the introduction of additional genera. By means of a 10-locus phylogenetic analysis, Lombard et al. (2015) delineated several genera in the terminal *Fusarium* clade, e.g., *Bisifusarium* (*F. dimerum* species complex), *Rectifusarium* (*F. ventricosum* species complex), and also resurrected some older generic names, e.g., *Albonectria* (*F. decemcellulare* species complex), and *Neocosmospora* (*F. solani* species complex). Based on the combined ITS-LSU-*rpb1-rpb2-tef1* dataset, Crous et al. (2021) re-examined the fusarioid taxa in *Nectriaceae* and showed that the Wollenweber concept of *Fusarium* presently encompasses 20 distinct genera, including four new genera (*Luteonectria*, *Nothofusarium*, *Scolecofusarium*, and *Setofusarium*). Following the end of dual nomenclature, the genus *Fusarium* as currently circumscribed accommodates members that belong to the *Gibberella* clade (O'Donnell et al. 2013, Lombard et al. 2015), including 18 species complexes (Laurence et al. 2011, Aoki et al. 2014, O'Donnell et al. 2013, Zhou et al. 2016, Sandoval-Denis et al. 2018a, Lombard et al. 2019a, Crous et al. 2021). Numerous cryptic species have recently been uncovered based on multi-locus phylogeny, morphology, and ecological characteristics (Gordon & Martyn 1997, O'Donnell et al. 2000a, b, 2008, 2009a, b, Laurence et al. 2014, Lombard et al. 2019a, b, Sandoval-Denis et al. 2018a, b, 2019, Maryani et al. 2019a, b, Wang et al. 2019, Xia et al. 2019, Yilmaz et al. 2021).

Previous investigations on *Fusarium* in China were summarised by Yu (1955), in which 77 species, varieties and formae speciales of pathogenic *Fusarium* spp. from 55 plant hosts were listed. A wider sampling region included 103 species, varieties and formae speciales of *Fusarium* and *Gibberella* (sexual morph of *Fusarium* s.str.) obtained from at least 111 plant species, faeces, and soil (Tai 1979). Identifications in both studies employed the morphology-based taxonomic system of Wollenweber & Reinking (1935). According to the currently used taxonomic system, only 31 of the 77 names in Yu (1955), and 36 of the 103 names in Tai (1979) remain in *Fusarium*. Considering the importance of *Fusarium* and allied species, it is necessary to clarify the species diversity and distribution of *Fusarium* in China in a modern taxonomic framework.

In our continuous survey of phytopathogenic fungi from China, 356 fusarioid strains have been isolated from diverse plant materials and various environmental samples including air, carbonatite, compost, faeces, water, and soil. In this study through a combination of morphology, multi-locus phylogeny and ecological characteristics, we advanced our knowledge on the species diversity of fusarioid taxa from China, as well as their host range and distribution.

MATERIALS AND METHODS

Sample collection

Samples were collected from 15 provinces (Fujian, Guangdong, Guizhou, Hainan, Hebei, Hubei, Hunan, Jiangsu, Jiangxi, Qinghai, Shandong, Shanxi, Sichuan, Yunnan, and Zhejiang), three autonomous regions (Guangxi Zhuang, Neimenggu, and Tibet) and two municipalities (Beijing and Chongqing) in China, and isolated from agricultural products imported into China from 13 other countries (Argentina, Australia, Brazil, Canada, Italy, Japan, Netherlands, Philippines, Poland, Saudi Arabia, Spain, Ukraine, and USA). Diseased and healthy plant tissues were collected and placed in paper bags. Air samples were collected using the Koch sedimentation method (Zhang et al. 2017). Water samples were collected as 10 mL samples and kept in sterile 15 mL centrifuge tubes (Zhang et al. 2017). Compost, faeces, pollen, and soil samples were collected (10–100 g per sample) after removing the surface layer (Zhang et al. 2017). Carbonatite samples were collected as five pieces in different orientations at each sample site (Zhang et al. 2017).

Fungal isolation

Fungi were isolated from plant tissues using single spore isolation as outlined in Zhang et al. (2013). Fungal endophytes were isolated using a tissue isolation method. Briefly, plant tissue pieces (4–5 mm^2) were taken from the margin of leaf or stem spots as well as healthy sections, consecutively immersed in 70 % ethanol for 1 min, 5 % NaClO for 3 min, 70 % ethanol for 1 min, and rinsed in sterile distilled water for 30 s. Tissue pieces were blotted dry in sterile paper towels and incubated on 1/4 strength potato dextrose agar (PDA; Crous et al. 2019) containing ampicillin and streptomycin (50 mg/L each) (Liu et al. 2015). Isolates were retrieved from compost, pollen, soil, and water using the plate dilution method. One gram of compost, faeces, pollen, soil, or water was suspended in 9 mL sterile water. The suspension was shaken on the Vortex vibration meter for 10 min. The extract was diluted to a series of concentrations, i.e., 10^{-2} to 10^{-5}. For each concentration, 200 µL suspensions were spread onto the 1/4 strength potato dextrose agar (PDA) with three replicates. Carbonatite samples were treated following the protocol of Zhang et al. (2017).

All plates were incubated at room temperature and examined every 2 d for fungal hyphae. Individual colonies were picked up with a sterilised needle and transferred onto fresh PDA plates. All the cultures were then purified using an optimized protocol of single spore isolation (Zhang et al. 2013).

All isolates examined in this study were deposited in Lei Cai's personal culture collection (LC), housed at the Institute of Microbiology, Chinese Academy of Sciences, Beijing, China. Information of isolates including geographic distribution and host/habitat are listed in Table 1. Type specimens of new species were deposited in the Mycological Fungarium of the Institute of Microbiology, Chinese Academy of Sciences, Beijing, China (HMAS), and living ex-type cultures in the China General Microbiological Culture Collection Centre (CGMCC).

Morphological observation

Examined isolates were incubated on synthetic nutrient poor agar plates (SNA; Nirenberg 1976) for 7 d at 25 °C. Agar pieces of approximately 5 × 5 mm were cut from the edge of colonies and transferred onto media for morphological characterisation. Culture characteristics, including colony morphology, pigmentation and odour, were observed after 7 d incubation in the dark on PDA, oatmeal agar (OA; Crous et al. 2019), and SNA. Colours were rated according to the colour charts of Kornerup & Wanscher (1978). Sporodochia were induced by incubating

Table 1 Details of examined isolates included in the phylogenetic analyses. Newly generated GenBank accessions are in **bold**.

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
Albonectria										
A. rigidiuscula	LC13606 = F503	Japan	unidentified plant	**MW016388**	**MW566255**	**MW580428**	**MW024420**	**MW474374**	**MW533715**	–
Bisifusarium										
B. aseptatum	CGMCC 3.20816 = LC1075 T	China, Guangdong Province, Guangzhou city	*Orchidaceae* sp.	**MW016389**	**MW566256**	**MW580429**	**MW024421**	**MW474375**	**MW533716**	–
	LC13607	China, Guangdong Province, Guangzhou city	*Orchidaceae* sp.	**MW016390**	**MW566257**	**MW580430**	**MW024422**	**MW474376**	**MW533717**	–
	LC13608	China, Guangdong Province, Guangzhou city	*Orchidaceae* sp.	**MW016391**	**MW566258**	**MW580431**	**MW024423**	**MW474377**	**MW533718**	–
Fusarium										
F. concolor species complex										
F. anguioides	LC13612 = M0563	China, Guangdong Province, Shenzhen city	*Cordyline stricta*	**MW016395**	**MW566262**	**MW580435**	**MW024426**	**MW474381**	**MW533721**	–
	LC13613 = M0568	China, Guangdong Province, Shenzhen city	*Alocasia odora*	**MW016396**	**MW566263**	**MW580436**	**MW024427**	**MW474382**	**MW533722**	–
	LC7007	China, Jiangxi Province	bamboo	**MW016397**	**MW566264**	**MW580437**	**MW024428**	**MW474383**	–	–
	LC7151	China, Jiangxi Province	bamboo	**MW016398**	**MW566265**	**MW580438**	**MW024429**	**MW474384**	**MW533723**	–
	LC7178	China, Jiangxi Province	bamboo	**MW016399**	**MW566266**	**MW580439**	**MW024430**	**MW474385**	**MW533724**	–
	LC7189	China, Guangdong Province, Guangzhou city	bamboo	**MW016400**	**MW566267**	**MW580440**	**MW024431**	**MW474386**	**MW533725**	–
	LC7190	China, Guangdong Province, Guangzhou city	bamboo	**MW016401**	**MW566268**	**MW580441**	**MW024432**	**MW474387**	–	–
	LC7240	China, Jiangxi Province, Ganzhou city	bamboo	**MW016402**	**MW566269**	**MW580442**	**MW024433**	**MW474388**	**MW533726**	–
F. bambusarum	CGMCC 3.20820 = LC7180 T	China, Jiangxi Province	bamboo	**MW016403**	**MW566270**	**MW580443**	**MW024434**	**MW474389**	–	–
	LC7187	China, Guangdong Province, Guangzhou city	bamboo	**MW016404**	**MW566271**	**MW580444**	**MW024435**	**MW474390**	–	–
F. falsibabinda species complex										
F. falsibabinda	CGMCC 3.20823 = LC13610 = F015 T	Japan	*Podocarpus macrophyllus*	**MW016393**	**MW566260**	**MW580433**	**MW024424**	**MW474379**	**MW533719**	–
	LC13611 = F058	Japan	*Camellia sasanqua*	**MW016394**	**MW566261**	**MW580434**	**MW024425**	**MW474380**	**MW533720**	–
F. fujikuroi species complex										
F. annulatum	LC1105	China	*Lithocarpus glabra*	**MW016472**	**MW566339**	**MW580512**	**MW024500**	**MW474458**	**MW533791**	–
	LC11490 = G2	China, Beijing	*Vitis* sp.	**MW016473**	**MW566340**	**MW580513**	**MW024501**	**MW474459**	**MW533792**	–
	LC11527 = G358	China, Hebei Province	*Vitis* sp.	**MW016474**	**MW566341**	**MW580514**	**MW024502**	**MW474460**	**MW533793**	–
	LC11584 = G373	China, Hebei Province	*Vitis* sp.	**MW016475**	**MW566342**	**MW580515**	**MW024503**	**MW474461**	**MW533794**	–
	LC11650 = HM259-L09	China, Hainan Province	*Oryza* sp.	**MW016476**	**MW566343**	**MW580516**	**MW024504**	**MW474462**	**MW533795**	–
	LC11670 = HM259-S07	China, Hainan Province	*Oryza* sp.	**MW016477**	**MW566344**	**MW580517**	**MW024505**	**MW474463**	**MW533796**	–
	LC11672 = HM259-S12	China, Hainan Province	*Oryza* sp.	**MW016478**	**MW566345**	**MW580518**	**MW024506**	**MW474464**	**MW533797**	–
	LC13658 = CF4	China, Neimenggu Province	unidentified mushroom	**MW016479**	**MW566346**	**MW580519**	**MW024507**	**MW474465**	**MW533798**	–
	LC13659 = F007	USA	*Glycine max*	**MW016480**	**MW566347**	**MW580520**	**MW024508**	**MW474466**	**MW533799**	–
	LC13660 = F023	Philippines	*Musa* sp.	**MW016481**	**MW566348**	**MW580521**	**MW024509**	**MW474467**	**MW533800**	–
	LC13661 = F028	Italy	*Malus domestica*	**MW016482**	**MW566349**	**MW580522**	**MW024510**	**MW474468**	**MW533801**	–
	LC13662 = F059	Spain	*Chamaerops humilis*	**MW016483**	**MW566350**	**MW580523**	**MW024511**	**MW474469**	**MW533802**	–
	LC13663 = F100	Ukraine	*Zea mays*	**MW016484**	**MW566351**	**MW580524**	**MW024512**	**MW474470**	**MW533803**	–
	LC13664 = F102	USA	*Sorghum bicolor*	**MW016485**	**MW566352**	**MW580525**	**MW024513**	**MW474471**	**MW533804**	–
	LC13665 = F405	Spain	*Olea europaea*	**MW016486**	**MW566353**	**MW580526**	**MW024514**	**MW474472**	**MW533805**	–
	LC13666 = GDBYL08-E1	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016487**	**MW566354**	**MW580527**	**MW024515**	**MW474473**	**MW533806**	–
	LC13667 = GDBYL10-E1	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016488**	**MW566355**	**MW580528**	**MW024516**	**MW474474**	**MW533807**	–
	LC13668 = GDGZSJL01E1	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016489**	**MW566356**	**MW580529**	**MW024517**	**MW474475**	**MW533808**	–
	LC13669 = GXBSMAS2-E3	China, Guangxi Zhuang Autonomous Region, Baise city	*Musa nana*	**MW016490**	**MW566357**	**MW580530**	**MW024518**	**MW474476**	**MW533809**	–
	LC13670 = GXCZMQS1-E2	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	**MW016491**	**MW566358**	**MW580531**	**MW024519**	**MW474477**	**MW533810**	–
	LC13671 = GXLBL15-3	China, Guangxi Zhuang Autonomous Region, Laibin city	*Musa nana*	**MW016492**	**MW566359**	**MW580532**	**MW024520**	**MW474478**	**MW533811**	–
	LC13673 = HBF3-2	China, Hebei Province	*Oryza* sp.	**MW016494**	**MW566361**	**MW580534**	**MW024522**	**MW474480**	**MW533813**	–
	LC13674 = JXF3-22	China, Jiangxi Province	*Oryza* sp.	**MW016495**	**MW566362**	**MW580535**	**MW024523**	**MW474481**	**MW533814**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. annulatum (cont.)	LC13675 = JXN1-21	China, Jiangxi Province	*Oryza* sp.	**MW016496**	**MW566363**	**MW580536**	**MW024524**	**MW474482**	**MW533815**	–
	LC2825	China, Beijing	unidentified grass	**MW016497**	**MW566364**	**MW580537**	**MW024525**	**MW474483**	**MW533816**	–
	LC5984	China	submerged wood	**MW016498**	**MW566365**	**MW580538**	**MW024526**	**MW474484**	**MW533817**	–
	LC6002	China	submerged wood	**MW016499**	**MW566366**	**MW580539**	**MW024527**	**MW474485**	**MW533818**	–
	LC7208	China, Guangdong Province, Guangzhou city	bamboo	**MW016500**	**MW566367**	**MW580540**	**MW024528**	**MW474486**	**MW533819**	–
	LC7924	China, Shandong Province	*Capsicum* sp.	**MW016501**	**MW566368**	**MW580541**	**MW024529**	**MW474487**	**MW533820**	–
F. aquaticum	LC13615	China, Guizhou Province, Zunyi city	water	**MW016406**	**MW566273**	**MW580446**	**MW024437**	**MW474392**	**MW533728**	–
	LC13616	China, Guizhou Province, Zunyi city	water	**MW016407**	**MW566274**	**MW580447**	**MW024438**	**MW474393**	**MW533729**	–
	CGMCC 3.20819 = LC7502 T	China, Guizhou Province, Zunyi city	water	**MW016408**	**MW566275**	**MW580448**	**MW024439**	**MW474394**	**MW533730**	–
F. concentricum	LC1003	China, Guangdong Province, Guangzhou city	*Reineckia carnea*	**MW016409**	**MW566276**	**MW580449**	**MW024440**	**MW474395**	**MW533731**	–
	LC11489 = G1	China, Beijing	*Vitis* sp.	**MW016410**	**MW566277**	**MW580450**	**MW024441**	**MW474396**	**MW533732**	–
	LC11491 = G5	China, Beijing	*Vitis* sp.	**MW016411**	**MW566278**	**MW580451**	**MW024442**	**MW474397**	**MW533733**	–
	LC11507 = G36	China, Beijing	*Vitis* sp.	**MW016412**	**MW566279**	**MW580452**	**MW024443**	**MW474398**	**MW533734**	–
	LC13617 = CQ1128	China, Jiangsu Province, Changshu city	unknown plant	**MW016413**	**MW566280**	**MW580453**	**MW024444**	**MW474399**	**MW533735**	–
	LC13618 = F409	Japan	*Podocarpus macrophyllus*	**MW016414**	**MW566281**	**MW580454**	**MW024445**	**MW474400**	**MW533736**	–
	LC13619 = FJWYS10-3	China, Fujian Province, Wuyi Mountain	*Musa nana*	**MW016415**	**MW566282**	**MW580455**	**MW024446**	**MZ399207**	**MW533737**	–
	LC13620 = FJWYS3-1	China, Fujian Province, Wuyi Mountain	*Musa nana*	**MW016416**	**MW566283**	**MW580456**	**MW024447**	**MW474402**	**MW533738**	–
	LC13621 = GXLB9-1-1	China, Guangxi Zhuang Autonomous Region, Laibin city	*Musa nana*	**MW016417**	**MW566284**	**MW580457**	**MW024448**	**MW474403**	**MW533739**	–
	LC13623 = LJM1471	China, Hainan Province, Haikou city	*Maianthemum* sp.	**MW016419**	**MW566286**	**MW580459**	**MW024450**	**MW474405**	**MW533741**	–
	LC13624 = M0514	China, Fujian Province, Fuzhou city, Wuyi Mountain	*Lablab* sp.	**MW016420**	**MW566287**	**MW580460**	**MW024451**	**MW474406**	**MW533742**	–
	LC13647 = M0155	China, Fujian Province, Fuzhou city	*Lablab* sp.	**MW016457**	**MW566324**	**MW580497**	**MW024485**	**MW474443**	**MW533776**	–
	LC13648 = M0155.2	China, Fujian Province, Fuzhou city	*Lablab* sp.	**MW016458**	**MW566325**	**MW580498**	**MW024486**	**MW474444**	**MW533777**	–
	LC13649 = M0155.3	China, Fujian Province, Fuzhou city	*Lablab* sp.	**MW016459**	**MW566326**	**MW580499**	**MW024487**	**MW474445**	**MW533778**	–
	LC4326	China, Jiangxi Province	*Aglaonema modestum*	**MW016421**	**MW566288**	**MW580461**	**MW024452**	**MW474407**	**MW533743**	–
	LC4359	China, Jiangxi Province	*Hedera nepalensis*	**MW016422**	**MW566289**	**MW580462**	**MW024453**	**MW474408**	**MW533744**	–
	LC7032	China, Hainan Province	*Musa nana*	**MW016423**	**MW566290**	**MW580463**	**MW024454**	**MW474409**	**MW533745**	–
F. elaeagni	CGMCC 3.20822 = LC13627 = CQ1053 T	China, Jiangsu Province, Suzhou city	*Elaeagnus pungens*	**MW016426**	**MW566293**	**MW580466**	**MW024457**	**MW474412**	**MW533748**	–
	LC13628 = CQ1053.2	China, Jiangsu Province, Suzhou city	*Elaeagnus pungens*	**MW016427**	**MW566294**	**MW580467**	**MW024458**	**MW474413**	**MW533749**	–
	LC13629 = CQ1053.3	China, Jiangsu Province, Suzhou city	*Elaeagnus pungens*	**MW016428**	**MW566295**	**MW580468**	**MW024459**	**MW474414**	**MW533750**	–
F. fujikuroi	LC13633 = F013	USA	*Glycine max*	**MW016432**	**MW566299**	**MW580472**	**MW024460**	**MW474418**	**MW533751**	–
	LC13634 = F032	Japan	*Acer palmatum*	**MW016433**	**MW566300**	**MW580473**	**MW024461**	**MW474419**	**MW533752**	–
	LC13635 = F063	USA	*Sorghum bicolor*	**MW016434**	**MW566301**	**MW580474**	**MW024462**	**MW474420**	**MW533753**	–
	LC13636 = F402	Japan	*Rhododendron simsii*	**MW016435**	**MW566302**	**MW580475**	**MW024463**	**MW474421**	**MW533754**	–
	LC13637 = FJWYS2-1	China, Fujian Province, Wuyi mountain	*Musa nana*	**MW016436**	**MW566303**	**MW580476**	**MW024464**	**MW474422**	**MW533755**	–
	LC13638 = GDQY3-1	China, Guangdong Province, Qingyuan city	*Musa nana*	**MW016437**	**MW566304**	**MW580477**	**MW024465**	**MW474423**	**MW533756**	–
	LC13639 = GXBSNXS01-E1	China, Guangxi Zhuang Autonomous Region, Baise city	*Musa nana*	**MW016438**	**MW566305**	**MW580478**	**MW024466**	**MW474424**	**MW533757**	–
	LC13640 = GXLZBDL06-E2	China, Guangxi Zhuang Autonomous Region, Liuzhou city	*Musa nana*	**MW016439**	**MW566306**	**MW580479**	**MW024467**	**MW474425**	**MW533758**	–
	LC13641 = HBF4-8	China, Hebei Province	*Oryza* sp.	**MW016440**	**MW566307**	**MW580480**	**MW024468**	**MW474426**	**MW533759**	–
	LC13642 = LJM1535	China, Hainan Province, Wanning city	*Panicum* sp.	**MW016441**	**MW566308**	**MW580481**	**MW024469**	**MW474427**	**MW533760**	–
	LC13643 = LJM1536	China, Hainan Province, Wanning city	*Panicum* sp.	**MW016442**	**MW566309**	**MW580482**	**MW024470**	**MW474428**	**MW533761**	–
	LC5916	China, Jiangxi Province, Nanchang city	submerged wood	**MW016443**	**MW566310**	**MW580483**	**MW024471**	**MW474429**	**MW533762**	–
	LC5927	China, Jiangxi Province, Nanchang city	submerged wood	**MW016444**	**MW566311**	**MW580484**	**MW024472**	**MW474430**	**MW533763**	–
	LC5945	China, Jiangxi Province, Nanchang city	submerged wood	**MW016445**	**MW566312**	**MW580485**	**MW024473**	**MW474431**	**MW533764**	–
	LC5955	China, Jiangxi Province, Nanchang city	submerged wood	**MW016446**	**MW566313**	**MW580486**	**MW024474**	**MW474432**	**MW533765**	–
	LC5979	China, Jiangxi Province, Nanchang city	submerged wood	**MW016447**	**MW566314**	**MW580487**	**MW024475**	**MW474433**	**MW533766**	–
	LC6014	China, Jiangxi Province, Nanchang city	submerged wood	**MW016448**	**MW566315**	**MW580488**	**MW024476**	**MW474434**	**MW533767**	–
	LC6015	China, Jiangxi Province, Nanchang city	submerged wood	**MW016449**	**MW566316**	**MW580489**	**MW024477**	**MW474435**	**MW533768**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. fujikuroi (cont.)	LC6024	China, Jiangxi Province, Nanchang city	submerged wood	**MW016450**	**MW566317**	**MW580490**	**MW024478**	**MW474436**	**MW533769**	–
	LC6973	China, Jiangxi Province	*Citrus reticulata*	**MW016451**	**MW566318**	**MW580491**	**MW024479**	**MW474437**	**MW533770**	–
	LC7147	China, Jiangxi Province	bamboo	**MW016452**	**MW566319**	**MW580492**	**MW024480**	**MW474438**	**MW533771**	–
	LC7864	China, Guangxi Zhuang Autonomous Region	*Poaceae* sp.	**MW016453**	**MW566320**	**MW580493**	**MW024481**	**MW474439**	**MW533772**	–
F. hechiense	CGMCC 3.20824 = LC13644 = GXHCSWL14-E1 T	China, Guangxi Zhuang Autonomous Region, Hechi city	*Musa nana*	**MW016454**	**MW566321**	**MW580494**	**MW024482**	**MW474440**	**MW533773**	–
	LC13645 = GXHCSWL14-E12	China, Guangxi Zhuang Autonomous Region, Hechi city,	*Musa nana*	**MW016455**	**MW566322**	**MW580495**	**MW024483**	**MW474441**	**MW533774**	–
	LC13646 = GXHCSWL14-E13	China, Guangxi Zhuang Autonomous Region, Hechi city	*Musa nana*	**MW016456**	**MW566323**	**MW580496**	**MW024484**	**MW474442**	**MW533775**	–
F. lumajangense	LC13650 = GXCZMQF02-1	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	**MW016461**	**MW566328**	**MW580501**	**MW024489**	**MW474447**	**MW533780**	–
	LC13651 = GXCZMQF02-2	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	**MW016462**	**MW566329**	**MW580502**	**MW024490**	**MW474448**	**MW533781**	–
	LC13652 = MH0493	China, Guangxi Zhuang Autonomous Region	*Arenga caudata*	**MW016463**	**MW566330**	**MW580503**	**MW024491**	**MW474449**	**MW533782**	–
F. madaense	LC13614 = HBN5-22	China, Hebei Province	*Oryza* sp.	**MW016405**	**MW566272**	**MW580445**	**MW024436**	**MW474391**	**MW533727**	–
F. mundagurra	LC13689 = LGS129	China, Hainan Province	*Paspalum vaginatum*	**MW016516**	**MW566383**	**MW580556**	**MW024544**	**MW474502**	**MW533835**	–
	LGS129.2	China, Hainan Province	*Paspalum vaginatum*	**MZ379241**	**MZ399201**	**MZ399211**	**MZ399204**	**MZ399208**	**MZ399214**	–
	LGS129.3	China, Hainan Province	*Paspalum vaginatum*	**MZ379242**	**MZ399202**	**MZ399212**	**MZ399205**	**MZ399209**	**MZ399215**	–
F. panlongense	CGMCC 3.20825 = LC13656 = GXGLPLL15E2 T	China, Guangxi Zhuang Autonomous Region, Guilin city	*Musa nana*	**MW016470**	**MW566337**	**MW580510**	**MW024498**	**MW474456**	**MW533789**	–
F. proliferatum	F026	China, Zhejiang Province, Ningbo city	*Musa* sp.	**MZ379243**	**MZ399203**	**MZ399213**	**MZ399206**	**MZ399210**	**MZ399216**	–
F. pseudocircinatum	LC13676 = F428	China, Taiwan Province	*Syzygium samarangense*	**MW016502**	**MW566369**	**MW580542**	**MW024530**	**MW474488**	**MW533821**	–
	LC13677 = F429	China, Taiwan Province	*Syzygium samarangense*	**MW016503**	**MW566370**	**MW580543**	**MW024531**	**MW474489**	**MW533822**	–
F. sacchari	LC1058	China, Guangdong Province, Guangzhou city	*Arundina graminifolia*	**MW016504**	**MW566371**	**MW580544**	**MW024532**	**MW474490**	**MW533823**	–
	LC13625 = F162	Philippines	*Musa* sp.	**MW016424**	**MW566291**	**MW580464**	**MW024455**	**MW474410**	**MW533746**	–
	LC13626 = GDGZTHL40-E4	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016425**	**MW566292**	**MW580465**	**MW024456**	**MW474411**	**MW533747**	–
	LC13657 = GXBSCGS01-E2	China, Guangxi Zhuang Autonomous Region, Baise city	*Musa nana*	**MW016471**	**MW566338**	**MW580511**	**MW024499**	**MW474457**	**MW533790**	–
	LC13678 = GDGZ2-2	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016505**	**MW566372**	**MW580545**	**MW024533**	**MW474491**	**MW533824**	–
	LC13679 = GXQZPSL01-E1	China, Guangxi Zhuang Autonomous Region, Qinzhou city	*Musa nana*	**MW016506**	**MW566373**	**MW580546**	**MW024534**	**MW474492**	**MW533825**	–
	LC13680 = GXQZPSL01-E2	China, Guangxi Zhuang Autonomous Region, Qinzhou city	*Musa nana*	**MW016507**	**MW566374**	**MW580547**	**MW024535**	**MW474493**	**MW533826**	–
	LC13681 = LJM1180	China, Beijing	*Poa annua*	**MW016508**	**MW566375**	**MW580548**	**MW024536**	**MW474494**	**MW533827**	–
F. subglutinans	LC13682 = F055	USA	*Glycine max*	**MW016509**	**MW566376**	**MW580549**	**MW024537**	**MW474495**	**MW533828**	–
	LC13683 = F057	USA	*Zea mays*	**MW016510**	**MW566377**	**MW580550**	**MW024538**	**MW474496**	**MW533829**	–
	LC13684 = F154	Canada	*Glycine max*	**MW016511**	**MW566378**	**MW580551**	**MW024539**	**MW474497**	**MW533830**	–
	LC13685 = F154-2	Canada	*Glycine max*	**MW016512**	**MW566379**	**MW580552**	**MW024540**	**MW474498**	**MW533831**	–
	LC13686 = F154-3	Canada	*Glycine max*	**MW016513**	**MW566380**	**MW580553**	**MW024541**	**MW474499**	**MW533832**	–
F. temperatum	LC5848	China, Guizhou Province	unidentified lichen	**MW016460**	**MW566327**	**MW580500**	**MW024488**	**MW474446**	**MW533779**	–
F. thapsinum	LC13687 = F103	USA	*Sorghum bicolor*	**MW016514**	**MW566381**	**MW580554**	**MW024542**	**MW474500**	**MW533833**	–
	LC13688 = F411	USA	*Glycine max*	**MW016515**	**MW566382**	**MW580555**	**MW024543**	**MW474501**	**MW533834**	–
F. verticillioides	LC13653 = F410	Brazil	*Glycine max*	**MW016464**	**MW566331**	**MW580504**	**MW024492**	**MW474450**	**MW533783**	–
	LC13654 = F412	USA	*Glycine max*	**MW016465**	**MW566332**	**MW580505**	**MW024493**	**MW474451**	**MW533784**	–
	LC13655 = GDGZP4-1-1	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016466**	**MW566333**	**MW580506**	**MW024494**	**MW474452**	**MW533785**	–
	LC2810	China, Sichuan Province, Zhangjiajie	bamboo	**MW016467**	**MW566334**	**MW580507**	**MW024495**	**MW474453**	**MW533786**	–
	LC2818	China, Beijing	*Physosfegia virginiana*	**MW016468**	**MW566335**	**MW580508**	**MW024496**	**MW474454**	**MW533787**	–
	LC5896	China, Jiangxi Province, Nanchang city	submerged wood	**MW016469**	**MW566336**	**MW580509**	**MW024497**	**MW474455**	**MW533788**	–
F. incarnatum-equiseti species complex										
F. arcuatisporum	LC11639 = HA5-S04	China, Hainan Province	*Oryza* sp.	MK280840	MK289658	MK289586	MK289798	MK289736	**MW533836**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. arcuatisporum (cont.)	CGMCC 3.19493 = LC12147 = LF1502 T	China, Hubei Province	*Brassica campestris*	MK280802	MK289697	MK289584	MK289799	MK289739	**MW533837**	–
	LC13690 = LGS034	China, Beijing	soil	**MW016517**	**MW574182**	**MW594360**	**MW024545**	**MW474503**	**MW533838**	–
	LC13691 = LGS119	China, Hainan Province	*Paspalum vaginatum*	**MW016518**	**MW574183**	**MW594361**	**MW024546**	**MW474504**	**MW533839**	–
	LC13692 = LJM0900	China, Beijing	*Poa annua*	**MW016519**	**MW574184**	**MW594362**	**MW024547**	**MW474505**	**MW533840**	–
	LC13693 = LJM0939	China, Beijing	unidentified grass	**MW016520**	**MW574185**	**MW594363**	**MW024548**	**MW474506**	**MW533841**	–
	LC13694 = LJM1441	China, Hainan Province, Sanya city	*Panicum* sp.	**MW016521**	**MW574186**	**MW594364**	**MW024549**	**MW474507**	**MW533842**	–
	LC6026	China, Jiangxi Province, Nanchang city	*Nelumbo nucifera* bloom	MK280792	MK289667	MK289585	MK289800	MK289770	**MW533843**	–
F. citri	LC13695 = MH0430	China, Guangxi Zhuang Autonomous Region	*Castanopsis boisii*	**MW016522**	**MW574187**	**MW594365**	**MW024550**	**MW474508**	**MW533844**	–
	LC13696 = MH0439	China, Guangxi Zhuang Autonomous Region	*Castanopsis boisii*	**MW016523**	**MW574188**	**MW594366**	**MW024551**	**MW474509**	**MW533845**	–
	LC13697 = MH0446	China, Guangxi Zhuang Autonomous Region	*Smilax corbularia*	**MW016524**	**MW574189**	**MW594367**	**MW024552**	**MW474510**	**MW533846**	–
	LC13698 = YNTBL08E1	China, Yunnan Province, Xishuangbanna	*Musa nana*	**MW016525**	**MW574190**	**MW594368**	**MW024553**	**MW474511**	**MW533847**	–
	LC4879	China, Beijing	*Amygdalus triloba*	MK280820	MK289665	MK289615	MK289827	MK289768	**MW533848**	–
	CGMCC 3.19467 = LC6896 T	China, Hunan Province	*Citrus reticulata*	MK280803	MK289668	MK289617	MK289828	MK289771	–	–
	LC7922	China, Shandong Province	*Capsicum* sp.	MK280817	MK289687	MK289634	MK289829	MK289788	–	–
	LC7937	China, Shandong Province	*Capsicum* sp.	MK280797	MK289693	MK289640	MK289830	MK289794	**MW533849**	–
F. compactum	LC13699 = LGS085	China, Beijing	soil	**MW016526**	**MW574191**	**MW594369**	**MW024554**	**MW474512**	–	–
	LC13700 = LJM1181	China, Beijing	*Poa annua*	**MW016527**	**MW574192**	**MW594370**	**MW024555**	**MW474513**	**MW533850**	–
F. guilinense	CGMCC 3.19495 = LC12160 = GXGL9-3 T	China, Guangxi Zhuang Autonomous Region	*Musa nana*	MK280837	MK289652	MK289594	MK289831	MK289747	**MW533851**	–
F. hainanense	CGMCC 3.19478 = LC11638 = HA5-S03 T	China, Hainan Province	*Oryza* sp.	MK280836	MK289657	MK289581	MK289833	MK289735	**MW533852**	–
	LC12161 = GXCZ-9-1	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	MK280793	MK289648	MK289595	MK289832	MK289748	**MW533853**	–
	LC13701 = YNTBL31E2	China, Yunnan Province, Xishuangbanna	*Musa nana*	**MW016528**	**MW574193**	**MW594371**	**MW024556**	**MW474514**	**MW533854**	–
F. humuli	CQ1027	China, Jiangsu Province	*Ligustrum lucidum*	MK280843	MK289709	MK289567	MK289838	MK289721	**MW533855**	–
	CQ1032	China, Jiangsu Province	*Cedrela* sp.	MK280844	MK289710	MK289568	MK289839	MK289722	**MW533856**	–
	CGMCC 3.19374 = CQ1039T	China, Jiangsu Province	*Humulus scandens*	MK280845	MK289712	MK289570	MK289840	MK289724	**MW533857**	–
	CQ1048	China, Jiangsu Province	*Viburnum* sp.	MK280850	MK289713	MK289571	MK289841	MK289725	**MW533858**	–
	CQ1073	China, Jiangsu Province	*Liquidambar formosana*	MK280848	MK289714	MK289572	MK289842	MK289726	**MW533859**	–
	CQ1133	China, Jiangsu Province	*Vinca major*	MK280847	MK289717	MK289575	MK289843	MK289729	**MW533860**	–
	CQ969	China, Jiangsu Province	*Rosa sempervirens*	MK280851	MK289718	MK289576	MK289844	MK289730	**MW533861**	–
	CQ970	China, Jiangsu Province	*Rosa sempervirens*	MK280849	MK289719	MK289577	MK289845	MK289731	**MW533862**	–
	CQ975	China, Jiangsu Province	*Paederia foetida*	MK280846	MK289720	MK289578	MK289846	MK289732	**MW533863**	–
	LC12158 = GDBYL14-E1	China, Guangdong Province, Guangzhou city	*Musa nana*	MK280823	MK289645	MK289592	MK289834	MK289745	**MW533864**	–
	LC12159 = GDGZLHL14-E1	China, Guangdong Province, Guangzhou city	*Musa nana*	MK280827	MK289646	MK289593	MK289835	MK289746	**MW533865**	–
	LC13702 = LJM1412	China, Hainan Province, Haikou city	*Megathyrsus* sp.	**MW016529**	**MW574194**	**MW594372**	**MW024557**	**MW474515**	**MW533866**	–
	LC13703 = MH0134	China, Guangxi Zhuang Autonomous Region	*Coriaria nepalensis*	**MW016530**	**MW574195**	**MW594373**	**MW024558**	**MW474516**	**MW533867**	–
	LC13704 = MH0240	China, Guangxi Zhuang Autonomous Region	*Chimonanthus praecox*	**MW016531**	**MW574196**	**MW594374**	**MW024559**	**MW474517**	**MW533868**	–
	LC4490	China, Jiangxi Province	*Osmanthus* sp.	MK280826	MK289664	MK289614	MK289836	MK289767	**MW533869**	–
	LC7003	China, Hainan Province	*Musa paradisiaca*	MK280833	MK289674	MK289623	MK289837	MK289777	**MW533870**	–
F. incarnatum	LC13705 = LGS051	China, Beijing	soil	**MW016532**	**MW574197**	**MW594375**	**MW024560**	**MW474518**	**MW533871**	–
F. ipomoeae	CQ1099	China, Jiangsu Province	*Rhododendron pulchrum*	MK280853	MK289715	MK289573	MK289861	MK289727	**MW533872**	–
	CQ1132	China, Jiangsu Province	*Vinca major*	MK280854	MK289716	MK289574	MK289862	MK289728	**MW533873**	–
	LC0166	China, Beijing	*Solanum lycopersicum*	MK280780	MK289659	MK289579	MK289848	MK289733	–	–
	LC0455	China, Beijing	*Hosta* sp.	MK280819	MK289660	MK289580	MK289849	MK289734	**MW533874**	–
	LC12162 = GXLZCJL05-E2	China, Guangxi Zhuang Autonomous Region, Liuzhou city	*Musa nana*	MK280795	MK289655	MK289596	MK289847	MK289749	**MW533875**	–
	LC12163 = M0027	China, Fujian Province, Fuzhou city	*Hibiscus syriacus*	MK280790	MK289700	MK289597	MK289857	MK289750	**MW533876**	–
	LC12164 = M0028	China, Fujian Province, Fuzhou city	*Hibiscus syriacus*	MK280822	MK289701	MK289598	MK289858	MK289751	**MW533877**	–
	CGMCC 3.19496 = LC12165 = M0111 T	China, Fujian Province	*Ipomoea aquatica*	MK280832	MK289704	MK289599	MK289859	MK289752	**MW533878**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. ipomoeae (cont.)	LC12166 = M0138	China, Fujian Province, Fuzhou city	*Lagenaria siceraria*	MK280791	MK289706	MK289600	MK289860	MK289753	–	–
	LC13706 = JXN4-3	China, Jiangxi Province	*Oryza* sp.	**MW016533**	**MW574198**	**MW594376**	**MW024561**	**MW474519**	–	–
	LC13707 = LGS036	China, Beijing	soil	**MW016534**	**MW574199**	**MW594377**	**MW024562**	**MW474520**	**MW533879**	–
	LC13708 = LGS052	China, Beijing	soil	**MW016535**	**MW574200**	**MW594378**	**MW024563**	**MW474521**	–	–
	LC13709 = LGS071	China, Beijing	soil	**MW016536**	**MW574201**	**MW594379**	**MW024564**	**MW474522**	**MW533880**	–
	LC13710 = LJM0958	China, Beijing	*Agrostis matsumurae*	**MW016537**	**MW574202**	**MW594380**	**MW024565**	**MW474523**	**MW533881**	–
	LC5912	China, Jiangxi Province	submerged wood	MK280821	MK289666	MK289616	MK289850	MK289769	**MW533882**	–
	LC6926	China, Hubei Province	*Oryza sativa*	MK280799	MK289670	MK289619	MK289851	MK289773	–	–
	LC7150	China, Jiangxi Province	bamboo	MK280818	MK289678	MK289627	MK289852	MK289781	**MW533883**	–
	LC7923	China, Shandong Province	*Capsicum* sp.	MK280800	MK289688	MK289635	MK289853	MK289789	**MW533884**	–
	LC7925	China, Shandong Province	*Capsicum* sp.	MK280796	MK289689	MK289636	MK289854	MK289790	–	–
	LC7936	China, Shandong Province	*Capsicum* sp.	MK280785	MK289692	MK289639	MK289855	MK289793	–	–
	LC7940	China, Shandong province	*Capsicum* sp.	MK280798	MK289695	MK289642	MK289856	MK289796	**MW533885**	–
F. irregulare	LC12145	China, Guangdong Province	bamboo	MK280830	MK289681	MK289582	MK289864	MK289737	–	–
	LC12146	China, Guangdong Province	bamboo	MK280831	MK289682	MK289583	MK289865	MK289738	–	–
	LC13711 = LJM1544	China, Hainan Province, Wanning city	*Digitaria* sp.	**MW016538**	**MW574203**	**MW594381**	**MW024566**	**MW474524**	**MW533886**	–
	LC13712 = LJM1545	China, Hainan Province, Wanning city	*Digitaria* sp.	**MW016539**	**MW574204**	**MW594382**	**MW024567**	**MW474525**	**MW533887**	–
	LC13713 = MH0410	China, Guangxi Zhuang Autonomous Region	*Vigna unguiculata*	**MW016540**	**MW574205**	**MW594383**	**MW024568**	**MW474526**	**MW533888**	–
	CGMCC 3.19489 = LC7188 T	China, Guangdong Province	bamboo	MK280829	MK289680	MK289629	MK289863	MK289783	–	–
F. lacertarum	LC7927	China, Shandong Province	*Capsicum* sp.	MK280838	MK289690	MK289637	MK289866	MK289791	–	–
	LC7931	China, Shandong Province	*Capsicum* sp.	MK280801	MK289691	MK289638	MK289867	MK289792	–	–
	LC7942	China, Shandong Province	*Capsicum* sp.	MK280834	MK289696	MK289643	MK289868	MK289797	–	–
F. luffae	CQ1038	China, Jiangsu Province	*Humulus scandens*	MK280852	MK289711	MK289569	MK289870	MK289723	**MW533889**	–
	CGMCC 3.19497 = LC12167 T	China, Fujian Province	*Luffa aegyptiaca*	MK280807	MK289698	MK289601	MK289869	MK289754	–	–
	LC13714 = JXN4-19	China, Jiangxi Province	*Oryza* sp.	**MW016541**	**MW574206**	**MW594384**	**MW024569**	**MW474527**	–	–
F. nanum	CGMCC 3.19498 = LC12168 = GXGL14-2 T	China, Guangxi Zhuang Autonomous Region	*Musa nana*	MK280794	MK289651	MK289602	MK289871	MK289755	–	–
	LC1384	Saudi Arabia	*Solanum lycopersicum*	MK280842	MK289661	MK289611	MK289872	MK289764	**MW533890**	–
	LC1385	Saudi Arabia	*Solanum lycopersicum*	MK280781	MK289662	MK289612	MK289873	MK289765	**MW533891**	–
	LC1516	Saudi Arabia	*Solanum lycopersicum*	MK280782	MK289663	MK289613	MK289874	MK289766	**MW533892**	–
F. pernambucanum	LC12148 = GDBYL12-E1	China, Guangdong Province, Guangzhou city	*Musa nana*	MK280778	MK289644	MK289587	MK289801	MK289740	**MW533893**	–
	LC12149 = GDGZP2-3	China, Guangdong Province, Guangzhou city	*Musa nana*	MK280783	MK289647	MK289588	MK289802	MK289741	**MW533894**	–
	LC12151 = GXCZMQF01-3	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	MK280825	MK289649	MK289589	MK289803	MK289742	**MW533895**	–
	LC12152 = GXCZMQF01-4	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	MK280824	MK289650	MK289590	MK289804	MK289743	**MW533896**	–
	LC13715 = LJM1300	China, Hainan Province, Haikou city	*Heteropogon* sp.	**MW016542**	**MW574207**	**MW594385**	**MW024570**	**MW474528**	**MW533897**	–
	LC13716 = LJM1312	China, Hainan Province	*Gerbera jamesonii*	**MW016543**	**MW574208**	**MW594386**	**MW024571**	**MW474529**	**MW533898**	–
	LC13717 = LJM1438	China, Hainan Province, Sanya city	*Cyperus* sp.	**MW016544**	**MW574209**	**MW594387**	**MW024572**	**MW474530**	**MW533899**	–
	LC13718 = LJM1523	China, Hainan Province, Haikou city	*Chamaedorea* sp.	**MW016545**	**MW574210**	**MW594388**	**MW024573**	**MW474531**	**MW533900**	–
	LC13719 = LJM1529	China, Hainan Province, Sanya city	*Panicum* sp.	**MW016546**	**MW574211**	**MW594389**	**MW024574**	**MW474532**	**MW533901**	–
	LC7014	China, Hainan Province	*Musa paradisiaca*	MK280786	MK289675	MK289624	MK289812	MK289778	–	–
	LC7019	China, Hainan Province	*Musa paradisiaca*	MK280816	MK289676	MK289625	MK289813	MK289779	–	–
	LC7040	China, Hainan Province	*Musa paradisiaca*	MK280787	MK289677	MK289626	MK289814	MK289780	**MW533902**	–
	LC7157	China, Jiangxi Province, Nanchang city	bamboo	MK280804	MK289679	MK289628	MK289815	MK289782	–	–
	LC7842	China, Hainan Province	*Zea* sp.	MK280813	MK289684	MK289631	MK289817	MK289785	**MW533903**	–
	LC7920	China, Shandong Province	*Capsicum* sp.	MK280805	MK289686	MK289633	MK289819	MK289787	–	–
F. sulawesiense	LC12170 = GXNN-6	China, Guangxi Zhuang Autonomous Region, Nanning city	*Musa nana*	MK280841	MK289656	MK289604	MK289807	MK289757	**MW533908**	–
	LC12173 = M0010	China, Fujian Province, Fuzhou city	*Luffa aegyptiaca*	MK280788	MK289699	MK289605	MK289821	MK289758	–	–
	LC12174 = M0079	China, Fujian Province, Fuzhou city	*Ipomoea batatas*	MK280815	MK289702	MK289606	MK289822	MK289759	–	–
	LC12175 = M0110	China, Fujian Province, Fuzhou city	*Ipomoea aquatica*	MK280808	MK289703	MK289607	MK289823	MK289760	**MW533909**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. sulawesiense (cont.)	LC12176 = M0117	China, Fujian Province, Fuzhou city	*Luffa aegyptiaca*	MK280839	MK289705	MK289608	MK289824	MK289761	–	–
	LC12177 = M0204	China, Fujian Province, Fuzhou city	*Colocasia esculenta*	MK280809	MK289707	MK289609	MK289825	MK289762	–	–
	LC12178 = M0751	China, Fujian Province, Fuzhou city	*Syngonium auritum*	MK280789	MK289708	MK289610	MK289826	MK289763	–	–
	LC13720 = JXN4-20	China, Jiangxi Province	*Oryza* sp.	**MW016547**	**MW574212**	**MW594390**	**MW024575**	**MW474533**	–	–
	LC13721 = MH0409	China, Guangxi Zhuang Autonomous Region	*Alocasia odora*	**MW016548**	**MW574213**	**MW594391**	**MW024576**	**MW474534**	**MW533904**	–
	LC13722 = MH0423	China, Guangxi Zhuang Autonomous Region	*Acalypha insulana*	**MW016549**	**MW574214**	**MW594392**	**MW024577**	**MW474535**	**MW533905**	–
	LC13723 = MH0447	China, Guangxi Zhuang Autonomous Region	*Smilax corbularia*	**MW016550**	**MW574215**	**MW594393**	**MW024578**	**MW474536**	**MW533906**	–
	LC6897	China, Hunan Province	*Citrus reticulata*	MK280810	MK289669	MK289618	MK289808	MK289772	–	–
	LC6928	China, Hubei Province	*Oryza sativa*	MK280835	MK289671	MK289620	MK289809	MK289774	–	–
	LC6936	China, Hubei Province	*Oryza sativa*	MK280835	MK289620	MK289671	MK289809	MK289774	–	–
	LC6990	China, Hainan Province	*Musa paradisiaca*	MK280814	MK289673	MK289622	MK289811	MK289776	–	–
	LC7210	China, Jiangxi Province, Nanchang city	bamboo	MK280804	MK289679	MK289628	MK289815	MK289782	–	–
	LC7919	China, Shandong Province	*Capsicum* sp.	MK280811	MK289685	MK289632	MK289818	MK289786	–	–
	LC7939	China, Shandong Province	*Capsicum* sp.	MK280806	MK289694	MK289641	MK289820	MK289795	–	–
F. tanahbumbuense	LC13724 = HBF4-12	China, Hebei Province	*Oryza* sp.	**MW016551**	**MW574216**	**MW594394**	**MW024579**	**MW474537**	–	–
	LC13725 = HBN4-19	China, Hebei Province	*Oryza* sp.	**MW016552**	**MW574217**	**MW594395**	**MW024580**	**MW474538**	–	–
	LC13726 = LJM1369	China, Hainan Province, Wanning city	*Digitaria* sp.	**MW016553**	**MW574218**	**MW594396**	**MW024581**	**MW474539**	**MW533910**	–
F. lateritium species complex										
F. cassiae	LC13727 = F092	China, Yunnan Province	*Coffea* sp.	**MW016554**	–	**MW594307**	**MW024582**	**MW474540**	**MW533911**	–
F. stilboides	LC13728 = CQ1109	China, Jiangsu Province, Changshu city	*Forsythia* sp.	**MW016555**	–	**MW594308**	**MW024583**	**MW474541**	**MW533912**	–
	LC13729 = CQ993	China, Jiangsu Province, Suzhou city	*Hedera nepalensis* var. *sinensis*	**MW016556**	–	**MW594309**	**MW024584**	**MW474542**	**MW533913**	–
	LC13730 = F004	Japan	*Acer palmatum*	**MW016557**	–	**MW594310**	**MW024585**	**MW474543**	**MW533914**	–
	LC13731 = M0759	China, Guangdong Province, Shenzhen city	*Schima noronhae*	**MW016558**	–	**MW594311**	**MW024586**	**MW474544**	**MW533915**	–
Fusarium sp.	LC13732 = F085	China, Yunnan Province	*Coffea* sp.	**MW016559**	–	**MW594312**	**MW024587**	**MW474545**	**MW533916**	–
	LC13733 = F088	China, Yunnan Province	*Coffea* sp.	**MW016560**	–	**MW594313**	**MW024588**	**MW474546**	**MW533917**	–
F. nisikadoi species complex										
F. commune	LC11660 = HM259-R03	China, Hainan Province	*Oryza* sp.	**MW016699**	–	**MW620160**	**MW024727**	**MW474685**	**MW534045**	–
	LC13823 = GDGZP2-2	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016700**	–	**MW620161**	**MW024728**	**MW474686**	**MW534046**	–
	LC13824 = GXQZPSRDE4	China, Guangxi Zhuang Autonomous Region, Qinzhou city	*Musa nana*	**MW016701**	–	**MW620162**	**MW024729**	**MW474687**	–	–
F. miscanthi	LC7503	China, Guizhou Province, Zunyi city	water	**MW016565**	–	**MW594318**	**MW024593**	**MW474551**	**MW533922**	–
F. paranisikadoi	CGMCC 3.20826 = LC2800 T	China, Beijing	unidentified grass	**MW016561**	–	**MW594314**	**MW024589**	**MW474547**	**MW533918**	–
	LC2819	China, Beijing	unidentified grass	**MW016562**	–	**MW594315**	**MW024590**	**MW474548**	**MW533919**	–
	LC2823	China, Beijing	*Pennisetum alopecuroides*	**MW016563**	–	**MW594316**	**MW024591**	**MW474549**	**MW533920**	–
	LC2824	China, Beijing	unidentified grass	**MW016564**	–	**MW594317**	**MW024592**	**MW474550**	**MW533921**	–
F. oxysporum species complex										
F. cugenangense	LC13734 = F001	Japan	*Acer palmatum*	**MW016566**	–	**MW594319**	**MW024594**	**MW474552**	**MW533923**	**MW024379**
	LC13735 = F080	Brazil	*Hordeum vulgare*	**MW016567**	–	**MW594320**	**MW024595**	**MW474553**	**MW533924**	**MW024380**
	LC13736 = F422	China, Zhejiang Province, Ningbo city	*Solanum tuberosum*	**MW016568**	–	**MW594321**	**MW024596**	**MW474554**	**MW533925**	**MW024381**
	LC4496	China, Jiangxi Province	*Smilax* sp.	**MW016571**	–	**MW594324**	**MW024599**	**MW474557**	**MW533928**	**MW024384**
F. curvatum	LC13739 = F155	Netherlands	*Tulipa gesneriana*	**MW016572**	–	**MW594325**	**MW024600**	**MW474558**	**MW533929**	**MW024385**
F. duoseptatum	LC13740 = GXHCFoc1	China, Guangxi Zhuang Autonomous Region, Hechi city	*Musa nana*	**MW016573**	–	**MW594326**	**MW024601**	**MW474559**	**MW533930**	**MW024386**
	LC13741 = GXQZPSRDE3	China, Guangxi Zhuang Autonomous Region, Qinzhou city	*Musa nana*	**MW016574**	–	**MW594327**	**MW024602**	**MW474560**	**MW533931**	**MW024387**
F. elaeidis	LC13742 = M0765	China, Guangdong Province, Shenzhen city	*Caryota mitis*	**MW016575**	–	**MW594328**	**MW024603**	**MW474561**	**MW533932**	**MW024388**
F. grosmichelii	GDGZP11-2-2	China, Guangdong Province, Guangzhou city	*Musa nana*	**OL744448**	–	**OL771389**	**OL771373**	**OL771381**	**OL771397**	**OL780783**
	GDZJLZ11-2-1	China, Guangdong Province, Zhanjiang city	*Musa nana*	**OL744449**	–	**OL771390**	**OL771374**	**OL771382**	**OL771398**	**OL780784**

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. grosmichelii (cont.)	GXCZMQS03E1	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	**OL744450**	–	**OL771391**	**OL771375**	**OL771383**	**OL771399**	**OL780785**
	GXCZMQS03E2	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	**OL744451**	–	**OL771392**	**OL771376**	**OL771384**	**OL771400**	**OL780786**
	JXF4-32	China, Jiangxi Province	*Oryza* sp.	**OL744452**	–	**OL771393**	**OL771377**	**OL771385**	**OL771401**	**OL780787**
	JXF4-6	China, Jiangxi Province	*Oryza* sp.	**OL744453**	–	**OL771394**	**OL771378**	**OL771386**	**OL771402**	**OL780788**
	JXN4-10	China, Jiangxi Province	*Oryza* sp.	**OL744454**	–	**OL771395**	**OL771379**	**OL771387**	**OL771403**	**OL780789**
	M0676	China, Guangdong Province, Shenzhen	*Chamaerops humilis*	**OL744455**	–	**OL771396**	**OL771380**	**OL771388**	**OL771404**	**OL780790**
F. nirenbergiae	LC13752 = F014	Italy	*Hydrangea macrophylla*	**MW016585**	–	**MW594338**	**MW024613**	**MW474571**	**MW533942**	**MW024398**
	LC13753 = F051	USA	*Glycine max*	**MW016586**	–	**MW594339**	**MW024614**	**MW474572**	**MW533943**	**MW024399**
	LC13754 = F077	Italy	*Olea europaea*	**MW016587**	–	**MW594340**	**MW024615**	**MW474573**	**MW533944**	**MW024400**
	LC13755 = F153	Canada	*Glycine max*	**MW016588**	–	**MW594341**	**MW024616**	**MW474574**	**MW533945**	**MW024401**
	LC13756 = F161	Netherlands	*Hippeastrum rutilum*	**MW016589**	–	**MW594342**	**MW024617**	**MW474575**	**MW533946**	**MW024402**
	LC13757 = F418	USA	*Allium sativum*	**MW016590**	–	**MW594343**	**MW024618**	**MW474576**	**MW533947**	**MW024403**
	LC13758 = GDZJLZ16-1	China, Guangdong Province, Zhanjiang city	*Musa nana*	**MW016591**	–	**MW594344**	**MW024619**	**MW474577**	**MW533948**	**MW024404**
	LC13760 = M0579	China, Guangdong Province	*Caryota mitis*	**MW016593**	–	**MW594346**	**MW024621**	**MW474579**	**MW533950**	**MW024406**
	LC2804	China, Beijing	*Setaria viridis*	**MW016594**	–	**MW594347**	**MW024622**	**MW474580**	**MW533951**	**MW024407**
F. odoratissimum	LC13761 = Foc4-6	China, Guangxi Zhuang Autonomous Region	*Musa* sp.	**MW016595**	–	**MW594348**	**MW024623**	**MW474581**	**MW533952**	**MW024408**
	LC13762 = Foc4-7	China, Guangxi Zhuang Autonomous Region	*Musa* sp.	**MW016596**	–	**MW594349**	**MW024624**	**MW474582**	–	**MW024409**
	LC13763 = Foc4-8	China, Guangxi Zhuang Autonomous Region	*Musa* sp.	**MW016597**	–	**MW594350**	**MW024625**	**MW474583**	–	**MW024410**
	LC13764 = GXLZCJL02-E5	China, Guangxi Zhuang Autonomous Region, Liuzhou city	*Musa nana*	**MW016598**	–	**MW594351**	**MW024626**	**MW474584**	**MW533953**	**MW024411**
	LC13765 = GXNNS2	China, Guangxi Zhuang Autonomous Region, Nanning city	*Musa* sp.	**MW016599**	–	**MW594352**	**MW024627**	**MW474585**	**MW533954**	**MW024412**
F. oxysporum	LC13766 = F065	China, Zhejiang Province, Ningbo city	*Malus spectabilis*	**MW016600**	–	**MW594353**	**MW024628**	**MW474586**	**MW533955**	**MW024413**
Fusarium sp.	LC13737 = J1BS1	China, Shandong Province, Weifang city	*Zingiber officinale*	**MW016569**	–	**MW594322**	**MW024597**	**MW474555**	**MW533926**	**MW024382**
	LC13743 = F163	Brazil	*Glycine max*	**MW016576**	–	**MW594329**	**MW024604**	**MW474562**	**MW533933**	**MW024389**
	LC13744 = F416	Brazil	*Glycine max*	**MW016577**	–	**MW594330**	**MW024605**	**MW474563**	**MW533934**	**MW024390**
	LC13745 = F151	Australia	*Hordeum vulgare*	**MW016578**	–	**MW594331**	**MW024606**	**MW474564**	**MW533935**	**MW024391**
	LC13746 = F151-2	Australia	*Hordeum vulgare*	**MW016579**	–	**MW594332**	**MW024607**	**MW474565**	**MW533936**	**MW024392**
	LC13747 = F151-3	Australia	*Hordeum vulgare*	**MW016580**	–	**MW594333**	**MW024608**	**MW474566**	**MW533937**	**MW024393**
	LC13748 = F050	Netherlands	*Tulipa gesneriana*	**MW016581**	–	**MW594334**	**MW024609**	**MW474567**	**MW533938**	**MW024394**
	LC13749 = F156	Netherlands	*Muscari botryoides*	**MW016582**	–	**MW594335**	**MW024610**	**MW474568**	**MW533939**	**MW024395**
	LC13750 = GDZJLZ16-2	China, Guangdong Province, Zhanjiang city	*Musa nana*	**MW016583**	–	**MW594336**	**MW024611**	**MW474569**	**MW533940**	**MW024396**
	LC13751 = GXCZ-4-1	China, Guangxi Zhuang Autonomous Region, Chongzuo city	*Musa nana*	**MW016584**	–	**MW594337**	**MW024612**	**MW474570**	**MW533941**	**MW024397**
	LC13767 = LJM1259	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	**MW016601**	–	**MW594354**	**MW024629**	**MW474587**	**MW533956**	**MW024414**
	LC13768 = LJM1259-2	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	**MW016602**	–	**MW594355**	**MW024630**	**MW474588**	**MW533957**	**MW024415**
	LC13769 = LJM1259-3	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	**MW016603**	–	**MW594356**	**MW024631**	**MW474589**	**MW533958**	**MW024416**
F. sambucinum species complex										
F. acaciae-mearnsii	LC13786 = FJWYS2-3	China, Fujian Province, Fuzhou city	*Musa nana*	**MW016630**	–	**MW620091**	**MW024658**	**MW474616**	**MW533978**	–
F. armeniacum	LC2797	China, Beijing	unidentified grass	**MW016608**	–	**MW620069**	**MW024636**	**MW474594**	**MW533963**	–
	LC2809	China, Beijing	unidentified grass	**MW016609**	–	**MW620070**	**MW024637**	**MW474595**	**MW533964**	–
F. asiaticum	LC13773 = CQ974	China, Jiangsu Province, Suzhou city	*Paederia foetida*	**MW016607**	–	**MW620068**	**MW024635**	**MW474593**	**MW533962**	–
	LC13774 = GXGLYSL08-1	China, Guangxi Zhuang Autonomous Region, Guilin city	*Musa nana*	**MW016610**	–	**MW620071**	**MW024638**	**MW474596**	**MW533965**	–
	LC13785 = F408	China, Zhejiang Province, Ningbo city	*Podocarpus macrophyllus*	**MW016629**	–	**MW620090**	**MW024657**	**MW474615**	**MW533977**	–
	LC13787 = GDBYL11-E1	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016631**	–	**MW620092**	**MW024659**	**MW474617**	**MW533979**	–
	LC13788 = GXGLPLL07E2	China, Guangxi Zhuang Autonomous Region, Guilin city	*Musa nana*	**MW016632**	–	**MW620093**	**MW024660**	**MW474618**	**MW533980**	–
	LC13789 = JXN5	China, Jiangxi Province	*Oryza* sp.	**MW016633**	–	**MW620094**	**MW024661**	**MW474619**	**MW533981**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. asiaticum (cont.)	LC5153	China, Jiangxi Province, Ganzhou city	*Prunus persica*	**MW016635**	–	**MW620096**	**MW024663**	**MW474621**	**MW533982**	–
	LC5308	China, Guizhou Province	air	**MW016636**	–	**MW620097**	**MW024664**	**MW474622**	**MW533983**	–
	LC7143	China, Jiangxi Province, Nanchang city	bamboo	**MW016637**	–	**MW620098**	**MW024665**	**MW474623**	**MW533984**	–
	LC7494	China, Guizhou Province, Zunyi city	carbonatite	**MW016638**	–	**MW620099**	**MW024666**	**MW474624**	**MW533985**	–
	LC7495	China, Guizhou Province, Zunyi city	carbonatite	**MW016639**	–	**MW620100**	**MW024667**	**MW474625**	**MW533986**	–
	LC7500	China, Guizhou Province, Zunyi city	carbonatite	**MW016640**	–	**MW620101**	**MW024668**	**MW474626**	**MW533987**	–
	LC7501	China, Guizhou Province, Zunyi city	soil	**MW016641**	–	**MW620102**	**MW024669**	**MW474627**	**MW533988**	–
F. graminearum	LC13775 = F056	USA	*Zea mays*	**MW016611**	–	**MW620072**	**MW024639**	**MW474597**	**MW533966**	–
	LC13776 = F110	Italy	*Pennisetum orientale*	**MW016612**	–	**MW620073**	**MW024640**	**MW474598**	–	–
F. kyushuense	LC0725	China, Zhejiang Province, Quzhou city	*Chamaedaphne calyculata*	**MW016613**	–	**MW620074**	**MW024641**	**MW474599**	**MW533967**	–
	LC1114	China	*Lithocarpus glabra*	**MW016614**	–	**MW620075**	**MW024642**	**MW474600**	**MW533968**	–
	LC13777 = F179	Philippines	unidentified plant	**MW016615**	–	**MW620076**	**MW024643**	**MW474601**	**MW533969**	–
	LC13778 = GXLZ6-1	China, Guangxi Zhuang Autonomous Region, Liuzhou city	*Musa nana*	**MW016616**	–	**MW620077**	**MW024644**	**MW474602**	**MW533970**	–
	LC5936	China, Jiangxi Province, Nanchang city	submerged wood	**MW016617**	–	**MW620078**	**MW024645**	**MW474603**	**MW533971**	–
	LC7000	China, Hainan Province	*Musa paradisiaca*	**MW016618**	–	**MW620079**	**MW024646**	**MW474604**	**MW533972**	–
F. longipes	LC13779 = LGS185	China, Hainan Province	*Paspalum vaginatum*	**MW016619**	–	**MW620080**	**MW024647**	**MW474605**	–	–
F. meridionale	LC13780 = F087	China, Yunnan Province	*Coffea* sp.	**MW016620**	–	**MW620081**	**MW024648**	**MW474606**	–	–
	LC7067	China, Yunnan Province	*Musa basjoo*	**MW016621**	–	**MW620082**	**MW024649**	**MW474607**	**MW533973**	–
	LC7496	China, Guizhou Province, Zunyi city	carbonatite	**MW016622**	–	**MW620083**	**MW024650**	**MW474608**	**MW533974**	–
F. nepalense	LC13781 = GDBYL14-E3	China, Guangdong Province, Guangzhou city	*Musa nana*	**MW016623**	–	**MW620084**	**MW024651**	**MW474609**	**MW533975**	–
	LC13782 = GXGLPLL14-1	China, Guangxi Zhuang Autonomous Region, Guilin city	*Musa nana*	**MW016624**	–	**MW620085**	**MW024652**	**MW474610**	–	–
	LC6678	China, Yunnan Province, Xishuangbanna	*Camellia sinensis*	**MW016625**	–	**MW620086**	**MW024653**	**MW474611**	**MW533976**	–
F. poae	LC13783 = F150	Canada	*Hordeum vulgare*	**MW016626**	–	**MW620087**	**MW024654**	**MW474612**	–	–
	LC6917	China, Hubei Province	*Oryza sativa*	**MW016627**	–	**MW620088**	**MW024655**	**MW474613**	–	–
F. transvaalense	LC13784 = F157	USA	*Medicago sativa*	**MW016628**	–	**MW620089**	**MW024656**	**MW474614**	–	–
F. ussurianum	LC13790 = LJM1343	China, Hainan Province, Wanning city	*Rhynchospora* sp.	**MW016634**	–	**MW620095**	**MW024662**	**MW474620**	–	–
	LC7573	China, Tibet Autonomous Region	*Poaceae* sp.	**MW016642**	–	**MW620103**	**MW024670**	**MW474628**	–	–
	LC7574	China, Tibet Autonomous Region	*Poaceae* sp.	**MW016643**	–	**MW620104**	**MW024671**	**MW474629**	**MW533989**	–
F. tricinctum species complex										
F. acuminatum	LC13791 = F034	Argentina	*Glycine max*	**MW016644**	–	**MW620105**	**MW024672**	**MW474630**	**MW533990**	–
	LC13794 = F111	Italy	*Feijoa sellowiana*	**MW016647**	–	**MW620108**	**MW024675**	**MW474633**	**MW533993**	–
	LC13795 = GM18	China, Qinghai Province	*Hylotelephium erythrostictum*	**MW016648**	–	**MW620109**	**MW024676**	**MW474634**	**MW533994**	–
	LC13796 = GM80	China, Qinghai Province	*Hylotelephium erythrostictum*	**MW016649**	–	**MW620110**	**MW024677**	**MW474635**	**MW533995**	–
	LC13797 = LF1633	China, Hubei Province, Xiangyang city	*Brassica* sp.	**MW016650**	–	**MW620111**	**MW024678**	**MW474636**	**MW533996**	–
	LC13798 = LF1636	China, Hubei Province, Xiangyang city	*Brassica* sp.	**MW016651**	–	**MW620112**	**MW024679**	**MW474637**	**MW533997**	–
	LC13799 = LGS021	China, Beijing	soil	**MW016652**	–	**MW620113**	**MW024680**	**MW474638**	**MW533998**	–
	LC5227	China, Neimenggu Province, Huhehaote city	*Prunus* sp.	**MW016654**	–	**MW620115**	**MW024682**	**MW474640**	**MW534000**	–
F. alpinum	LC2853	China, Yunnan Province	unidentified plant	**MW016684**	–	**MW620145**	**MW024712**	**MW474670**	**MW534030**	–
	LC2854	China, Yunnan Province	unidentified plant	**MW016685**	–	**MW620146**	**MW024713**	**MW474671**	**MW534031**	–
	LC6034	China, Tibet Autonomous Region	*Fabaceae* sp.	**MW016686**	–	**MW620147**	**MW024714**	**MW474672**	**MW534032**	–
	LC6037	China, Tibet Autonomous Region	*Fabaceae* sp.	**MW016687**	–	**MW620148**	**MW024715**	**MW474673**	**MW534033**	–
	LC6043	China, Tibet Autonomous Region	*Fabaceae* sp.	**MW016688**	–	**MW620149**	**MW024716**	**MW474674**	**MW534034**	–
	CGMCC 3.20818 = LC6045 T	China, Tibet Autonomous Region	*Fabaceae* sp.	**MW016689**	–	**MW620150**	**MW024717**	**MW474675**	**MW534035**	–
F. avenaceum	LC13801 = F010	Italy	*Hydrangea macrophylla*	**MW016655**	–	**MW620116**	**MW024683**	**MW474641**	**MW534001**	–
	LC13802 = F038	Australia	*Trifolium repens*	**MW016656**	–	**MW620117**	**MW024684**	**MW474642**	**MW534002**	–
	LC13803 = F039	Australia	*Trifolium repens*	**MW016657**	–	**MW620118**	**MW024685**	**MW474643**	**MW534003**	–
	LC13804 = F071	USA	*Acer saccharum*	**MW016658**	–	**MW620119**	**MW024686**	**MW474644**	**MW534004**	–
	LC13805 = F403	USA	*Acer truncatum*	**MW016659**	–	**MW620120**	**MW024687**	**MW474645**	**MW534005**	–
	LC13806 = F404	USA	*Acer truncatum*	**MW016660**	–	**MW620121**	**MW024688**	**MW474646**	**MW534006**	–
	LC13808 = GM149	China, Qinghai Province	*Halenia sibirica*	**MW016662**	–	**MW620123**	**MW024690**	**MW474648**	**MW534008**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	*cam*	*tef1*	*rpb1*	*rpb2*	*tub2*	IGS
F. avenaceum (cont.)	LC13809 = GM30	China, Qinghai Province	*Bidens bipinnata*	**MW016663**	–	**MW620124**	**MW024691**	**MW474649**	**MW534009**	–
	LC13811 = GM71	China, Qinghai Province	*Halenia sibirica*	**MW016665**	–	**MW620126**	**MW024693**	**MW474651**	**MW534011**	–
	LC6044	China, Tibet Autonomous Region	*Fabaceae* sp.	**MW016667**	–	**MW620128**	**MW024695**	**MW474653**	**MW534013**	–
	LC6321	China, Guizhou Province	*Camellia sinensis*	**MW016668**	–	**MW620129**	**MW024696**	**MW474654**	**MW534014**	–
	LC6328	China, Guizhou Province	*Camellia sinensis*	**MW016669**	–	**MW620130**	**MW024697**	**MW474655**	**MW534015**	–
	LC6376	China, Guizhou Province	*Camellia sinensis*	**MW016670**	–	**MW620131**	**MW024698**	**MW474656**	**MW534016**	–
	LC6387	China, Guizhou Province	*Camellia sinensis*	**MW016671**	–	**MW620132**	**MW024699**	**MW474657**	**MW534017**	–
	LC6388	China, Guizhou Province	*Camellia sinensis*	**MW016672**	–	**MW620133**	**MW024700**	**MW474658**	**MW534018**	–
	LC6389	China, Guizhou Province	*Camellia sinensis*	**MW016673**	–	**MW620134**	**MW024701**	**MW474659**	**MW534019**	–
	LC7584	China, Tibet Autonomous Region	*Poaceae* sp.	**MW016674**	–	**MW620135**	**MW024702**	**MW474660**	**MW534020**	–
F. chongqingense	LC13813	China, Chongqing	*Bothrocaryum controversum*	**MW016675**	–	**MW620136**	**MW024703**	**MW474661**	**MW534021**	–
	LC13814	China, Chongqing	*Bothrocaryum controversum*	**MW016676**	–	**MW620137**	**MW024704**	**MW474662**	**MW534022**	–
	CGMCC 3.20821 = LC4957 T	China, Chongqing	*Bothrocaryum controversum*	**MW016677**	–	**MW620138**	**MW024705**	**MW474663**	**MW534023**	–
F. iranicum	LC1112	China	*Lithocarpus glabra*	**MW016678**	–	**MW620139**	**MW024706**	**MW474664**	**MW534024**	–
F. paeoniae	LC13807 = GM123	China, Qinghai Province	*Plantago* sp.	**MW016661**	–	**MW620122**	**MW024689**	**MW474647**	**MW534007**	–
	LC13810 = GM65	China, Qinghai Province	*Gentiana scabra*	**MW016664**	–	**MW620125**	**MW024692**	**MW474650**	**MW534010**	–
	LC13812 = GM85	China, Qinghai Province	*Gentiana scabra*	**MW016666**	–	**MW620127**	**MW024694**	**MW474652**	**MW534012**	–
	LC13815 = GM56	China, Qinghai Province	*Elymus dahuricus*	**MW016679**	–	**MW620140**	**MW024707**	**MW474665**	**MW534025**	–
	LC13816 = YZG10-2	China, Qinghai Province	*Populus* sp.	**MW016680**	–	**MW620141**	**MW024708**	**MW474666**	**MW534026**	–
	CGMCC 3.20817 = LC13817 = YZG12-2 T	China, Qinghai Province	*Paeonia lactiflora*	**MW016681**	–	**MW620142**	**MW024709**	**MW474667**	**MW534027**	–
	LC5166	China, Qinghai Province	*Crataegus monogyna*	**MW016682**	–	**MW620143**	**MW024710**	**MW474668**	**MW534028**	–
	LC7358	China, Tibet Autonomous Region	*Poaceae* sp.	**MW016683**	–	**MW620144**	**MW024711**	**MW474669**	**MW534029**	–
F. tricinctum	LC0453	China, Beijing	*Hosta* sp.	**MW016690**	–	**MW620151**	**MW024718**	**MW474676**	**MW534036**	–
	LC0459	China, Beijing	*Zamia pumila*	**MW016691**	–	**MW620152**	**MW024719**	**MW474677**	**MW534037**	–
	LC13818 = F005	Japan	*Acer palmatum*	**MW016692**	–	**MW620153**	**MW024720**	**MW474678**	**MW534038**	–
	LC13819 = F020	Poland	*Clematis* sp.	**MW016693**	–	**MW620154**	**MW024721**	**MW474679**	**MW534039**	–
	LC13820 = F033	Japan	*Acer palmatum*	**MW016694**	–	**MW620155**	**MW024722**	**MW474680**	**MW534040**	–
	LC13821 = F400	Japan	*Chaenomeles japonica*	**MW016695**	–	**MW620156**	**MW024723**	**MW474681**	**MW534041**	–
	LC13822 = PH53	China, Zhejiang Province, Ningbo city	unidentified plant	**MW016696**	–	**MW620157**	**MW024724**	**MW474682**	**MW534042**	–
	LC5032	China, Jiangxi Province, Ganzhou city	*Litsea* sp.	**MW016697**	–	**MW620158**	**MW024725**	**MW474683**	**MW534043**	–
	LC5034	China, Jiangxi Province, Ganzhou city	*Litsea* sp.	**MW016698**	–	**MW620159**	**MW024726**	**MW474684**	**MW534044**	–
Neocosmospora										
N. brevis	LC2116	China, Jiangxi Province, Ganzhou city	submerged wood	**MW016702**	–	**MW620163**	**MW024730**	**MW474688**	–	–
N. diminuta	LC13825 = F009	Japan	*Acer palmatum*	**MW016703**	–	**MW620164**	**MW024731**	**MW474689**	**MW534047**	–
N. falciformis	LC11569 = G649	China	*Vitis* sp.	**MW016704**	–	**MW620165**	**MW024732**	**MW474690**	**MW534048**	–
	LC11572 = G694	China	*Vitis* sp.	**MW016705**	–	**MW620166**	**MW024733**	**MW474691**	**MW534049**	–
	LC13826 = LGS175	China, Hainan Province	*Paspalum vaginatum*	**MW016706**	–	**MW620167**	**MW024734**	**MW474692**	–	–
	LC13827 = LGS230	China, Hainan Province	*Paspalum vaginatum*	**MW016707**	–	**MW620168**	**MW024735**	**MW474693**	–	–
	LC13828 = LJM1271	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	**MW016708**	–	**MW620169**	**MW024736**	**MW474694**	**MW534050**	–
	LC13829 = LJM1289	China, Hainan Province	*Paspalum vaginatum*	**MW016709**	–	**MW620170**	**MW024737**	**MW474695**	–	–
	LC13830 = LJM1295	China, Hainan Province	*Paspalum vaginatum*	**MW016710**	–	**MW620171**	**MW024738**	**MW474696**	–	–
N. lithocarpi	CGMCC 3.20827 = LC1113 T	China	*Lithocarpus glabra*	**MW016711**	–	**MW620172**	**MW024739**	**MW474697**	**MW534051**	–
	LC13831	China	*Lithocarpus glabra*	**MW016712**	–	**MW620173**	**MW024740**	**MW474698**	**MW534052**	–
	LC13832	China	*Lithocarpus glabra*	**MW016713**	–	**MW620174**	**MW024741**	**MW474699**	**MW534053**	–
N. longissima	LC13833 = F301	Japan	*Armeniaca mume*	**MW016714**	–	**MW620175**	**MW024742**	**MW474700**	**MW534054**	–
	LC13834 = F303	Japan	*Armeniaca mume*	**MW016715**	–	**MW620176**	**MW024743**	**MW474701**	**MW534055**	–
N. metavorans	LC5930	China, Jiangxi Province, Nanchang city	submerged wood	**MW016716**	–	**MW620177**	**MW024744**	**MW474702**	**MW534056**	–
	LC5933	China, Jiangxi Province, Nanchang city	submerged wood	**MW016717**	–	**MW620178**	**MW024745**	**MW474703**	**MW534057**	–
N. oblonga	LC7499	China, Guizhou Province, Zunyi city	carbonatite	**MW016718**	–	**MW620179**	**MW024746**	**MW474704**	**MW534058**	–
N. paraeumartii	LC13835 = F066	Japan	*Acer* sp.	**MW016719**	–	**MW620180**	**MW024747**	**MW474705**	**MW534059**	–
	LC13836 = M0478	China, Fujian Province, Fuzhou city	*Castanopsis fargesii*	**MW016720**	–	**MW620181**	**MW024748**	**MW474706**	**MW534060**	–

Table 1 (cont.)

Species	Isolate	Country/Location	Host/Habitat	ITS	cam	tef1	rpb1	rpb2	tub2	IGS
N. petroliphila	LC1120	China	*Lithocarpus glabra*	MW016721	–	MW620182	MW024749	MW474707	–	–
N. pisi	LC13837 = F073	USA	*Acer platanoides*	MW016722	–	MW620183	MW024750	MW474708	–	–
N. pseudensiformis	LC13838 = LJM1257	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	MW016723	–	MW620184	MW024751	MW474709	MW534061	–
	LC13839 = LJM1263	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	MW016724	–	MW620185	MW024752	MW474710	MW534062	–
	LC13840 = LJM1273	China, Guangxi Zhuang Autonomous Region	*Passiflora edulis*	MW016725	–	MW620186	MW024753	MW474711	MW534063	–
N. silvicola	LC5482	China, Guizhou Province	faeces	MW016726	–	MW620187	MW024756	MW474712	MW534066	–
N. solani	LC13841 = 6S1	China, Shandong Province, Weifang city	*Capsicum annuum*	MW016727	–	MW620188	MW024757	MW474713	MW534067	–
	LC13842 = F002	Japan	*Acer palmatum*	MW016728	–	MW620189	MW024758	MW474714	MW534068	–
	LC13843 = F016	Italy	*Syringa vulgaris*	MW016729	–	MW620190	MW024759	MW474715	MW534069	–
	LC13844 = HBN6-5	China, Hebei Province	*Oryza* sp.	MW016730	–	MW620191	MW024760	MW474716	–	–
	LC13845 = J3R1	China, Shandong Province, Weifang city	*Zingiber officinale*	MW016731	–	MW620192	MW024761	MW474717	MW534070	–
	LC13846 = J3R2	China, Shandong Province, Weifang city	*Zingiber officinale*	MW016732	–	MW620193	MW024762	MW474718	MW534071	–
	LC13847 = LGS032	China, Beijing	soil	MW016733	–	MW620194	MW024763	MW474719	MW534072	–
	LC13848 = LGS033	China, Beijing	soil	MW016734	–	MW620195	MW024764	MW474720	–	–
	LC13849 = LGS054	China, Beijing	soil	MW016735	–	MW620196	MW024765	MW474721	MW534073	–
	LC3717	China, Guangxi Zhuang Autonomous Region, Nanning city	soil	MW016736	–	MW620197	MW024766	MW474722	MW534074	–
	LC3785	China, Shanxi Province, Baode city	soil	MW016737	–	MW620198	MW024767	MW474723	MW534075	–
	LC3932	China, Shanxi Province, Baode city	compost	MW016738	–	MW620199	MW024768	MW474724	MW534076	–
	LC5548	China, Guizhou Province	soil	MW016739	–	MW620200	MW024769	MW474725	–	–
N. stercicola	LC5387	China, Guizhou Province	soil	MW016740	–	MW620201	MW024770	MW474726	MW534077	–

Note: T = Ex-type specimen of new species; *A.* = *Albonectria*, *B.* = *Bisifusarium*, *F.* = *Fusarium*, *N.* = *Neocosmospora*.

under a 12/12 h near-ultraviolet light/dark cycle, on SNA and water agar amended with sterilised pieces of carnation leaves (CLA; Snyder & Hansen 1947, Fisher et al. 1982) at 25 °C, respectively. 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, respectively 30 conidiophores, conidiogenous cells and chlamydospores, 50 micro- and macroconidia were mounted and randomly measured to calculate the mean size and standard deviation (SD).

DNA extraction and amplification

Genomic DNA was extracted from fungal mycelia grown on PDA, using a modified CTAB protocol as described in Guo et al. (2000). Seven loci, including the 5.8S nuclear ribosomal RNA gene with the two flanking internal transcribed spacer (ITS) regions, intergenic spacer region of the rDNA (IGS), partial translation elongation factor (*tef1*), partial calmodulin (*cam*), partial RNA polymerase largest subunit (*rpb1*), partial RNA polymerase second largest subunit (*rpb2*) gene regions, and partial β-tubulin (*tub2*), were amplified and sequenced, respectively. The primer pairs and PCR amplification procedures following protocols described by O'Donnell et al. (1998a, b, 2008, 2009a, b, 2010), Crous et al. (2009, 2021), and Lombard et al. (2015), are listed in Table 2. 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 µM primers, 1 µL of the undiluted genomic DNA, adjusted to a final volume of 25 µL with distilled deionized water. The PCR products were visualised on 1 % agarose electrophoresis gel. Sequencing was done bi-directionally, conducted by the Tianyi Huiyuan Company (Beijing, China). Consensus sequences were obtained using SeqMan of the Lasergene software package v. 14.1 (DNAstar, Madison, Wisconsin, USA).

Phylogenetic analyses

Sequences of the 425 fusarioid strains studied in this study (356 from China, 69 intercepted from 13 other countries) are listed in Table 1. For each locus, sequences were aligned using MAFFT v. 7 (Katoh et al. 2017), and the alignments were manually adjusted where necessary. The best-fit nucleotide substitution models under the Akaike Information Criterion (AIC) were selected using jModelTest v. 2.1.7 (Posada 2008, Darriba et al. 2012). Alignments derived from this study were deposited in TreeBASE (submission ID 29103), taxonomic novelties in MycoBank, and new sequences in NCBIs GenBank database (www.ncbi.nlm.nih.gov/; assession numbers shown in Table 1).

Phylogenetic analyses of both individual and combined datasets were performed using Bayesian inference (BI) and Maximum-likelihood (ML) methods. The BI analyses were conducted using MrBayes v. 3.2.1 (Huelsenbeck & Ronquist 2001) following the protocol of Wang et al. (2019), with optimisation of each locus treated as partitions in combined analyses, based on the Markov Chain Monte Carlo (MCMC) approach (Ronquist et al. 2012). All characters were equally weighted, and gaps were treated as missing data. Stationarity of analysis was determined by examining the standard deviation of split frequencies (< 0.01) and –ln likelihood plots in AWTY (Nylander et al. 2008). The ML analyses were conducted using PhyML v. 3.0 (Guindon et al. 2010), with 1 000 bootstrap replicates. The general time reversible model was applied with an invariable gamma-distributed rate variation (GTR+I+G).

Table 2 Primers information of PCR amplification of the seven loci.

Locus	Primer	Sequence of Primer (5'-3')	Annealing temperature (°C)	References
ITS	ITS5 ITS4	GGAAGTAAAAGTCGTAACAAGG TCCTCCGCTTATTGATATGC	55	White et al. (1990)
IGS	iNL11 iCNS1	AGGCTTCGGCTTAGCGTCTTAG TTTCGCAGTGAGGTCGGCAG	55	O'Donnell et al. (2009a)
tef1	EF1 EF2	ATGGGTAAGGARGACAAGAC GGARGTACCAGTSATCATG	55	O'Donnell et al. (1998b)
cam	CL1 CL2A	GARTWCAAGGAGGCCTTCTC TTTTTGCATCATGAGTTGGAC	55	O'Donnell et al. (2000a)
rpb1	RPB1-Fa RPB1-G2R	CAYAARGARTCYATGATGGGWC GTCATYTGDGTDGCDGGYTCDCC	58 (5 cycles)→57 (5)→56 (35)	O'Donnell et al. (2010)
rpb2	RPB2-5f2 RPB2-11ar	GGGGWGAYCAGAAGAAGGC GCRTGGATCTTRTCRTCSACC	57	Reeb et al. (2004) Liu et al. (1999)
tub2	T1 T2	AACATGCGTGAGATTGTAAGT TAGTGACCCTTGGCCCAGTTG	54	O'Donnell & Cigelnik (1997)

RESULTS

Phylogenetic analyses

Analyses of the generic level phylogeny of fusarioid fungi were conducted by using a combined *tef1*, *rpb1*, and *rpb2* dataset that included 643 bp for *tef1*, 1 583 bp of *rpb1*, and 1 311 bp for *rpb2*. For the BI and ML analyses, a GTR+I+G model was selected for the combined *tef1-rpb1-rpb2* dataset. The combined *tef1*, *rpb1*, and *rpb2* phylogeny (Fig. 1) revealed that the Chinese isolates clustered into nine species complexes in *Fusarium*, and two allied genera (*Bisifusarium* and *Neocosmospora*). Isolate LC13606 from *Podocarpus macrophyllus* imported from Japan was closest to *Albonectria rigidiuscula* CBS 122570 (Fig. 1).

Phylogenetic analyses of different *Fusarium* species complexes and allied genera were conducted using different multi-locus datasets following O'Donnell et al. (2009b), Jacobs-Venter et al. (2018), Sandoval-Denis et al. (2018a, b, 2019), Lombard et al. (2019a, b), Xia et al. (2019), Crous et al. (2021), and Yilmaz et al. (2021). Briefly, phylogenetic analyses of the *F. concolor*, *F. falsibabinda*, and *F. nisikadoi* species complexes were performed by using the *tef1-rpb1-rpb2* dataset, and rooted with *F. humuli* CQ1039 (Fig. 2), and single gene trees were performed respectively (Supplementary Fig. S1). Phylogenetic analyses of the *F. fujikuroi* species complex was performed by using the *tef1-cam-rpb1-rpb2-tub2* dataset and rooted with *F. nirenbergiae* CBS 744.97 (Fig. 3), and single gene trees were performed respectively (Supplementary Fig. S2). A *tef1-cam-rpb2* dataset was constructed for phylogenetic analyses of the *F. incarnatum-equiseti* species complex and rooted with *F. concolor* NRRL 13994 (Fig. 4). Phylogeny of the *F. lateritium* species complex was performed using the *tef1-rpb1-rpb2-tub2* dataset, and rooted with *F. sublunatum* NRRL 13384 (Fig. 5). Phylogenetic analyses of the *F. oxysporum* species complex was performed by using the *tef1-cam-rpb1-rpb2-tub2* dataset and rooted with *F. globosum* NRRL 26131 (Fig. 6). Phylogenetic analyses of the *F. sambucinum* species complex was performed using *tef1-rpb1-rpb* dataset and rooted with *F. lactis* CBS 411.97 (Fig. 7). Phylogenetic analyses of the *F. tricinctum* species complex was performed by using a combined ITS-*tef1-rpb1-rpb2* dataset and rooted with *F. concolor* NRRL 13994 (Fig. 8), and single gene trees were performed respectively (Supplementary Fig. S3). Phylogenetic analyses of the genus *Bisifusarium* were performed by using the ITS-*tef1-cam-rpb2-tub2* dataset and rooted by *Rectifusarium robinianum* CBS 430.91 (Fig. 9), and single gene trees were performed respectively (Supplementary Fig. S4). Phylogenetic analyses of *Neocosmospora* were performed using ITS-*tef1-rpb2* dataset, and rooted by *Geejayessia cicatricum* CBS 125552 and *G. atrofusca* NRRL 22316 (Fig. 10), and single gene trees were performed respectively (Supplementary Fig. S5). Composition of the multi-locus datasets, outgroup taxa and character numbers and the best model of each locus were listed in Table 3.

Taxonomy

In total 425 strains were isolated. Of these, 356 isolated from China and were identified to 72 species, including 61 known and 11 novel species (Table 1). Sixty-nine isolates from diverse plants imported from 13 countries were identified as 26 species including one new species, namely *F. falsibabinda*. New species in *Fusarium* are treated alphabetically based on their respective species complexes.

text continues on p. 25

Table 3 Number of characters/model for BI analysis of each locus in phylogenetic analyses of different *Fusarium* species complexes and two other genera.

Genus/Species complex	ITS	*tef1*	*cam*	*rpb1*	*rpb2*	*tub2*	Outgroup taxon
Bisifusarium	480/SYM+I+G	660/GTR+G	565/SYM+G	–	1455/SYM+G	528/HKY+I+G	*F. concolor*
Fusarium concolor	–	627/GTR+G	–	1585/SYM+G	1601/GTR+G	–	*F. humuli*
F. falsibabinda	–	627/GTR+G	–	1585/SYM+G	1601/GTR+G	–	*F. humuli*
F. fujikuroi	–	666/GTR+I+G	673/SYM+I	1549/SYM+G	1455/SYM+I+G	573/SYM+G	*F. nirenbergiae*
F. incarnatum-equiseti	–	592/GTR+I+G	547/SYM+G	–	816/GTR+I+G	–	*F. concolor*
F. lateritium	–	645/HKY+G	–	1586/SYM+G	1716/GTR+I+G	555/HKY+G	*F. sublunatum*
F. nisikadoi	–	627/GTR+G	–	1585/SYM+G	1601/GTR+G	–	*F. humuli*
F. oxysporum	–	544/HKY+G	552/K80	1455/SYM+G	1704/GTR+G	505/SYM+G	*F. udum*
F. sambucinum	–	621/GTR+G	–	1492/SYM+G	1293/SYM+I	–	*F. lactis*
F. tricinctum	491/SYM+I	613/GTR+G	–	1575/SYM+G	1270/SYM+G	–	*F. concolor*
Neocosmospora	333/GTR+I+G	606/GTR+G	–	–	1202/SYM+I+G	–	*Geejayessia atrofusca* and *G. cicatricum*

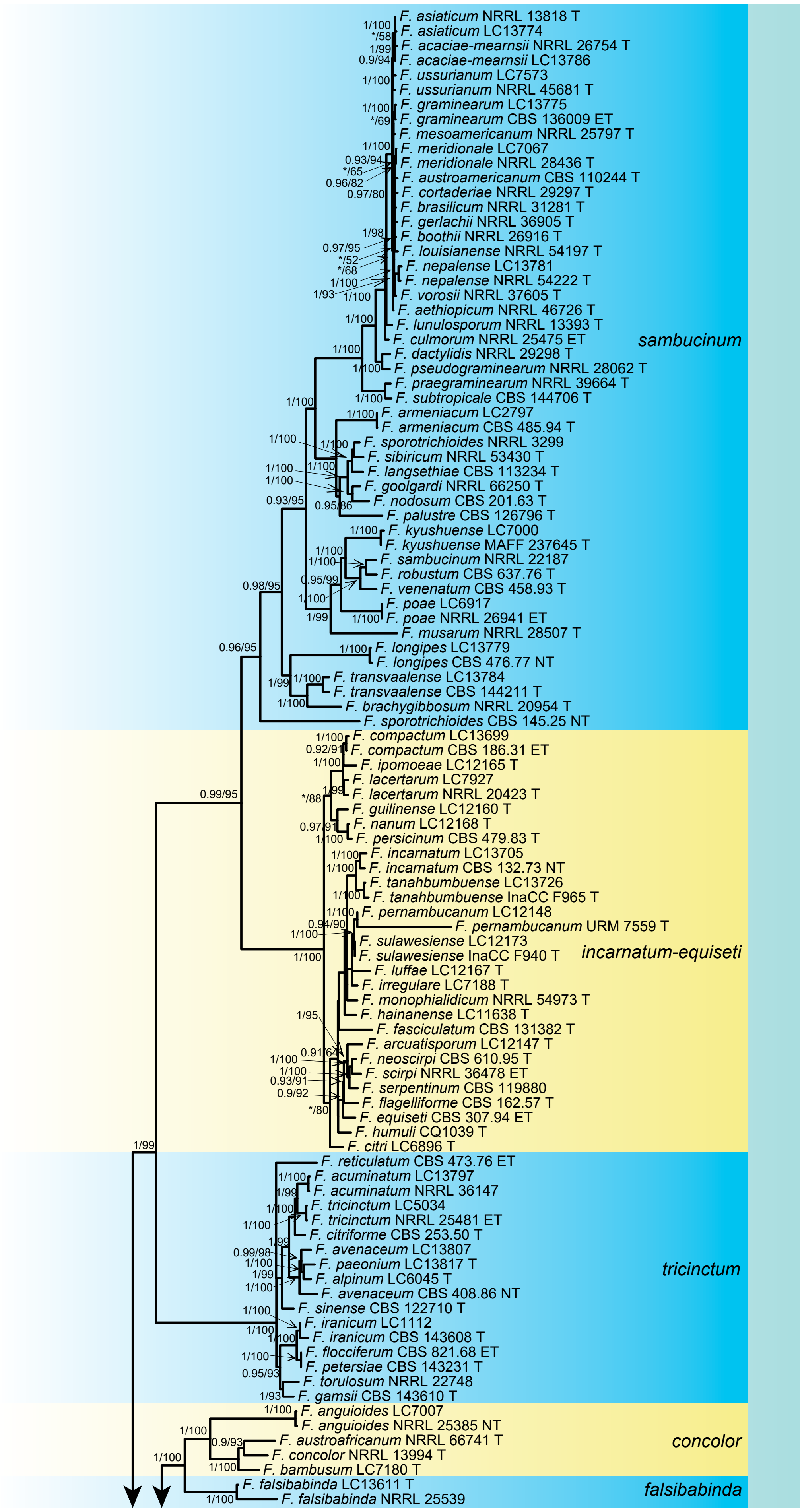

Fig. 1 Fifty percent majority rule consensus tree from a Bayesian analysis based on a three-locus combined dataset (*tef1*, *rpb1*, and *rpb2*) showing the phylogenetic relationships of *Fusarium* and allied genera. The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *Fusicolla violacea* (CBS 634.76 T). Ex-type cultures are indicated with 'T', epi-type with 'ET', neotype with 'NT'.

F. cugenangense LC4496
F. cugenangense InaCC F984 T
Fusarium sp. LC13767
F. fabacearum LC13743
F. fabacearum CBS 144743 T
F. callistephi CBS 187.53 T
F. inflexum NRRL 20433 T
F. gossypinum CBS 116613 T
Fusarium sp. LC13745
F. duoseptatum LC13740
F. duoseptatum InaCC F916 T
F. elaeidis LC13742
F. elaeidis CBS 217.49 T
F. grosmichelii InaCC F833 T
F. hexaseptatum InaCC F866 T
Fusarium sp. LC13751
F. glycines CBS 144746 T
F. carminascens CBS 144738 T
F. tardichlamydosporum InaCC F958 T
F. tardicrescens CBS 102024 T
Fusarium sp. LC13749
F. curvatum LC13739
F. curvatum CBS 238.94 T
F. nirenbergiae LC13760
F. nirenbergiae CBS 840.88 T
F. contaminatum CBS 114899 T
F. veterinarium CBS 109898 T
F. pharetrum CBS 144751 T
F. languescens CBS 645.78 T
F. oxysporum LC13766
F. oxysporum CBS 144134 ET
F. kalimantanense InaCC F917 T
F. sangayamense InaCC F960 T
F. hoodiae CBS 132474 T
F. libertatis CBS 144749 T
F. odoratissimum LC13761
F. odoratissimum InaCC F822 T
F. phialophorum InaCC F971 T
F. odoratissimum InaCC F886
F. triseptatum CBS 258.50 T
F. foetens CBS 110286 T
oxysporum
F. commune LC11660
F. commune CBS 110090 T
F. gaditjirrii F15048 T
F. lyarnte CBS 125536 T
F. miscanthi NRRL 26231 T
F. paranisikadoi LC2800 T
F. nisikadoi BBA 69015 T
nisikadoi
F. annulatum LC2825
F. annulatum CBS 217.76
F. hechiense LC13644 T
F. globosum NRRL 26131 T
F. siculi CBS 142422 T
F. fujikuroi LC13639
F. fujikuroi NRRL 13566
F. elaeagni LC13627 T
F. concentricum LC13647
F. lablabus LC13647 T
F. concentricum NRRL 25181 T
F. lumajangense LC13650
F. proliferatum F026
F. proliferatum CBS 480.96 ET
F. mangifeae CBS 120994 T
F. lumajangense InaCC F872 T
F. fractiflexum NRRL 28852 T
F. panlongense LC13656 T
F. sacchari LC13681
F. sacchari CBS 147.25
F. sacchari CBS 223.76 ET
F. sacchari LC13657
F. sacchari InaCC F951
F. madaense LC13614
F. madaense CBS 146669 T
F. andiyazi CBS 119857 T
F. verticillioides LC2818
F. verticillioides CBS 218.76 ET
F. verticillioides LC2810
F. musae CBS 624.87 T
F. coicis RBG 5368 T
F. volatile CBS 143874 T
F. napiforme NRRL 13604 T
F. ramigenum NRRL 25208 T
F. tjaetaba NRRL 66243 T
F. brevicatenulatum CBS 404.97 T
F. pseudoanthophilum CBS 414.97 T
F. pseudonygamai NRRL 13592 T
F. thapsinum LC13687
F. thapsinum CBS 777.96 T
F. ficicrescens CBS 125178 T
F. pseudocircinatum LC13676
F. pseudocircinatum NRRL 22946 T
F. xyrophilum NRRL 62721 T
F. lactis NRRL 25200 NT
F. nygamai CBS 749.97 T
F. sudanense CBS 454.97 T
F. terricola CBS 483.94 T
F. brachiariae CML 3032 T
F. mundagurra LGS129.2
F. mundagurra LC13689
F. mundagurra NRRL 66235 T
F. chinhoyiense NRRL 25221 T
F. caapi CML 3657 T
F. acutatum CBS 402.97 T
F. secorum NRRL 62593 T
F. aquaticum LC7502 T
F. longicornicola NRRL 52706 T
F. phyllophilum NRRL 13617 T
F. udum NRRL 25199 ET
F. xylarioides CBS 258.52 ET
F. subglutinans LC13684
F. subglutinans NRRL 22016 NT
F. temperatum CBS 135539
F. temperatum LC5848
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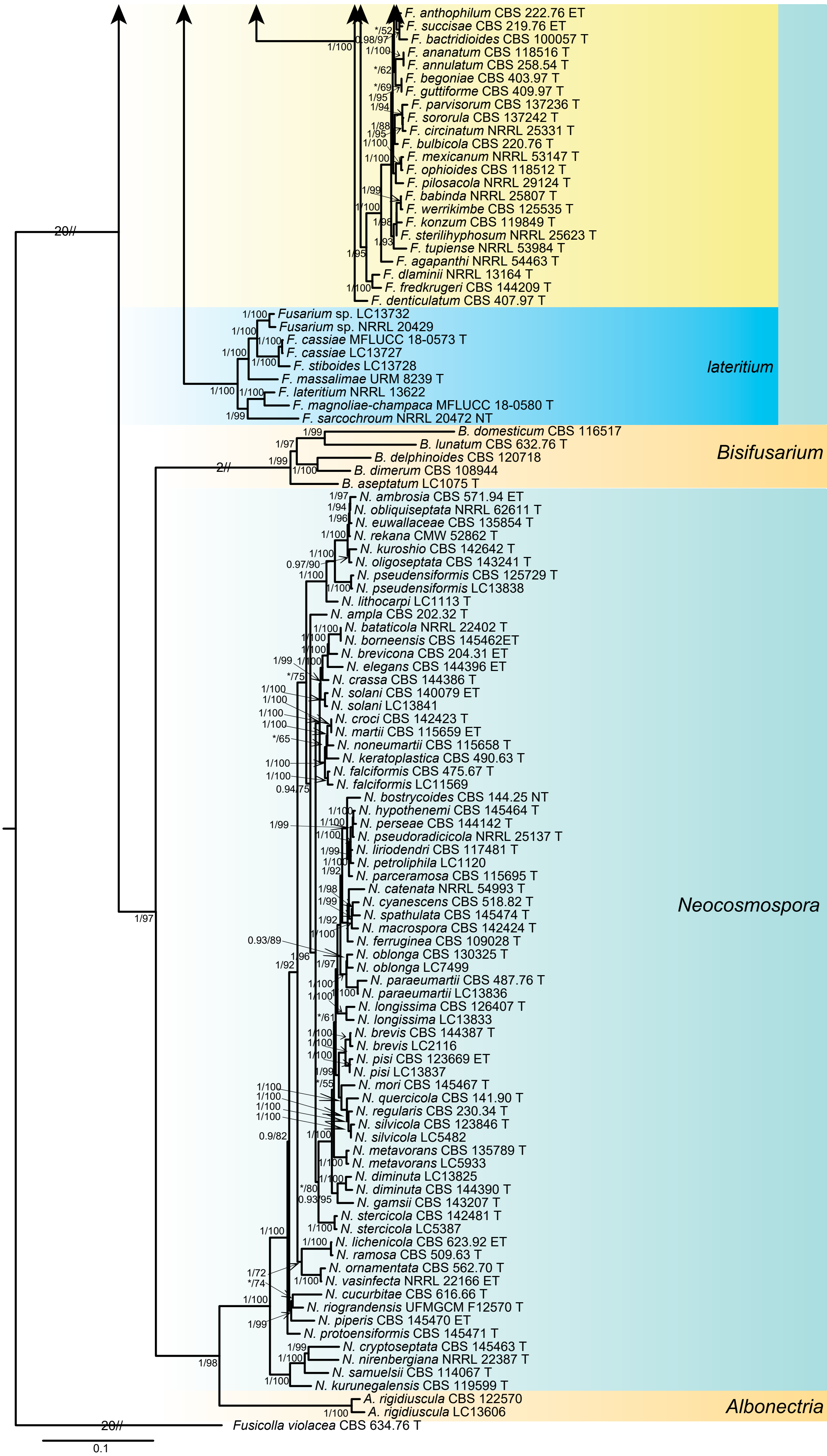
F. awaxy LGMF 1930 T
fujikuroi
Fusarium
0.94/99
1/100
1/98

Fig. 1 (cont.)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F. bulbicola CBS 220.76 T
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F. babinda NRRL 25807 T
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F. agapanthi NRRL 54463 T
F. dlaminii NRRL 13164 T
F. fredkrugeri CBS 144209 T
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Fusarium sp. NRRL 20429
F. cassiae MFLUCC 18-0573 T
F. cassiae LC13727
F. stiboides LC13728
F. massalimae URM 8239 T
F. lateritium NRRL 13622
F. magnoliae-champaca MFLUCC 18-0580 T
F. sarcochroum NRRL 20472 NT
lateritium
B. domesticum CBS 116517
B. lunatum CBS 632.76 T
B. delphinoides CBS 120718
B. dimerum CBS 108944
B. aseptatum LC1075 T
Bisifusarium
N. ambrosia CBS 571.94 ET
N. obliquiseptata NRRL 62611 T
N. euwallaceae CBS 135854 T
N. rekana CMW 52862 T
N. kuroshio CBS 142642 T
N. oligoseptata CBS 143241 T
N. pseudensiformis CBS 125729 T
N. pseudensiformis LC13838
N. lithocarpi LC1113 T
N. ampla CBS 202.32 T
N. batiticola NRRL 22402 T
N. borneensis CBS 145462ET
N. brevicona CBS 204.31 ET
N. elegans CBS 144396 ET
N. crassa CBS 144386 T
N. solani CBS 140079 ET
N. solani LC13841
N. croci CBS 142423 T
N. martii CBS 115659 ET
N. noneumartii CBS 115658 T
N. keratoplastica CBS 490.63 T
N. falciformis CBS 475.67 T
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N. bostrycoides CBS 144.25 NT
N. hypothenemi CBS 145464 T
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N. petroliphila LC1120
N. parceramosa CBS 115695 T
N. catenata NRRL 54993 T
N. cyanescens CBS 518.82 T
N. spathulata CBS 145474 T
N. macrospora CBS 142424 T
N. ferruginea CBS 109028 T
N. oblonga CBS 130325 T
N. oblonga LC7499
N. paraeumartii CBS 487.76 T
N. paraeumartii LC13836
N. longissima CBS 126407 T
N. longissima LC13833
N. brevis CBS 144387 T
N. brevis LC2116
N. pisi CBS 123669 ET
N. pisi LC13837
N. mori CBS 145467 T
N. quercicola CBS 141.90 T
N. regularis CBS 230.34 T
N. silvicola CBS 123846 T
N. silvicola LC5482
N. metavorans CBS 135789 T
N. metavorans LC5933
N. diminuta LC13825
N. diminuta CBS 144390 T
N. gamsii CBS 143207 T
N. stercicola CBS 142481 T
N. stercicola LC5387
N. lichenicola CBS 623.92 ET
N. ramosa CBS 509.63 T
N. ornamentata CBS 562.70 T
N. vasinfecta NRRL 22166 ET
N. cucurbitae CBS 616.66 T
N. riograndensis UFMGCM F12570 T
N. piperis CBS 145470 ET
N. protoensiformis CBS 145471 T
N. cryptoseptata CBS 145463 T
N. nirenbergiana NRRL 22387 T
N. samuelsii CBS 114067 T
N. kurunegalensis CBS 119599 T
Neocosmospora
A. rigidiuscula CBS 122570
A. rigidiuscula LC13606
Albonectria
Fusicolla violacea CBS 634.76 T
20//
2//
0.1

Fig. 1 (cont.)

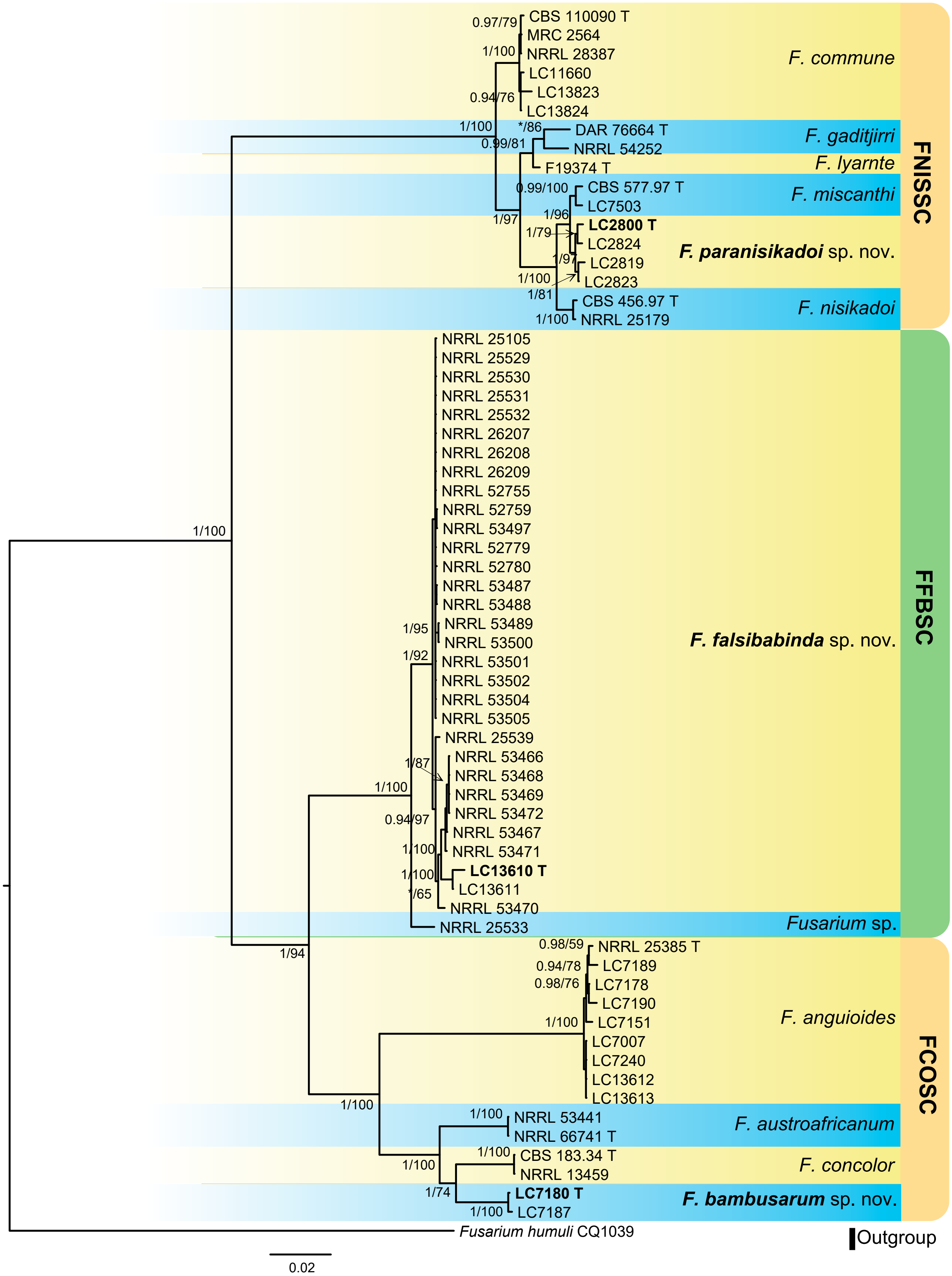


Fig. 2 Fifty percent majority rule consensus tree from a Bayesian analysis based on a three-locus combined dataset (*tef1*, *rpb1*, and *rpb2*) showing the phylogenetic relationships of five species complexes within the *Fusarium*, namely *F. concolor* (FCOSC), *F. falsibabinda* (FFBSC), and *F. nisikadoi* (FNISSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *Fusarium humuli* (CQ1039). New species are indicated in **bold**, ex-type cultures in **bold** with 'T'.

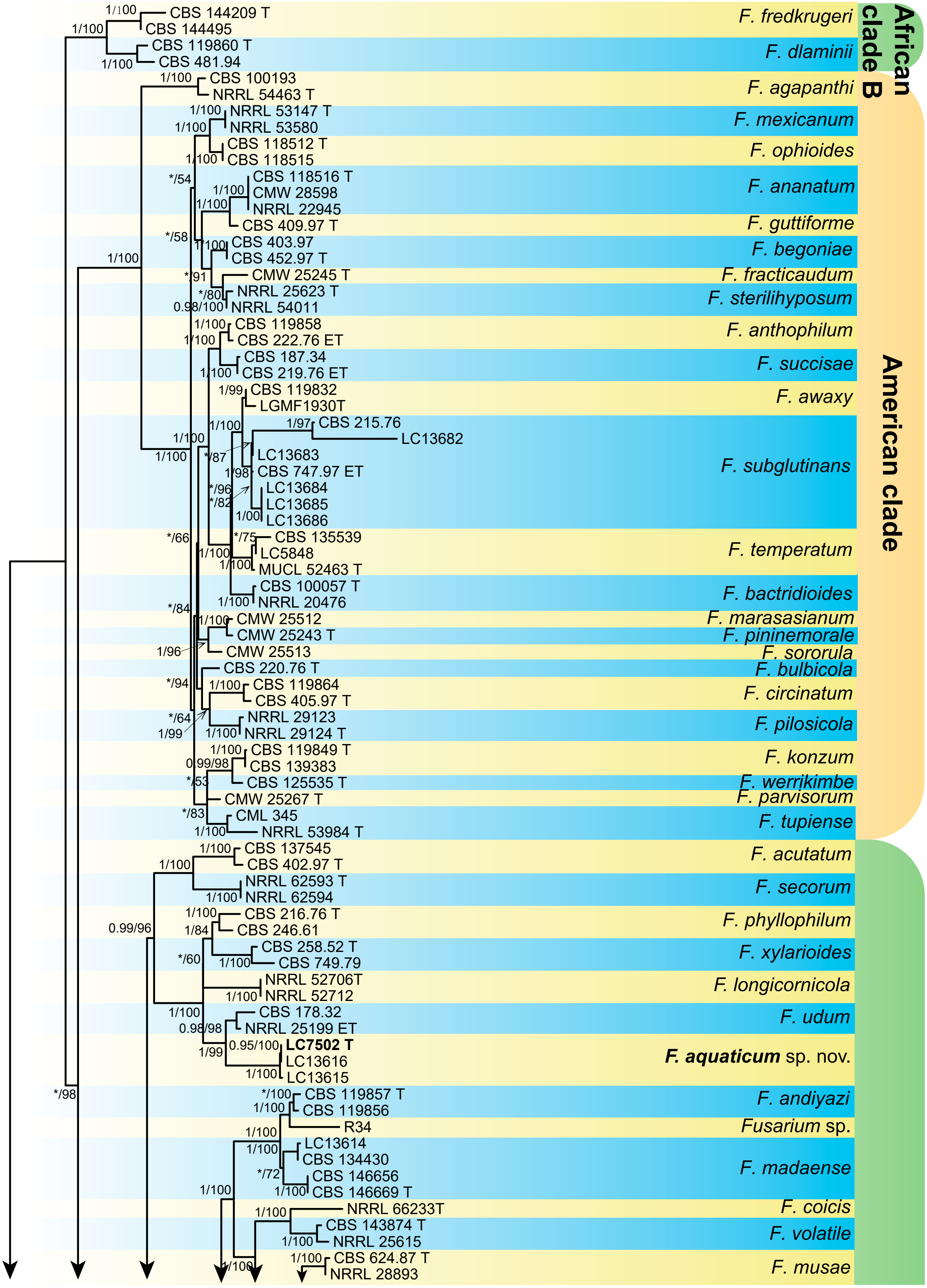
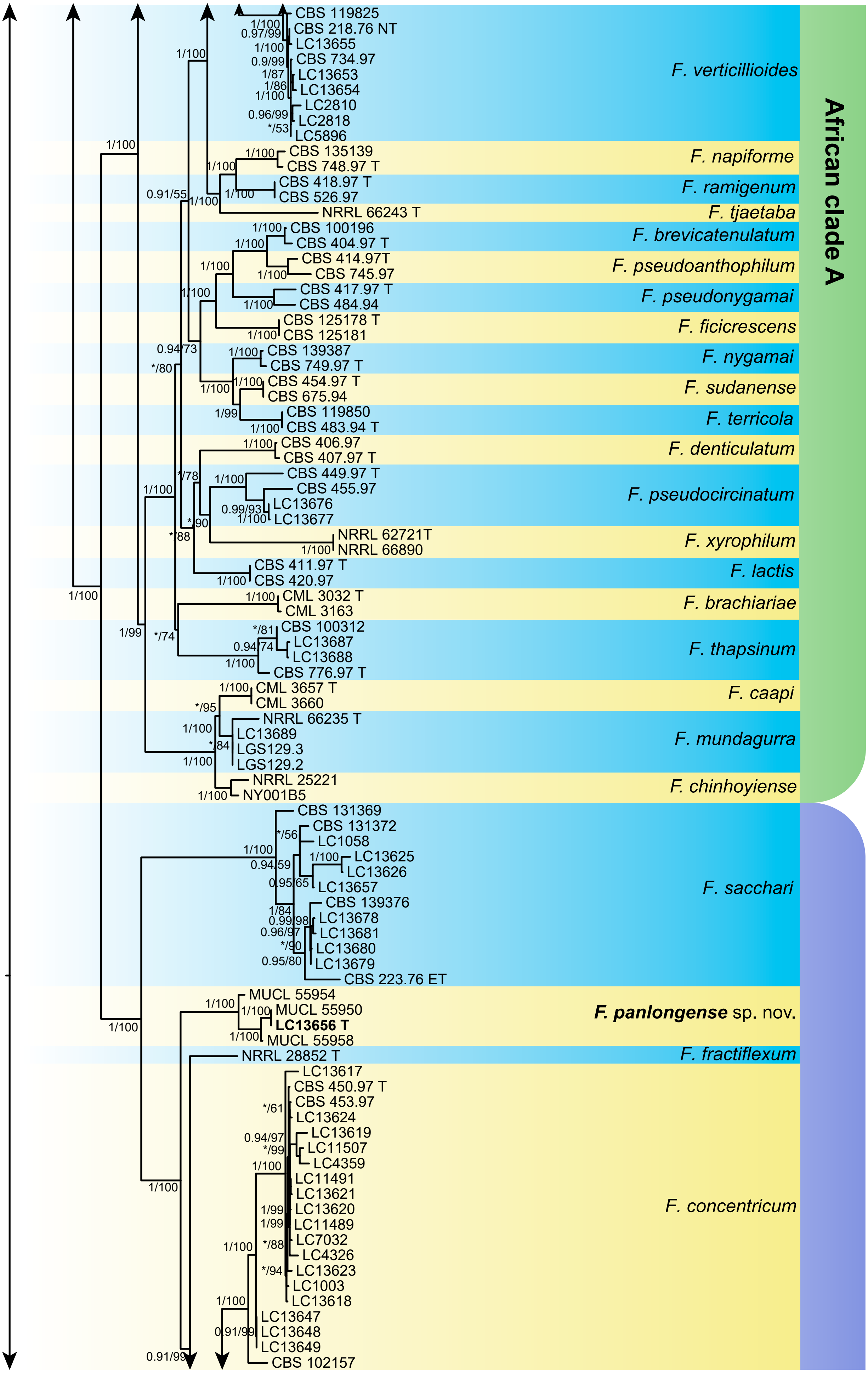


Fig. 3 Fifty percent majority rule consensus tree from a Bayesian analysis based on a five-locus combined dataset (*tef1*, *cam*, *rpb1*, *rpb2*, and *tub2*) showing the phylogenetic relationships of species within the *Fusarium fujikuroi* species complex (FFSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. nirenbergiae* (CBS 744.97). New species are indicated in **bold**, ex-type cultures with 'T', epi-type with 'ET', neotype with 'NT'.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F. ficicrescens
F. nygamai
F. sudanense
F. terricola
F. denticulatum
F. pseudocircinatum
F. xyrophilum
F. lactis
F. brachiariae
F. thapsinum
F. caapi
F. mundagurra
F. chinhoyiense
F. sacchari
F. panlongense sp. nov.
F. fractiflexum
F. concentricum
African clade A
CBS 119825
CBS 218.76 NT
LC13655
CBS 734.97
LC13653
LC13654
LC2810
LC2818
LC5896
CBS 135139
CBS 748.97 T
CBS 418.97 T
CBS 526.97
NRRL 66243 T
CBS 100196
CBS 404.97 T
CBS 414.97T
CBS 745.97
CBS 417.97 T
CBS 484.94
CBS 125178 T
CBS 125181
CBS 139387
CBS 749.97 T
CBS 454.97 T
CBS 675.94
CBS 119850
CBS 483.94 T
CBS 406.97
CBS 407.97 T
CBS 449.97 T
CBS 455.97
LC13676
LC13677
NRRL 62721T
NRRL 66890
CBS 411.97 T
CBS 420.97
CML 3032 T
CML 3163
CBS 100312
LC13687
LC13688
CBS 776.97 T
CML 3657 T
CML 3660
NRRL 66235 T
LC13689
LGS129.3
LGS129.2
NRRL 25221
NY001B5
CBS 131369
CBS 131372
LC1058
LC13625
LC13626
LC13657
CBS 139376
LC13678
LC13681
LC13680
LC13679
CBS 223.76 ET
MUCL 55954
MUCL 55950
LC13656 T
MUCL 55958
NRRL 28852 T
LC13617
CBS 450.97 T
CBS 453.97
LC13624
LC13619
LC11507
LC4359
LC11491
LC13621
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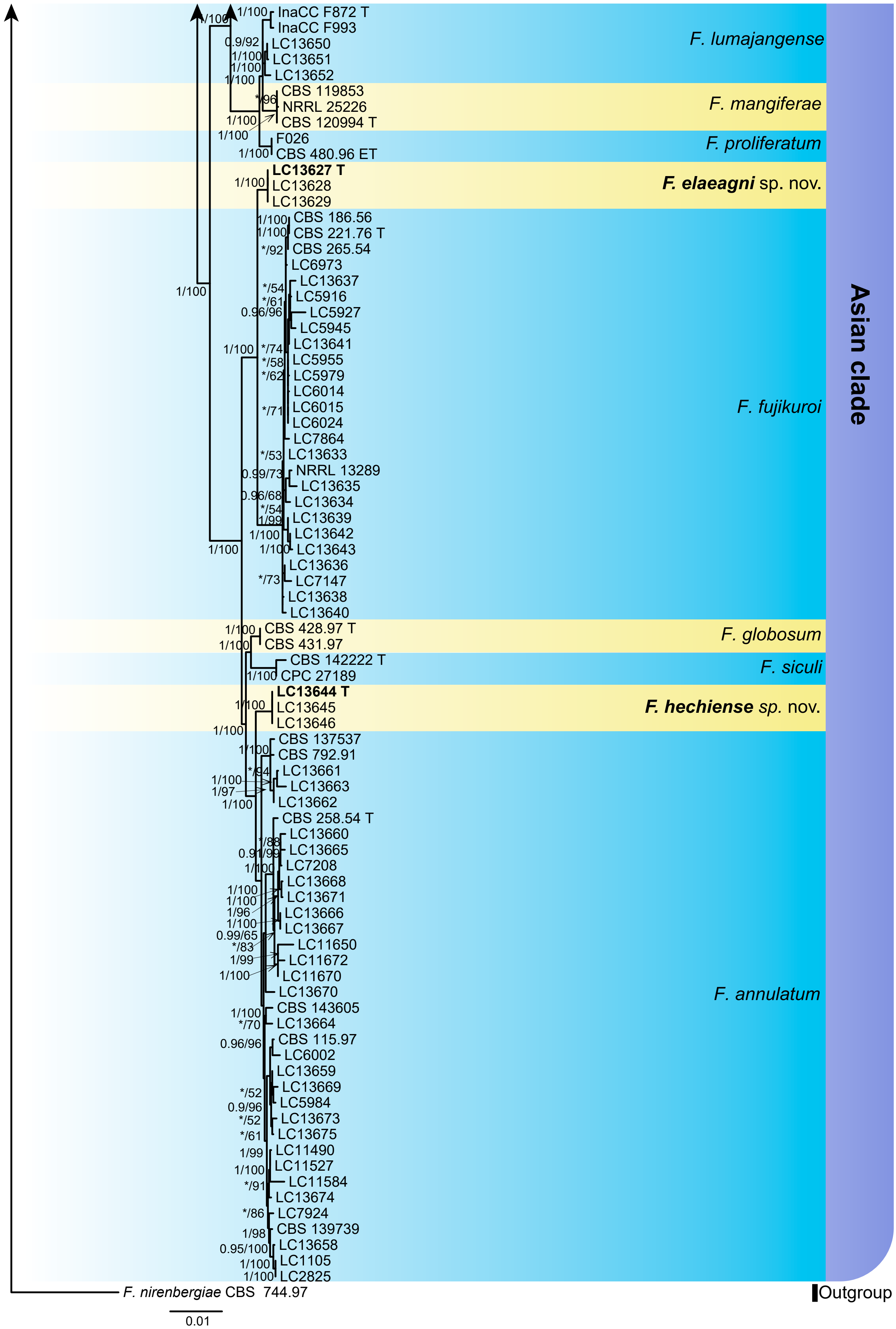
CBS 102157

Fig. 3 (cont.)


InaCC F872 T
InaCC F993
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LC13651
LC13652
F. lumajangense
CBS 119853
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F. mangiferae
F026
CBS 480.96 ET
F. proliferatum
LC13627 T
LC13628
LC13629
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CBS 186.56
CBS 221.76 T
CBS 265.54
LC6973
LC13637
LC5916
LC5927
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LC5979
LC6014
LC6015
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LC13643
LC13636
LC7147
LC13638
LC13640
F. fujikuroi
CBS 428.97 T
CBS 431.97
F. globosum
CBS 142222 T
CPC 27189
F. siculi
LC13644 T
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F. hechiense sp. nov.
CBS 137537
CBS 792.91
LC13661
LC13663
LC13662
CBS 258.54 T
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LC13665
LC7208
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LC13671
LC13666
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LC11672
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CBS 143605
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LC5984
LC13673
LC13675
LC11490
LC11527
LC11584
LC13674
LC7924
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Asian clade
F. nirenbergiae CBS 744.97
Outgroup
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Fig. 3 (cont.)

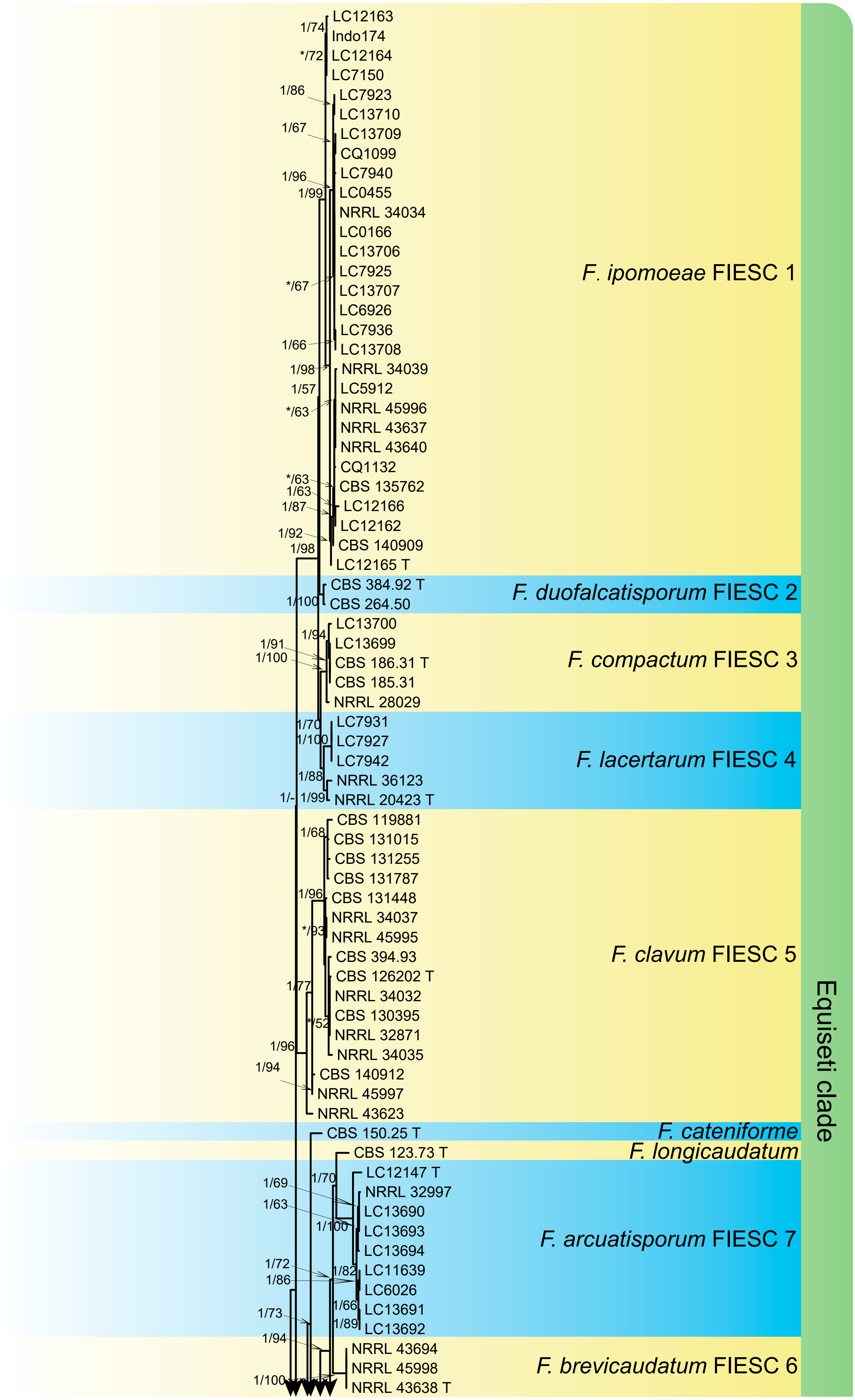
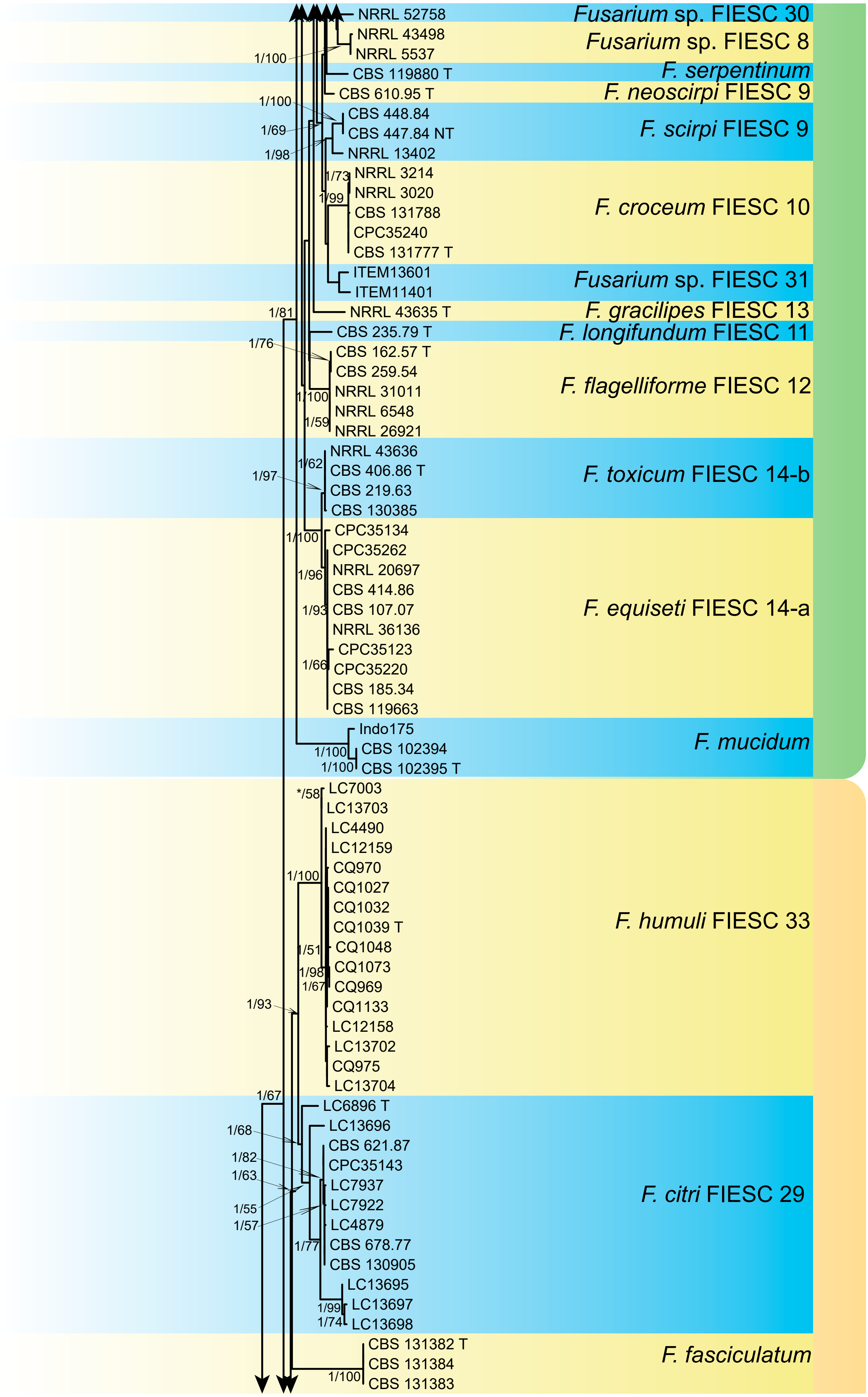


Fig. 4 Fifty percent majority rule consensus tree from a Bayesian analysis based on a three-locus combined dataset (*tef1*, *cam*, and *rpb2*) showing the phylogenetic relationships of species within the *Fusarium incarnatum-equiseti* species complex (FIESC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. concolor* (NRRL 13994 T). Ex-type cultures are indicated with 'T', neotype with 'NT'.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Fusarium sp. FIESC 30
NRRL 43498
NRRL 5537
Fusarium sp. FIESC 8
1/100
CBS 119880 T
F. serpentinum
CBS 610.95 T
F. neoscirpi FIESC 9
1/100
1/69
1/98
CBS 448.84
CBS 447.84 NT
NRRL 13402
F. scirpi FIESC 9
1/73
1/99
NRRL 3214
NRRL 3020
CBS 131788
CPC35240
CBS 131777 T
F. croceum FIESC 10
ITEM13601
ITEM11401
Fusarium sp. FIESC 31
1/81
NRRL 43635 T
F. gracilipes FIESC 13
CBS 235.79 T
F. longifundum FIESC 11
1/76
1/100
1/59
CBS 162.57 T
CBS 259.54
NRRL 31011
NRRL 6548
NRRL 26921
F. flagelliforme FIESC 12
1/62
1/97
NRRL 43636
CBS 406.86 T
CBS 219.63
CBS 130385
F. toxicum FIESC 14-b
1/100
1/96
1/93
1/66
CPC35134
CPC35262
NRRL 20697
CBS 414.86
CBS 107.07
NRRL 36136
CPC35123
CPC35220
CBS 185.34
CBS 119663
F. equiseti FIESC 14-a
1/100
1/100
Indo175
CBS 102394
CBS 102395 T
F. mucidum
*/58
1/100
1/51
1/98
1/67
1/93
LC7003
LC13703
LC4490
LC12159
CQ970
CQ1027
CQ1032
CQ1039 T
CQ1048
CQ1073
CQ969
CQ1133
LC12158
LC13702
CQ975
LC13704
F. humuli FIESC 33
1/67
1/68
1/82
1/63
1/55
1/57
1/77
1/99
1/74
LC6896 T
LC13696
CBS 621.87
CPC35143
LC7937
LC7922
LC4879
CBS 678.77
CBS 130905
LC13695
LC13697
LC13698
F. citri FIESC 29
1/100
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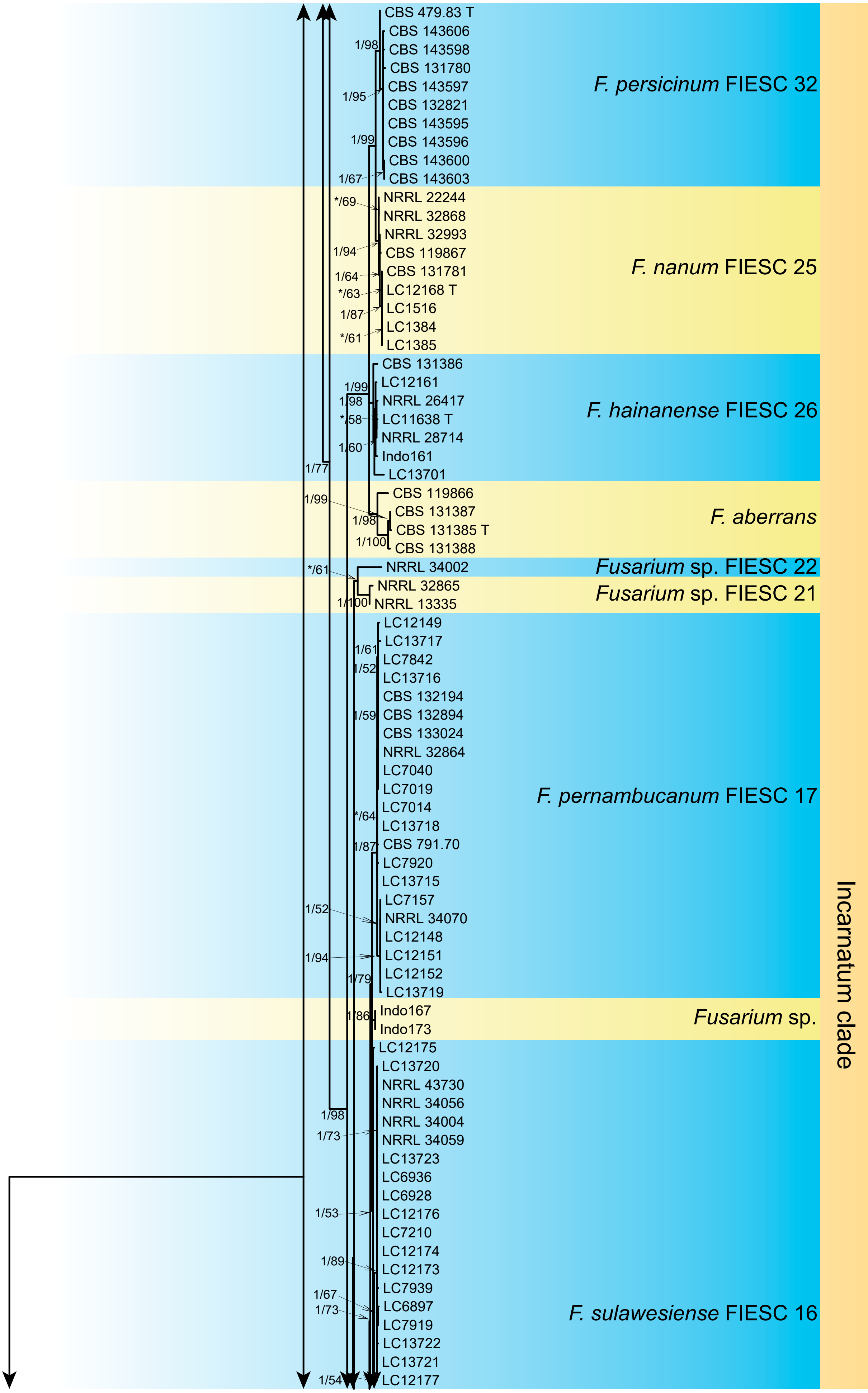
CBS 131383
F. fasciculatum

Fig. 4 (cont.)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1/95
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CBS 143600
1/67
CBS 143603
F. persicinum FIESC 32
*/69
NRRL 22244
NRRL 32868
NRRL 32993
1/94
CBS 119867
1/64
CBS 131781
*/63
LC12168 T
1/87
LC1516
LC1384
*/61
LC1385
F. nanum FIESC 25
CBS 131386
1/99
LC12161
1/98
NRRL 26417
*/58
LC11638 T
NRRL 28714
1/60
Indo161
1/77
LC13701
F. hainanense FIESC 26
1/99
CBS 119866
CBS 131387
1/98
CBS 131385 T
1/100
CBS 131388
F. aberrans
*/61
NRRL 34002
Fusarium sp. FIESC 22
NRRL 32865
1/100
NRRL 13335
Fusarium sp. FIESC 21
LC12149
LC13717
1/61
LC7842
1/52
LC13716
CBS 132194
1/59
CBS 132894
CBS 133024
NRRL 32864
LC7040
LC7019
LC7014
*/64
LC13718
1/87
CBS 791.70
LC7920
LC13715
LC7157
1/52
NRRL 34070
LC12148
1/94
LC12151
LC12152
1/79
LC13719
F. pernambucanum FIESC 17
1/86
Indo167
Indo173
Fusarium sp.
LC12175
LC13720
NRRL 43730
NRRL 34056
1/98
NRRL 34004
1/73
NRRL 34059
LC13723
LC6936
LC6928
1/53
LC12176
LC7210
1/89
LC12174
LC12173
LC7939
1/67
LC6897
1/73
LC7919
LC13722
LC13721
1/54
LC12177
F. sulawesiense FIESC 16
Incarnatum clade

Fig. 4 (cont.)

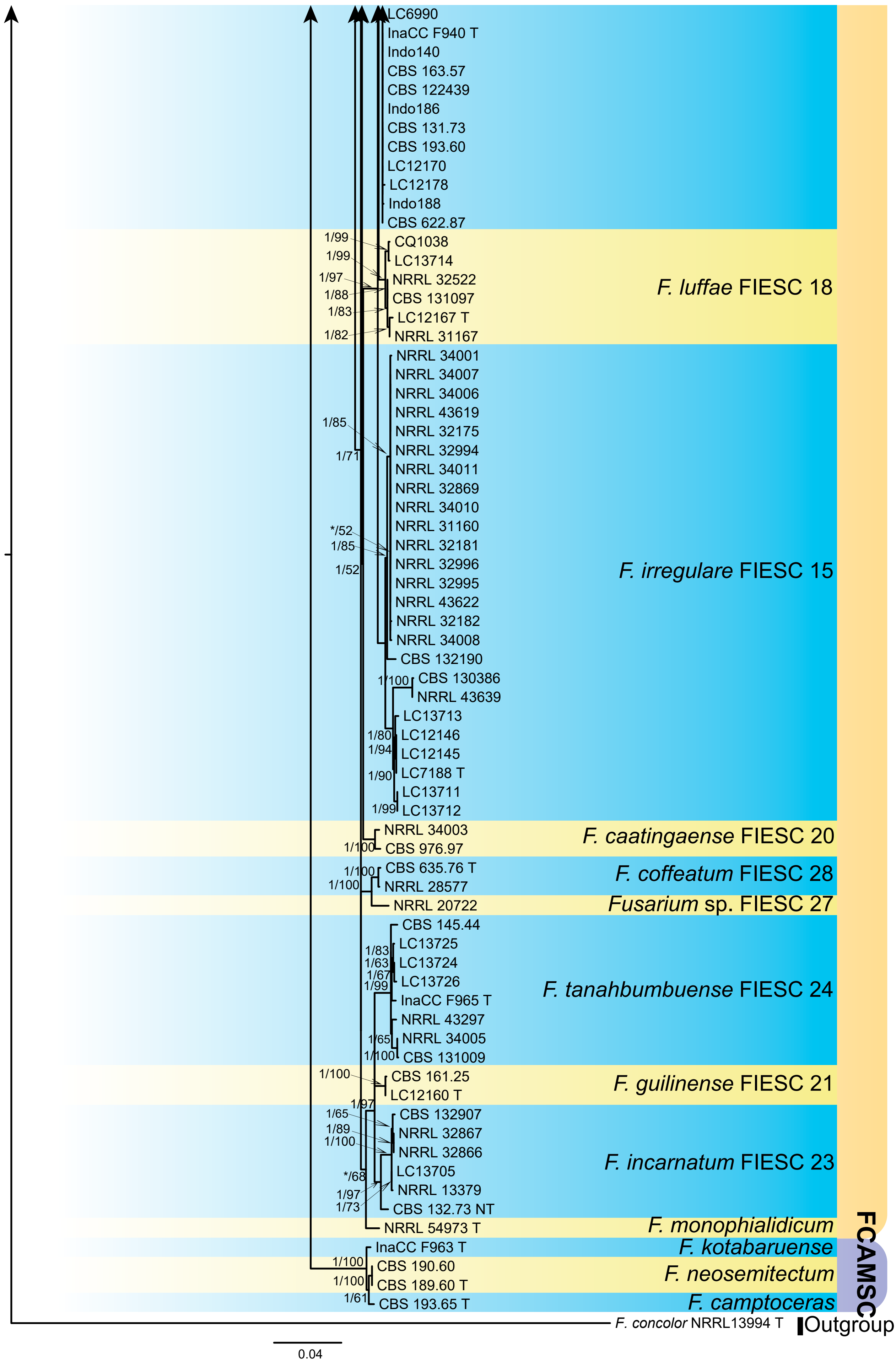

LC6990
InaCC F940 T
Indo140
CBS 163.57
CBS 122439
Indo186
CBS 131.73
CBS 193.60
LC12170
LC12178
Indo188
CBS 622.87
CQ1038
LC13714
NRRL 32522
CBS 131097
LC12167 T
NRRL 31167
F. luffae FIESC 18
NRRL 34001
NRRL 34007
NRRL 34006
NRRL 43619
NRRL 32175
NRRL 32994
NRRL 34011
NRRL 32869
NRRL 34010
NRRL 31160
NRRL 32181
NRRL 32996
NRRL 32995
NRRL 43622
NRRL 32182
NRRL 34008
CBS 132190
CBS 130386
NRRL 43639
LC13713
LC12146
LC12145
LC7188 T
LC13711
LC13712
F. irregulare FIESC 15
NRRL 34003
CBS 976.97
F. caatingaense FIESC 20
CBS 635.76 T
NRRL 28577
F. coffeatum FIESC 28
NRRL 20722
Fusarium sp. FIESC 27
CBS 145.44
LC13725
LC13724
LC13726
InaCC F965 T
NRRL 43297
NRRL 34005
CBS 131009
F. tanahbumbuense FIESC 24
CBS 161.25
LC12160 T
F. guilinense FIESC 21
CBS 132907
NRRL 32867
NRRL 32866
LC13705
NRRL 13379
CBS 132.73 NT
F. incarnatum FIESC 23
NRRL 54973 T
F. monophialidicum
InaCC F963 T
F. kotabaruense
CBS 190.60
CBS 189.60 T
F. neosemitectum
CBS 193.65 T
F. camptoceras
F. concolor NRRL13994 T
Outgroup
FCAMSC
0.04

Fig. 4 (cont.)

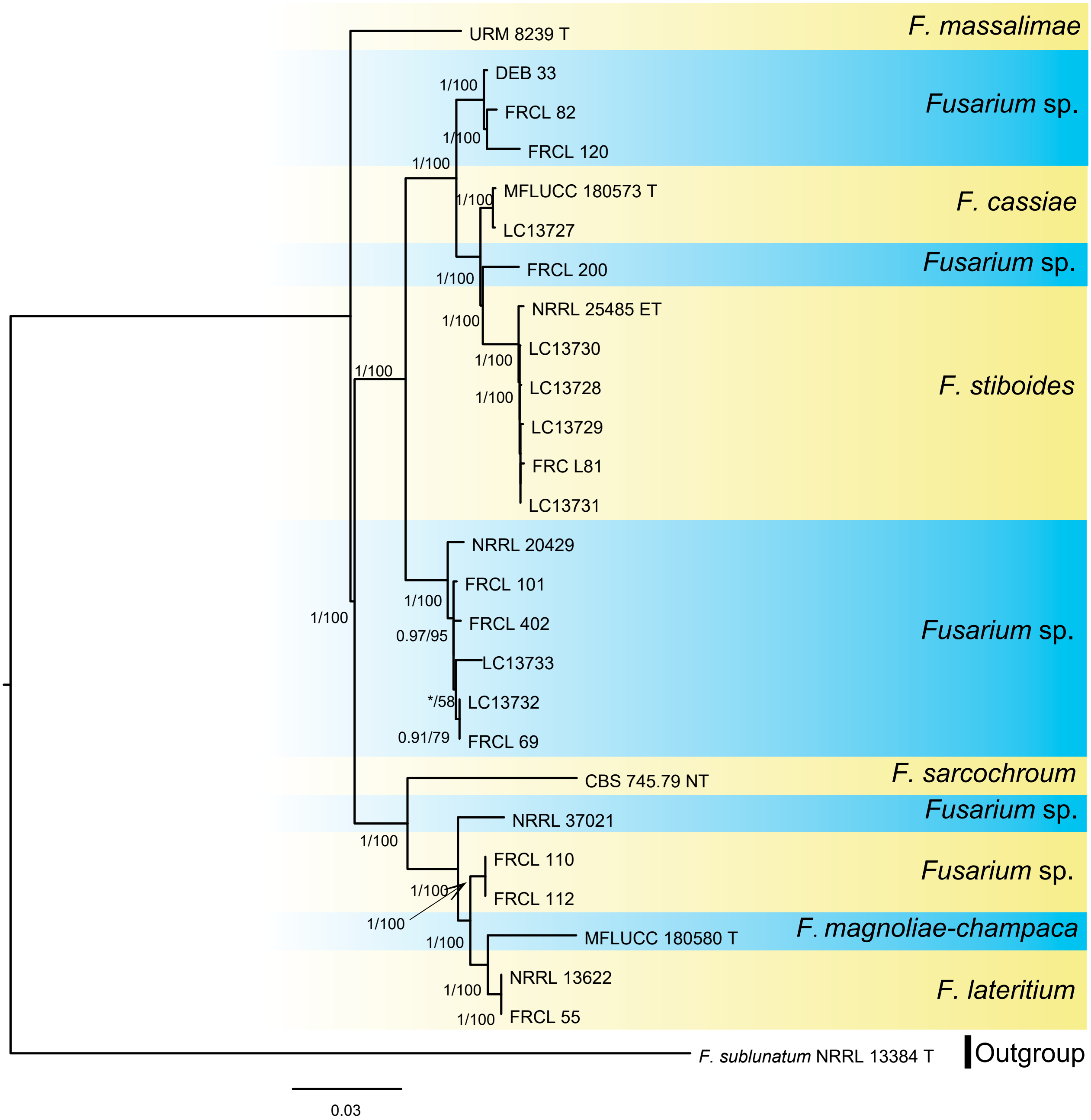


Fig. 5 Fifty percent majority rule consensus tree from a Bayesian analysis based on a four-locus combined dataset (*tef1*, *rpb1*, *rpb2*, and *tub2*) showing the phylogenetic relationships of species within the *Fusarium lateritium* species complex (FLSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. sublunatum* (NRRL 13384 T). Ex-type culture are indicated with 'T', epitype with 'ET', and neotype with 'NT'.

FUSARIUM

Fusarium concolor species complex

Fusarium bambusarum M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842152; Fig. 11

Etymology. Named after the host of the type specimen, bamboo.

Typus. China, Jiangxi Province, from bamboo, July 2016, *J.E. Huang* (HMAS 351575, holotype designated here, dried culture on SNA with carnation leaves, culture ex-type CGMCC 3.20820 = LC7180).

Colonies on PDA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin erose to entire, surface and reverse white. Colonies on OA grown in the dark reaching 5.9–6.1 cm diam after 7 d at 25 °C, raise, aerial mycelia dense, colony margin entire, surface and reverse white. Colonies on SNA grown in the dark reaching 5.2–5.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, surface and reverse white. Pigment and odour absent. *Sporodochia* orange grey (5B2), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed, consisting of a short, smooth- and thin-walled stipe, 4–7 × 3–5 µm, bearing an apical pair or whorls of 3 monophialides; *sporodochial phialides* subulate to subcylindrical, 12–15 × 3–5 µm, smooth- and thin-walled, sometimes showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, slender, slightly curved with almost parallel sides tapering slightly towards both ends, with a papillate to hooked, curved apical cell and a foot-like basal cell, 3–6-septate, hyaline, smooth- and thin-walled; 3-septate conidia: (39.4–)41.2–50(–51.3) × 3.4–5.6 µm (av. ± sd. 45.7 ± 2.4 × 4.3 ± 0.6 µm); 4-septate conidia: (50.3–)51–59.6(–59.7) × 3.1–5.9 µm (av. ± sd. 56 ± 2.7 × 4.4 ± 0.8 µm); 5–6-septate conidia: (62.9–)63.3–85.2(–85.7) × 3.6–6.2 µm (av. ± sd. 73.2 ± 5.5 × 4.9 ± 0.7 µm). *Conidiophores* borne on aerial mycelia

text continues on p. 30

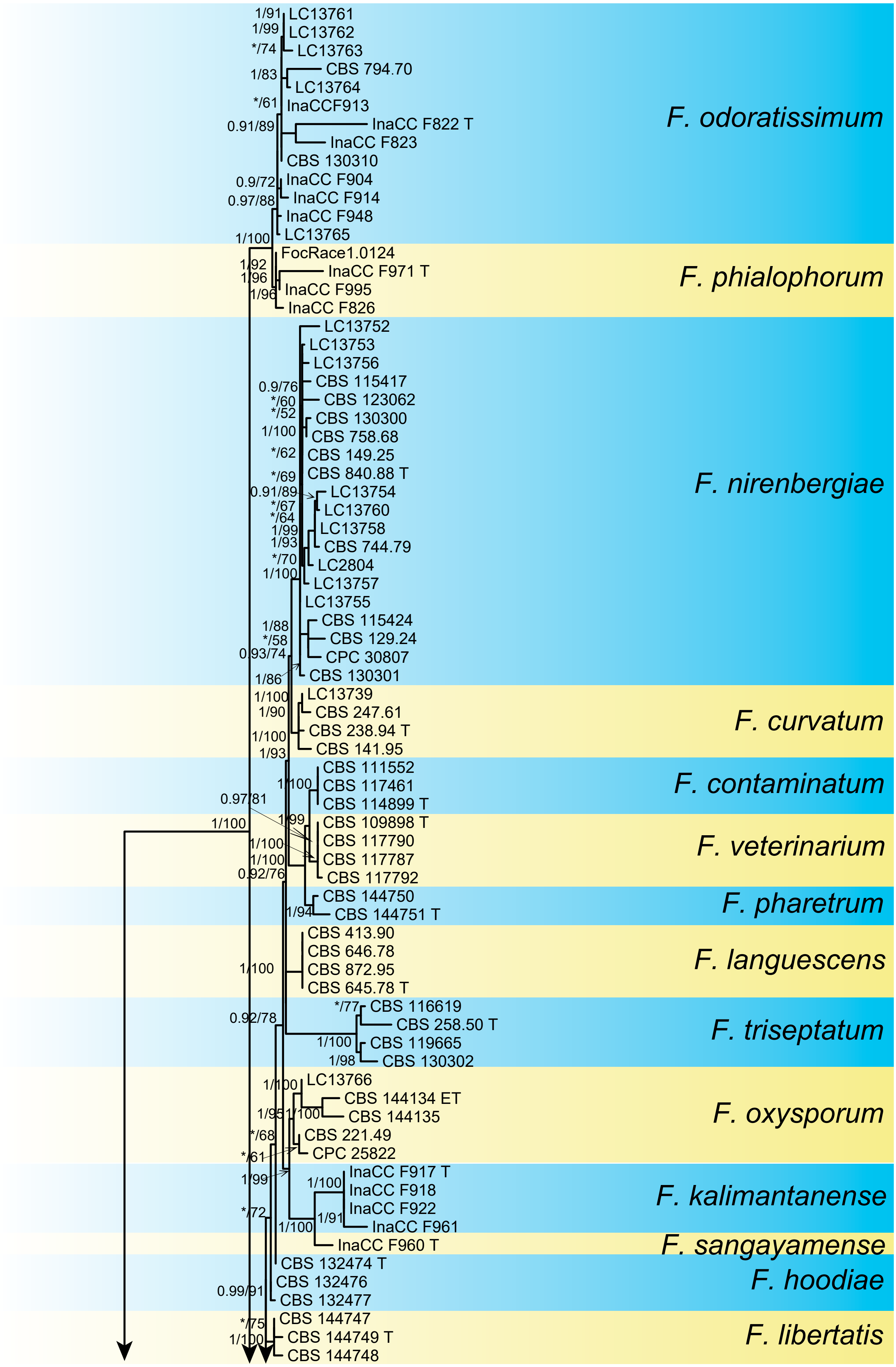


Fig. 6 Fifty percent majority rule consensus tree from a Bayesian analysis based on a five-locus combined dataset (*tef1*, *cam*, *rpb1*, *rpb2*, and *tub2*) showing the phylogenetic relationships of species within the *Fusarium oxysporum* species complex (FOSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. globosum* (NRRL 26131). Ex-type cultures are indicated with 'T', epitype with 'ET'.

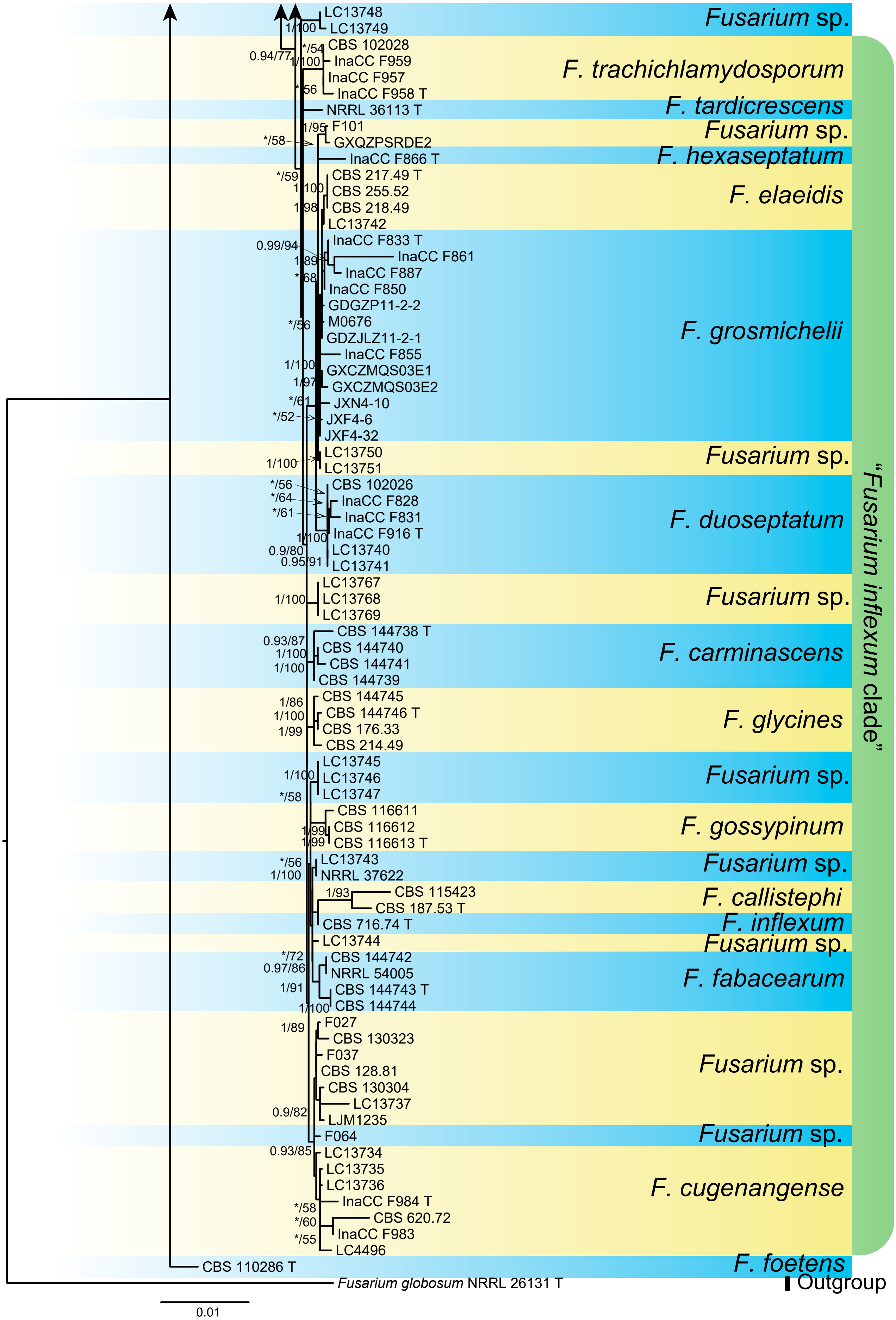

LC13748
LC13749
Fusarium sp.
CBS 102028
InaCC F959
InaCC F957
InaCC F958 T
F. trachichlamydosporum
NRRL 36113 T
F. tardicrescens
F101
GXQZPSRDE2
Fusarium sp.
InaCC F866 T
F. hexaseptatum
CBS 217.49 T
CBS 255.52
CBS 218.49
LC13742
F. elaeidis
InaCC F833 T
InaCC F861
InaCC F887
InaCC F850
GDGZP11-2-2
M0676
GDZJLZ11-2-1
InaCC F855
GXCZMQS03E1
GXCZMQS03E2
JXN4-10
JXF4-6
JXF4-32
F. grosmichelii
LC13750
LC13751
Fusarium sp.
CBS 102026
InaCC F828
InaCC F831
InaCC F916 T
LC13740
LC13741
F. duoseptatum
LC13767
LC13768
LC13769
Fusarium sp.
CBS 144738 T
CBS 144740
CBS 144741
CBS 144739
F. carminascens
CBS 144745
CBS 144746 T
CBS 176.33
CBS 214.49
F. glycines
LC13745
LC13746
LC13747
Fusarium sp.
CBS 116611
CBS 116612
CBS 116613 T
F. gossypinum
LC13743
NRRL 37622
Fusarium sp.
CBS 115423
CBS 187.53 T
F. callistephi
CBS 716.74 T
F. inflexum
LC13744
Fusarium sp.
CBS 144742
NRRL 54005
CBS 144743 T
CBS 144744
F. fabacearum
F027
CBS 130323
F037
CBS 128.81
CBS 130304
LC13737
LJM1235
Fusarium sp.
F064
Fusarium sp.
LC13734
LC13735
LC13736
InaCC F984 T
CBS 620.72
InaCC F983
LC4496
F. cugenangense
CBS 110286 T
F. foetens
Fusarium globosum NRRL 26131 T
Outgroup
"Fusarium inflexum clade"
0.01

Fig. 6 (cont.)

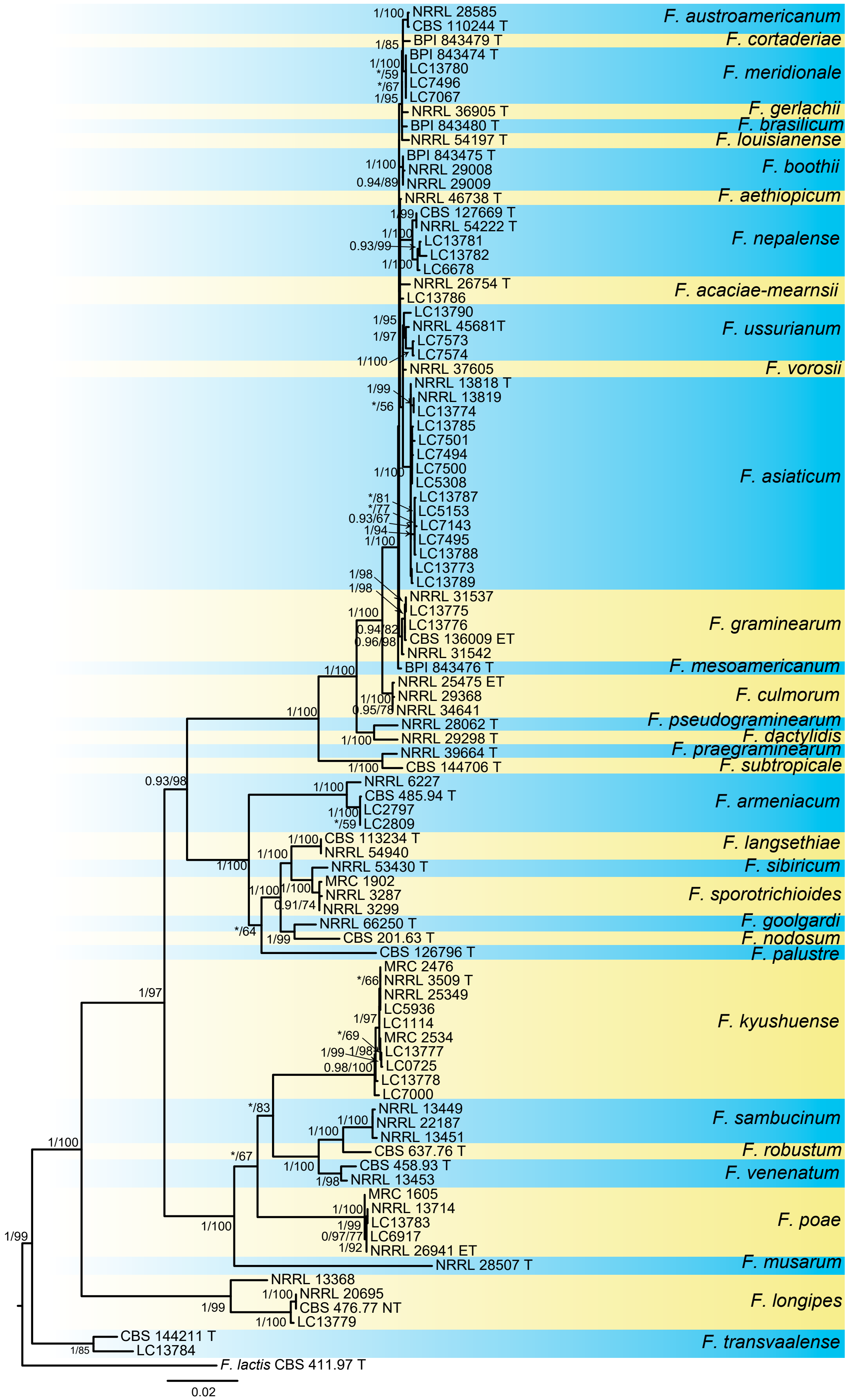


Fig. 7 Fifty percent majority rule consensus tree from a Bayesian analysis based on a three-locus combined dataset (*tef1*, *rpb1*, and *rpb2*) showing the phylogenetic relationships of species within the *Fusarium sambucinum* species complex (FSAMSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. lactis* (CBS 411.97 T). Ex-type cultures are indicated with 'T', epitype with 'ET'.

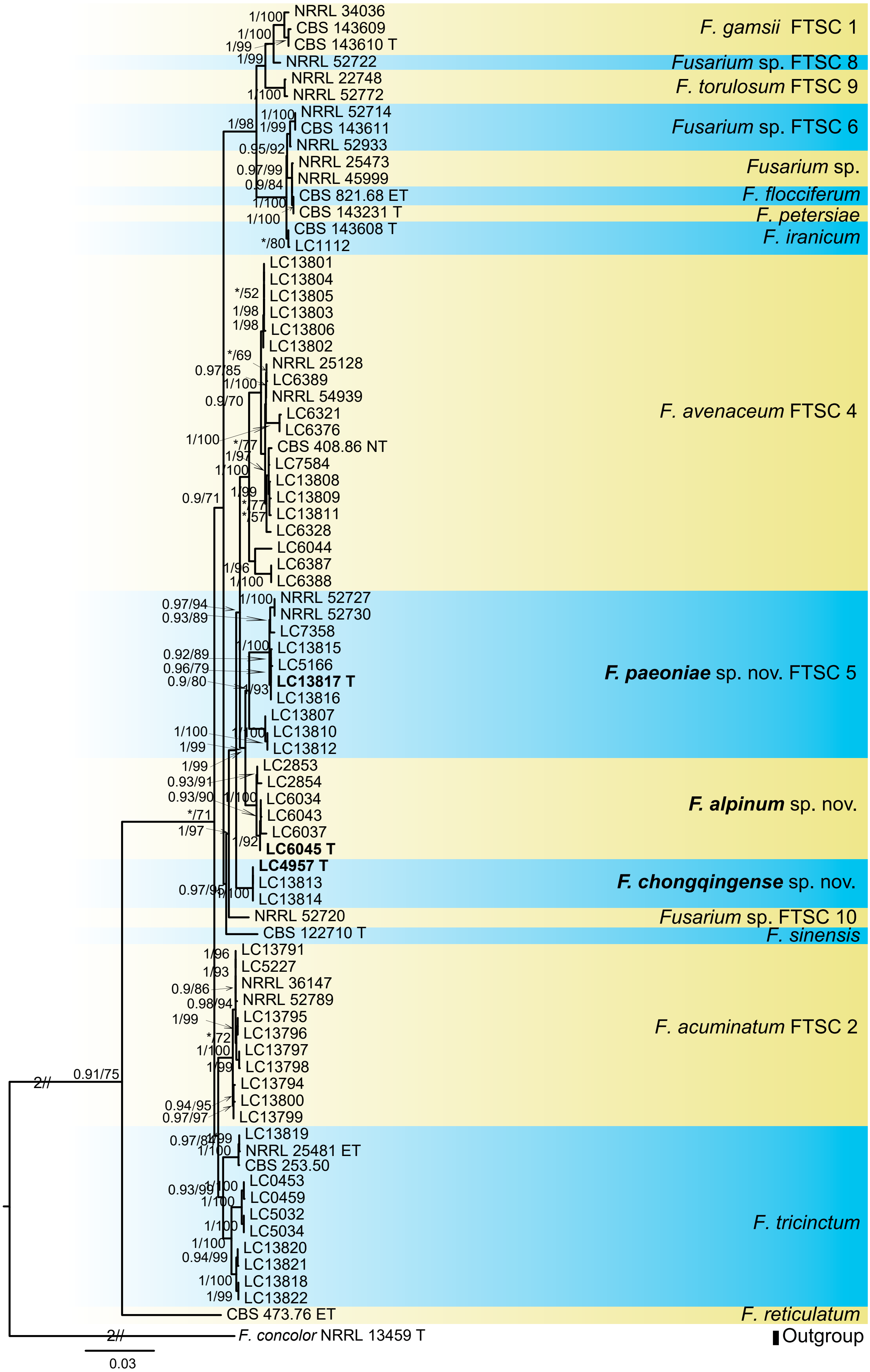


Fig. 8 Fifty percent majority rule consensus tree from a Bayesian analysis based on a four-locus combined dataset (ITS, *tef1*, *rpb1*, and *rpb2*) showing the phylogenetic relationships of species within the *Fusarium tricinctum* species complex (FTSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. concolor* (NRRL 13994 T). New species are indicated in **bold**, ex-type cultures are indicated with 'T', epitype with 'ET', neotype with 'NT'.

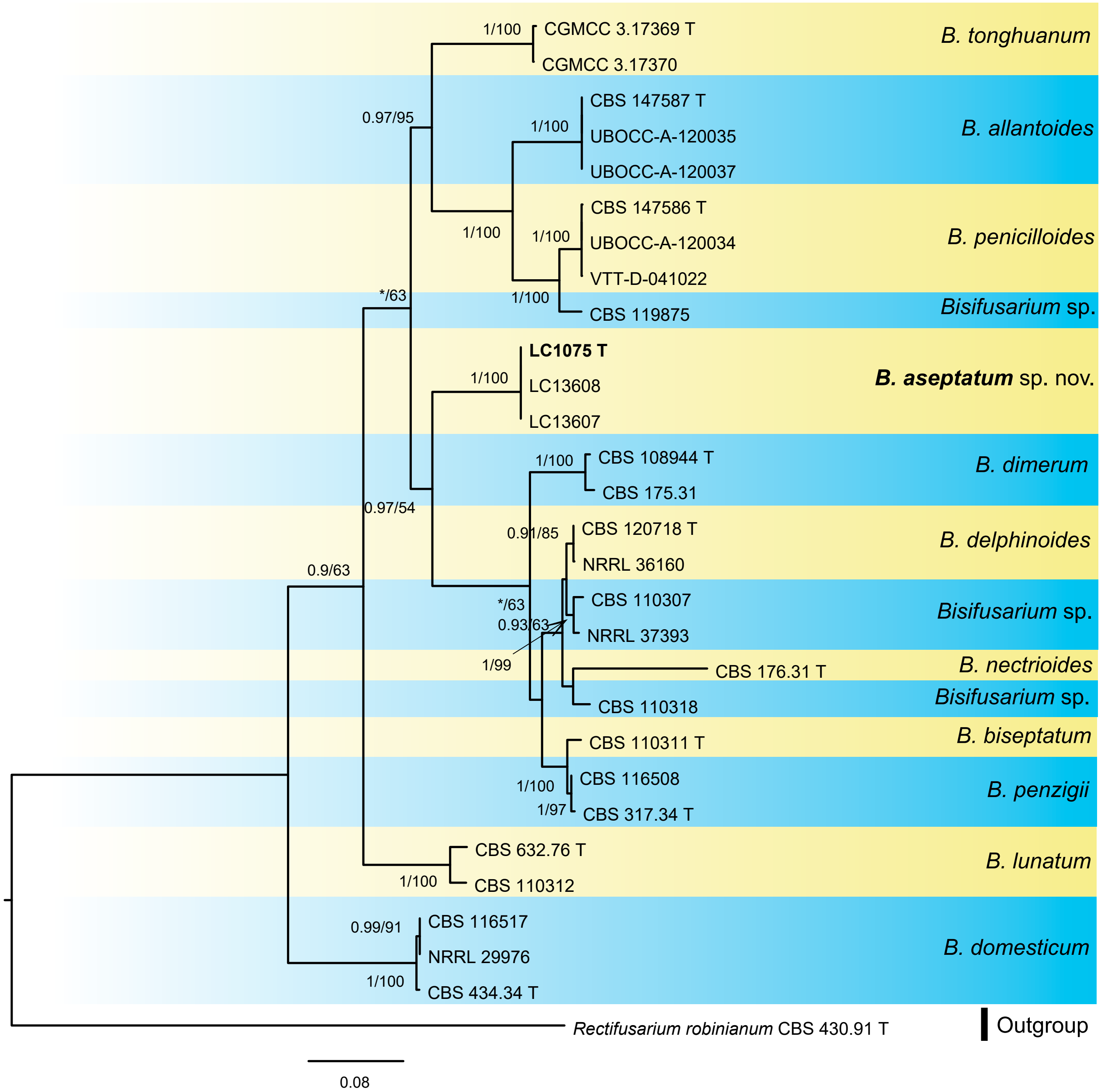


Fig. 9 Fifty percent majority rule consensus tree from a Bayesian analysis based on a five-locus combined dataset (ITS, *tef1*, *cam*, *rpb2*, and *tub2*) showing the phylogenetic relationships of species within the *Bisifusarium*. The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *Rectifusarium robinianum* (CBS 430.91 T). New species are indicated in **bold**, ex-type cultures with 'T'.

30–110 µm tall, unbranched or sparingly branched, bearing terminal or intercalary monophialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 23–30 × 3–4 µm; *aerial microconidia* forming small false heads on the tips of the monophialides, hyaline, oval, smooth- and thin-walled, aseptate, (5–)5.5–11(–12) × 1.6–3.5 µm (av. ± sd. 7.9 ± 1.4 × 2.8 ± 0.4 µm). *Chlamydospores* terminal, almost globose, rough, thick-walled, hyaline, aseptate, 6.3–12.8 µm diam (av. ± sd. 10.4 ± 2.1).

Additional material examined. China, Guangdong Province, Guangzhou city, from bamboo, July 2016, *L. Cai*, LC7187.

Notes — The two isolates were resolved as a strongly supported genealogically exclusive lineage in the combined *tef1*, *rpb1*, and *rpb2* phylogeny (Fig. 2). Phylogenetically, *F. bambusarum* is closely related to *F. austroafricanum* and *F. concolor*, but differs by 152 bp and 136 bp in the three loci dataset, respectively. Morphologically, this species is distinguished based on the number of septa in sporodochial macroconidia (3–6-septate in *F. bambusarum* vs 0–11-septate in *F. austroafricanum*) and in the type of aerial phialides (monophialides in *F. bambusarum* vs polyphialides in *F. concolor*) (Marasas et al. 1986).

Fusarium falsibabinda species complex

Fusarium falsibabinda M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842153; Fig. 12

Etymology. Named after species of this newly introduced clade, *F. babinda*.

Typus. Japan, intercepted and isolated at Ningbo Customs, from *Podocarpus macrophyllus* imported to China, Oct. 2012, *W.J. Duan* (HMAS 351576, holotype designated here, dried culture on SNA with carnation leaves, culture ex-type CGMCC 3.20823 = LC13610 = F015).

Colonies on PDA grown in the dark reaching 3.7–4.2 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin erose, surface white; reverse pale yellow in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.9–

text continues on p. 33

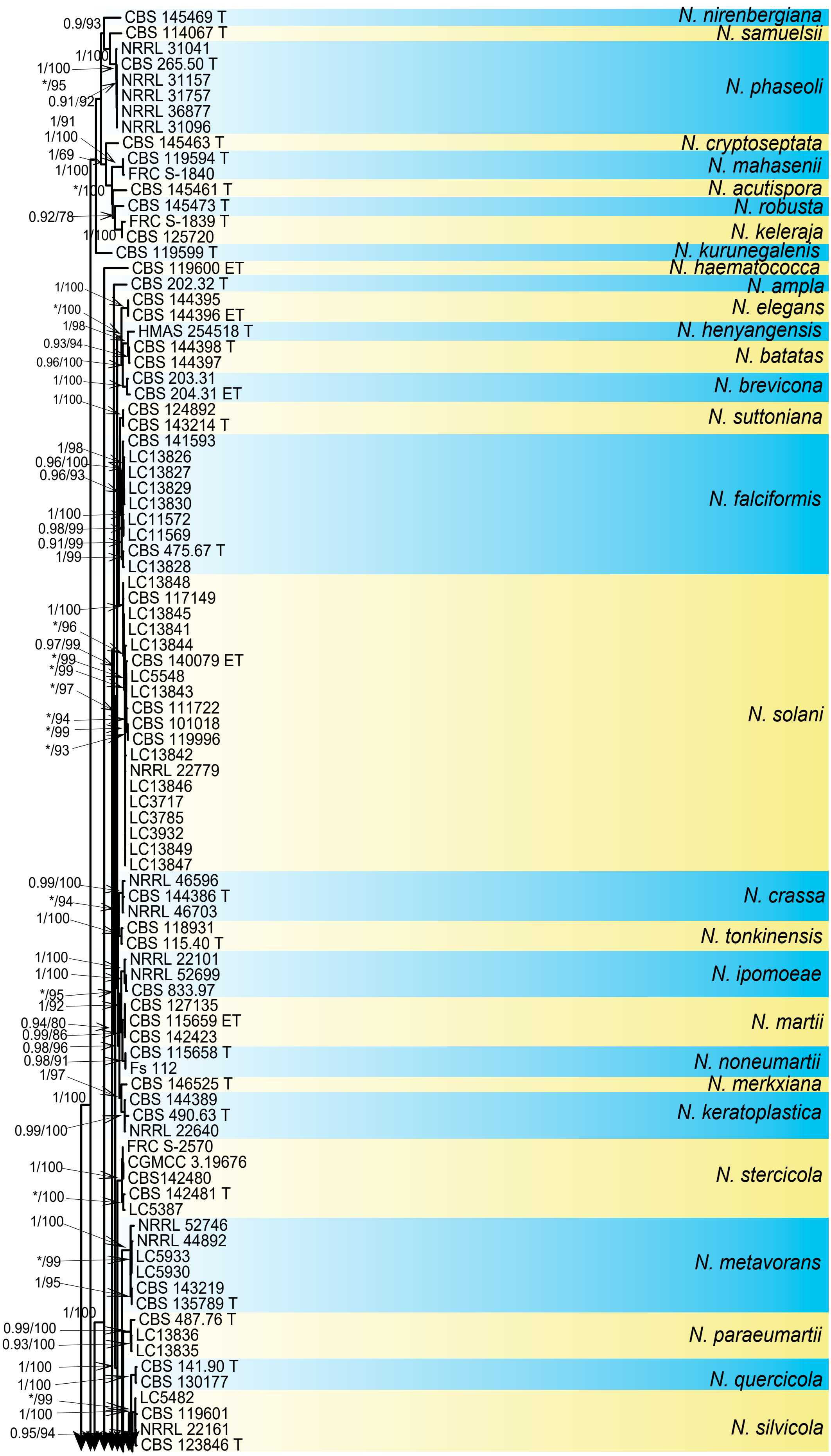
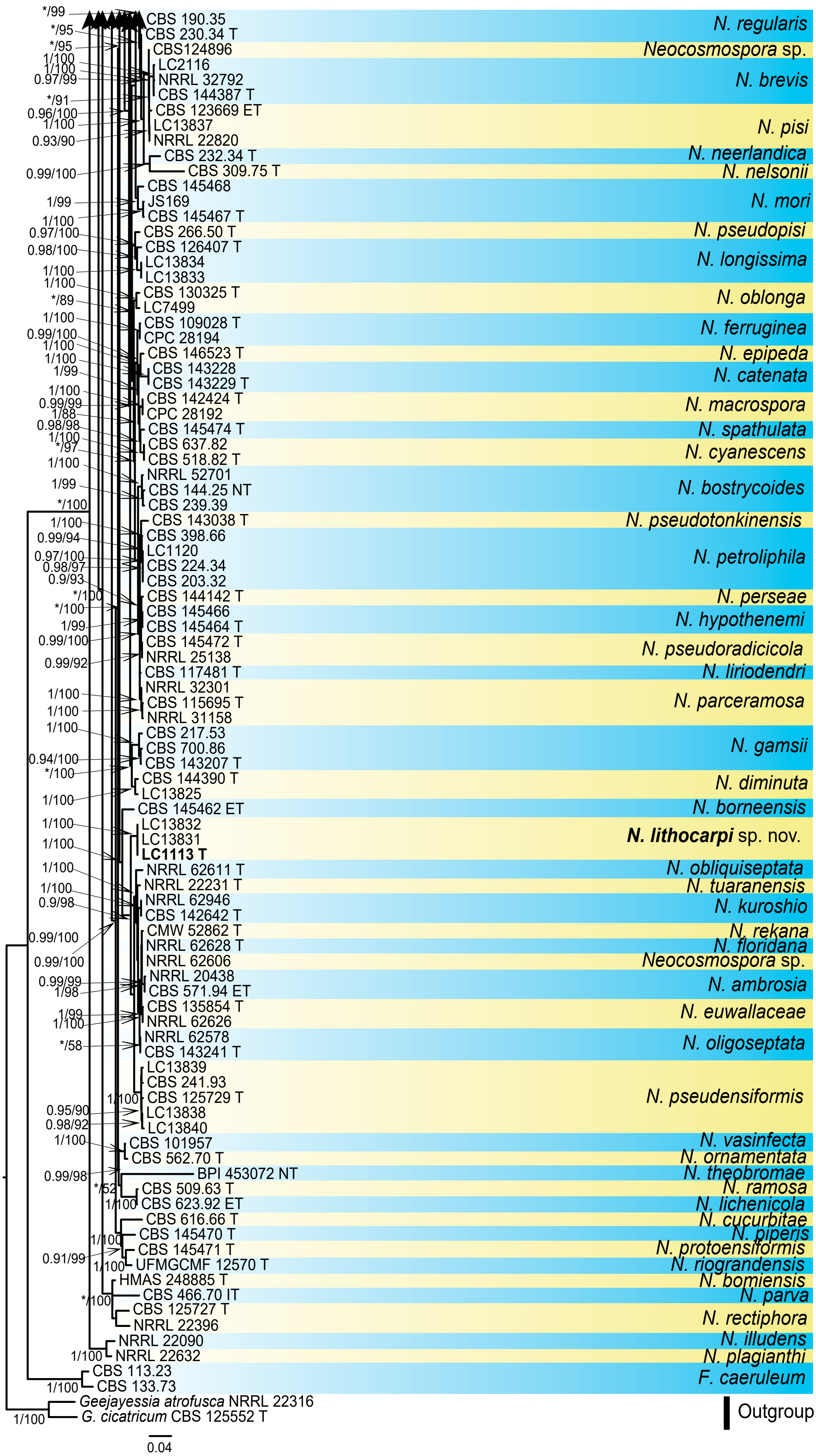


Fig. 10 Fifty percent majority rule consensus tree from a Bayesian analysis based on a three-locus combined dataset (ITS, *tef1*, and *rpb2*) showing the phylogenetic relationships of species within the genus *Neocosmospora*. The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *Geejayessia cicatricum* (CBS 125552) and *G. atrofusca* (NRRL 22316). Ex-type cultures are indicated with 'T', epitype with 'ET'.



CBS 190.35
CBS 230.34 T
N. regularis
CBS124896
Neocosmospora sp.
LC2116
NRRL 32792
CBS 144387 T
N. brevis
CBS 123669 ET
LC13837
NRRL 22820
N. pisi
CBS 232.34 T
N. neerlandica
CBS 309.75 T
N. nelsonii
CBS 145468
JS169
CBS 145467 T
N. mori
CBS 266.50 T
N. pseudopisi
CBS 126407 T
LC13834
LC13833
N. longissima
CBS 130325 T
LC7499
N. oblonga
CBS 109028 T
CPC 28194
N. ferruginea
CBS 146523 T
N. epipeda
CBS 143228
CBS 143229 T
N. catenata
CBS 142424 T
CPC 28192
N. macrospora
CBS 145474 T
N. spathulata
CBS 637.82
CBS 518.82 T
N. cyanescens
NRRL 52701
CBS 144.25 NT
CBS 239.39
N. bostrycoides
CBS 143038 T
N. pseudotonkinensis
CBS 398.66
LC1120
CBS 224.34
CBS 203.32
N. petroliphila
CBS 144142 T
N. perseae
CBS 145466
CBS 145464 T
N. hypothenemi
CBS 145472 T
NRRL 25138
N. pseudoradicicola
CBS 117481 T
N. liriodendri
NRRL 32301
CBS 115695 T
NRRL 31158
N. parceramosa
CBS 217.53
CBS 700.86
CBS 143207 T
N. gamsii
CBS 144390 T
LC13825
N. diminuta
CBS 145462 ET
N. borneensis
LC13832
LC13831
LC1113 T
N. lithocarpi sp. nov.
NRRL 62611 T
N. obliquiseptata
NRRL 22231 T
N. tuaranensis
NRRL 62946
CBS 142642 T
N. kuroshio
CMW 52862 T
N. rekana
NRRL 62628 T
N. floridana
NRRL 62606
Neocosmospora sp.
NRRL 20438
CBS 571.94 ET
N. ambrosia
CBS 135854 T
NRRL 62626
N. euwallaceae
NRRL 62578
CBS 143241 T
N. oligoseptata
LC13839
CBS 241.93
CBS 125729 T
LC13838
LC13840
N. pseudensiformis
CBS 101957
N. vasinfecta
CBS 562.70 T
N. ornamentata
BPI 453072 NT
N. theobromae
CBS 509.63 T
N. ramosa
CBS 623.92 ET
N. lichenicola
CBS 616.66 T
N. cucurbitae
CBS 145470 T
N. piperis
CBS 145471 T
N. protoensiformis
UFMGCMF 12570 T
N. riograndensis
HMAS 248885 T
N. bomiensis
CBS 466.70 IT
N. parva
CBS 125727 T
NRRL 22396
N. rectiphora
NRRL 22090
N. illudens
NRRL 22632
N. plagianthi
CBS 113.23
CBS 133.73
F. caeruleum
Geejayessia atrofusca NRRL 22316
G. cicatricum CBS 125552 T
Outgroup
0.04

Fig. 10 (cont.)

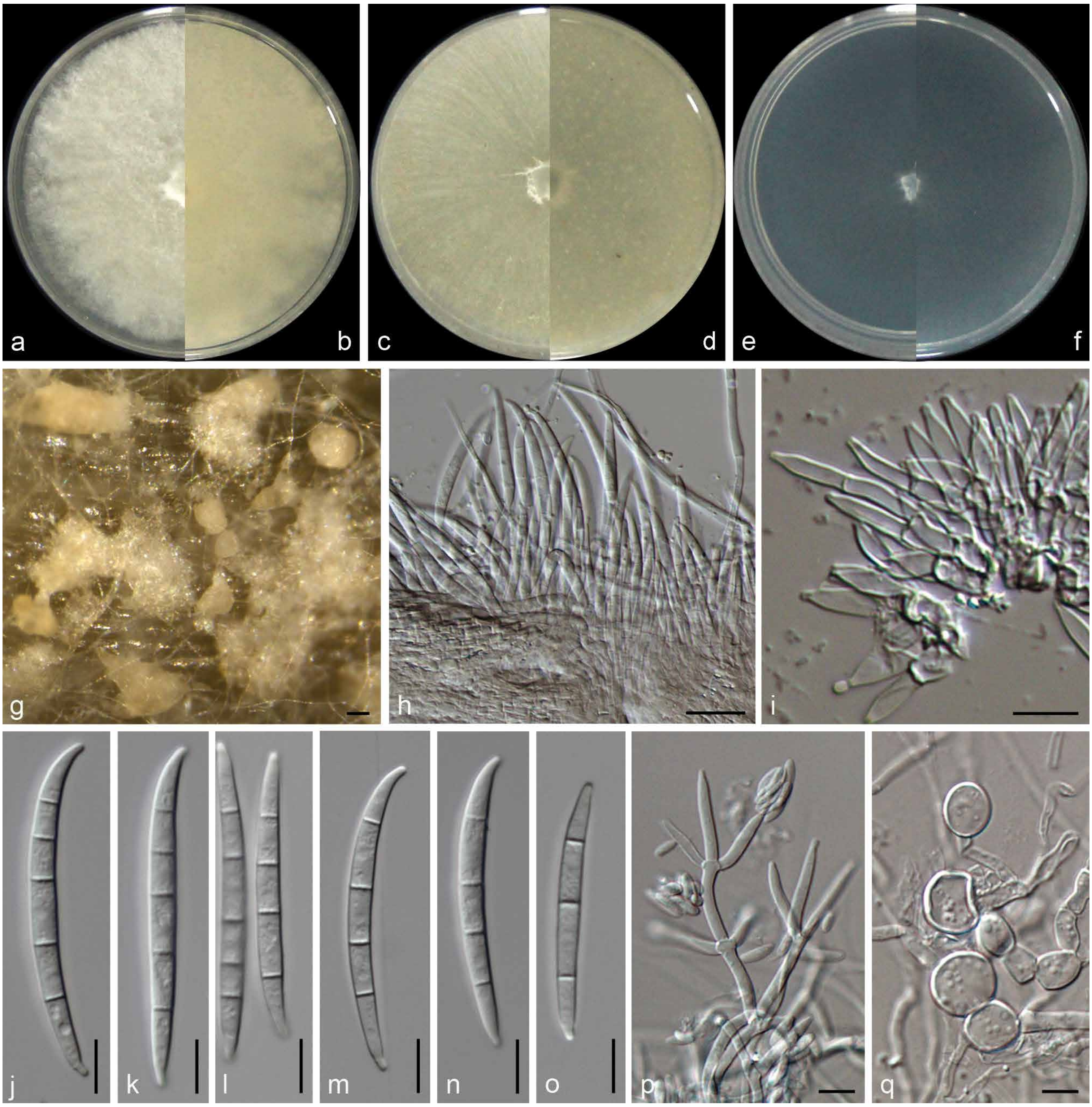


Fig. 11 *Fusarium bambusarum* (ex-type culture LC7180). a, b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA: e–f. colony on SNA; e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochia on carnation leaves; h–i. conidiophores and phialides on sporodochia; j–o. sporodochial conidia (macroconidia); p. conidiophores and phialides on aerial mycelium; q. chlamydospores. — Scale bars: g = 50 µm; h = 20 µm; i–q = 10 µm.

6.1 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin entire, surface and reverse white. Colonies on SNA grown in the dark reaching 5.2–5.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, surface and reverse white. Pigment and odour absent. *Sporodochia* golden yellow (5B7), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed, consisting of a smooth- and thin-walled stipe, 14–17 × 5–6 µm, bearing apical pairs or whorls of 3 monophialides; *sporodochial phialides* subulate to subcylindrical, 15–21 × 3–5 µm, smooth- and thin-walled, sometimes showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, slender, slightly curved with almost parallel sides tapering slightly towards both ends, with a papillate to hooked apical cell and a barely notched to distinctly notched basal cell, 3–5-septate, hyaline, smooth- and thin-walled; 3-septate conidia: (39.4–)41.2–47(–49.3) × 3.4–4.5 µm (av. ± sd. 44.6 ± 2.4 × 3.9 ± 0.6 µm); 4-septate conidia: (42.3–)44–49.6(–51.7) × 3.6–4.5 µm (av. ± sd. 47 ± 1.7 × 4.1 ± 0.4 µm); 5-septate conidia: (50.9–)51.3–53.2(–53.5) × 3.7–4.5 µm (av. ± sd. 52.2 ± 0.8 × 4.2 ± 0.3 µm). *Conidiophores* borne on aerial mycelia 30–50 µm tall, unbranched, polyphialides or monophialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 30–40 × 3–5 µm; *aerial microconidia* forming small false heads on tips of mono- and polyphialides, hyaline, oval or obovoid with a truncate base, smooth- and thin-walled, aseptate, (6–)6.5–11(–12) × 2.6–3.5 µm (av. ± sd. 7.9 ± 1.4 × 3.1 ± 0.4 µm). *Chlamydospores* intercalary, almost globose, slight rough, thick-walled, hyaline, aseptate, 4.3–5.1 µm diam (av. ± sd. 4.7 ± 0.3).

Additional material examined. Japan, intercepted and isolated at Ningbo Customs, from *Camellia sasanqua* imported to China, Mar. 2014, *W.J. Duan*, LC13611 (= F058).

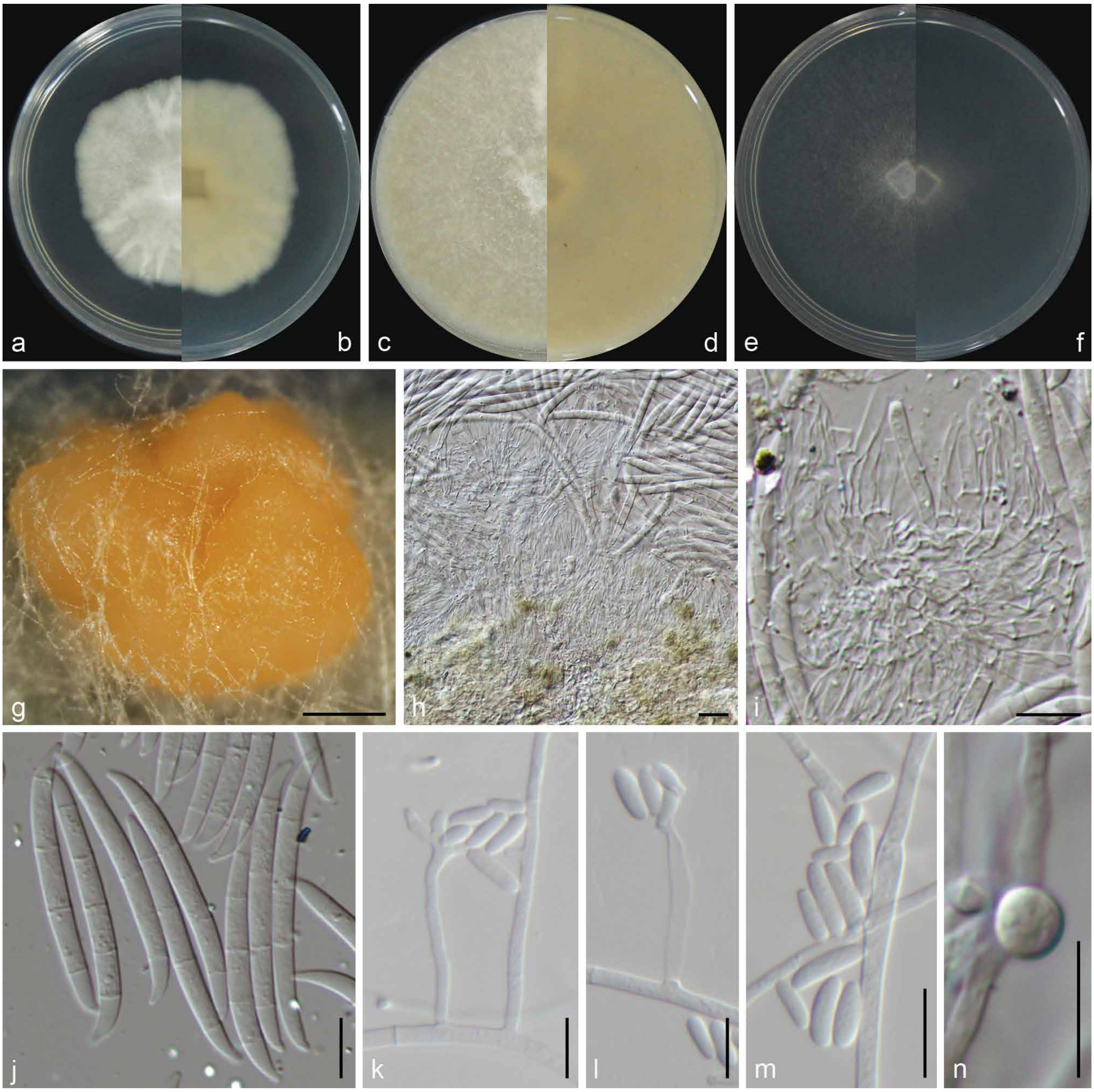


Fig. 12 *Fusarium falsibabinda* (ex-type culture LC13610). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochium on carnation leaves; h–i. conidiophores and phialides on sporodochia; j. sporodochial conidia (macroconidia); k–l. phialides on aerial mycelium; m. aerial conidia (microconidia); n. chlamydospores. — Scale bars: g = 50 μm; h = 20 μm; i–n = 10 μm.

Notes — Several strains isolated from soil in China (NRRL 25539, NRRL 53467, and NRRL 53470), and *Camellia sasanqua* and *Podocarpus macrophyllus* from Japan (LC13610 and LC13611), clustered as a distinct clade near the *F. concolor* complex (Fig. 2). This clade was recognised as *F. babinda* by Jacobs-Venter et al. (2018) and Sandoval-Denis et al. (2018a), with NRRL 25539 (= CBS 396.96) as the representative isolate. However, based on the ex-type isolate of *F. babinda* (BBA 69872 = F11217 = NRRL 25807) designated in Summerell et al. (1995), Crous et al. (2021) confirmed that *F. babinda* clustered in the *F. fujikuroi* complex, distant from the clade encompassing NRRL 25539. In this paper, we introduce a new species, *F. falsibabinda*, to represent this previously incorrectly named clade (Fig. 2). Based on morphology, *F. falsibabinda* is distinct from *F. babinda* in the sporodochia colour (golden yellow in *F. falsibabinda* vs pale orange in *F. babinda*), macroconidial size (39.4–53.5 × 3.4–4.5 μm in *F. falsibabinda* vs 32–72 × 4–6 μm in *F. babinda*), type of conidiophores (polyphialides or monophialides in *F. falsibabinda* vs monophialides in *F. babinda*), and shape and septation of microconidia (oval or obovoid with a truncate base, aseptate in *F. falsibabinda* vs fusiform, 0–1-septate in *F. babinda*) (Summerell et al. 1995, Leslie & Summerell 2006). Phylogenetically, *F. falsibabinda* is closest to an undescribed *Fusarium* species (represented by NRRL 25533), with both taxa residing in the *F. falsibabinda* species complex (Fig. 2).

Fusarium fujikuroi species complex

Fusarium aquaticum M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842154; Fig. 13

Etymology. Refers to its habitat, water, from which the holotype was isolated.

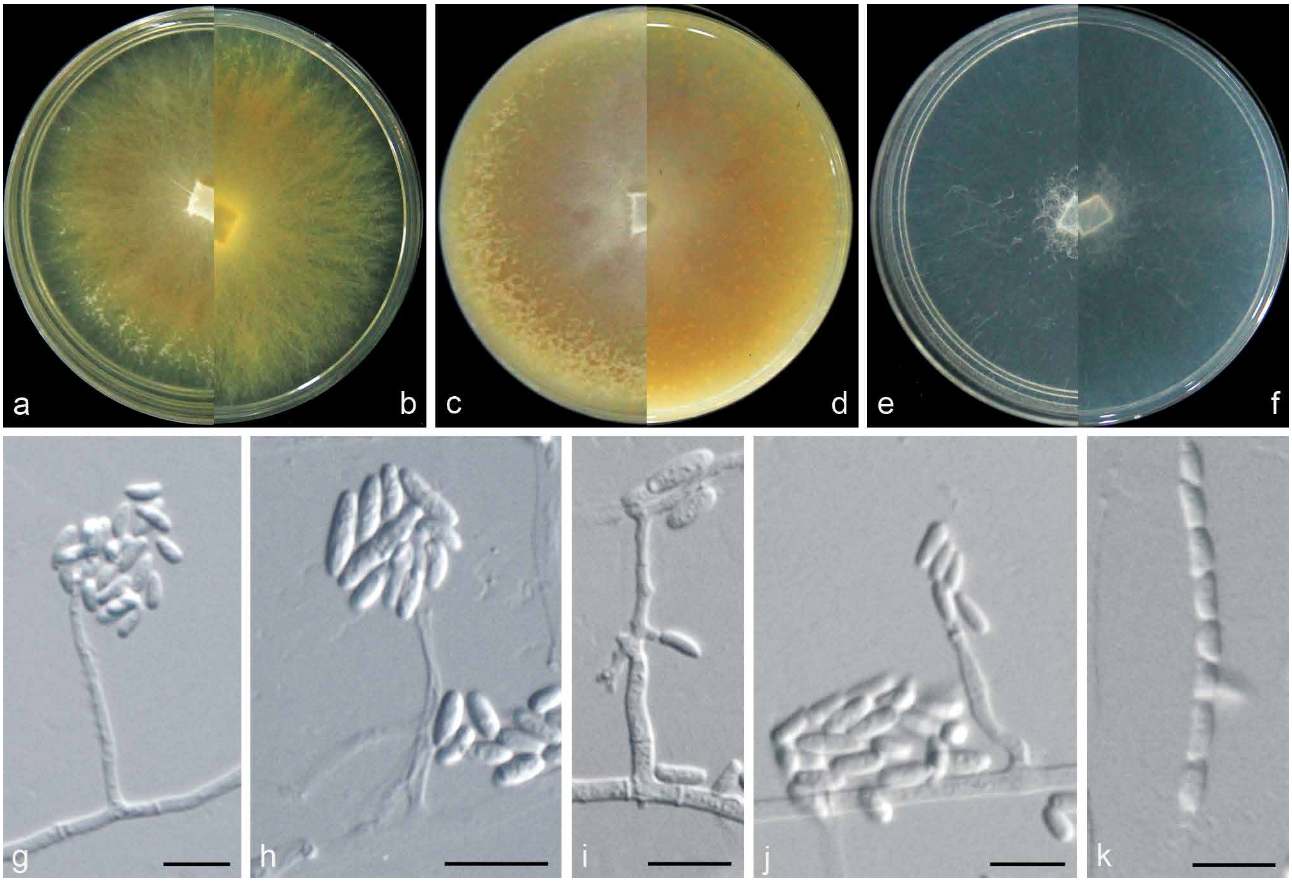


Fig. 13 *Fusarium aquaticum* (ex-type culture LC7502). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g–j. conidiophores and phialides on aerial mycelium; k. aerial conidia. — Scale bars: g–k = 10 μm.

Typus. China, Guizhou Province, Zunyi city, from water, May 2015, *L. Cai*, *Z.F. Zhang*, *X. Zhou* & *J.R. Jiang* (HMAS 351577, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20819 = LC7502).

Colonies on PDA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin filamentous to erose, filiform, surface pastel yellow (2A4) in the centre, white at the margin; reverse pastel yellow (2A4). Colonies on OA grown in the dark reaching 5.8–6.2 cm diam after 7 d at 25 °C, flat, aerial mycelia dense, colony margin entire, surface and reverse pastel yellow (3A4). Colonies on SNA grown in the dark reaching 5.4–5.7 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* not observed. *Conidiophores* borne on aerial mycelia 30–50 μm tall, unbranched or rarely branched, bearing terminal or intercalary mono- or polyphialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 2–23 × 2.5–3 μm, periclinal thickening inconspicuous or absent; *aerial microconidia* single, forming short chains or small false heads on tips of mono- and polyphialides, hyaline, ovoid, ellipsoid to reniform, smooth- and thin-walled, aseptate, (4–)4.1–11.9(–12.7) × 1.6–3.7 μm (av. ± sd. 6.9 ± 2 × 2.6 ± 0.5 μm). *Chlamydospores* not observed.

Additional material examined. China, Guizhou Province, Zunyi city, from water, May 2015, *L. Cai*, *Z.F. Zhang*, *X. Zhou* & *J.R. Jiang*, LC13615; ibid., LC13616.

Notes — *Fusarium aquaticum* is phylogenetically closely related to *F. udum* (Fig. 3), but differs by 68 bp in the five loci dataset. Morphologically, *F. aquaticum* is distinct from *F. udum* in the type of aerial phialides (polyphialides or monophialides in *F. aquaticum* vs monophialides in *F. udum*), shape and septation of aerial microconidia (ovoid, ellipsoid to reniform, aseptate in *F. aquaticum* vs fusoid to reniform or ovoid 0–1-septate in *F. udum*) (Leslie & Summerell 2006).

Fusarium elaeagni M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842155; Fig. 14

Etymology. Named after the host genus of the type specimen, *Elaeagnus*.

Typus. China, Jiangsu Province, Suzhou city, from *Elaeagnus pungens*, Nov. 2017, *Q. Chen* (HMAS 351578, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20822 = LC13627 = CQ1053).

Colonies on PDA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin erose, surface and reverse white. Colonies on OA grown in the dark, reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin entire, surface and reverse white. Colonies on SNA grown in the dark reaching 5.5–5.8 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, surface and reverse white. Pigment and odour absent. *Sporodochia* greyish orange (2C3), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed; *sporodochial phialides* subulate to subcylindrical, 13–17 × 3–4 μm, smooth- and thin-walled. *Sporodochial macroconidia* slender, falcate, slightly curved with almost parallel sides tapering slightly towards both ends, with a papillate to hooked, curved apical cell and a blunt to foot-like basal cell, 3–4-septate, hyaline, smooth- and thin-walled, (21–)23.5–35.8(–37) × 2.5–3.7 μm (av. ± sd. 30.7 ± 4.1 × 3.1 ± 0.9 μm). *Conidiophores* borne on aerial mycelia 20–40 μm tall,

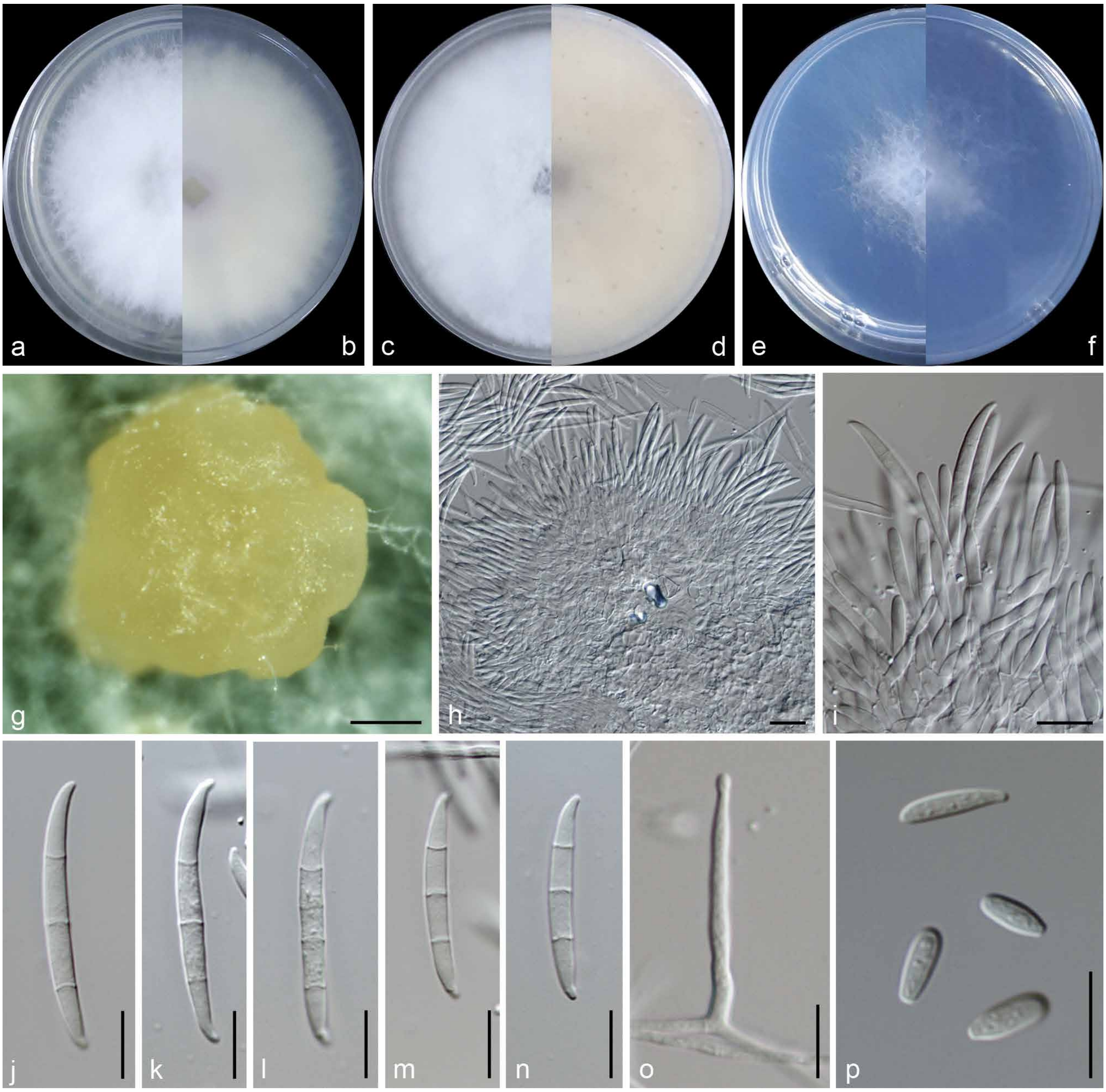


Fig. 14 *Fusarium elaeagni* (ex-type culture LC13627). a–b. Colony on PDA; a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochium on carnation leaves; h–i. conidiophores and phialides on sporodochia; j–n. sporodochial conidia (macroconidia); o. conidiophores and phialides on aerial mycelium; p. aerial conidia. — Scale bars: g = 50 μm; h = 20 μm; i–q = 10 μm.

often reduced to single mono- or polyphialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 20–29 × 2–3 μm; *aerial microconidia* forming small false heads on tips of mono- and polyphialides, hyaline, ellipsoid to falcate, rarely club-shaped, smooth- and thin-walled, 0–1-septate; aseptate conidia: (5–)6–9(–11) × 1.7–4.2 μm (av. ± sd. 6.9 ± 1.1 × 2.4 ± 0.5 μm); 1-septate conidia: (8–)9–17.5(–20) × 2.1–4.2 μm (av. ± sd. 13.5 ± 2.8 × 2.8 ± 0.5 μm). *Chlamydospores* not observed.

Additional material examined. China, Jiangsu Province, Suzhou city, from *Elaeagnus pungens*, Nov. 2017, *Q. Chen*, LC13628 (= CQ1053.2); ibid., LC13629 (= CQ1053.3).

Notes — This species is phylogenetically closely related to *F. fujikuroi*, but differs by 112 bp in the five loci dataset (Fig. 3). Morphologically, *F. elaeagni* is distinguished in sporodochial colour (greyish orange in *F. elaeagni* vs orange in *F. fujikuroi*), macroconidial septa (3–4-septate in *F. elaeagni* vs 3–5-septate in *F. fujikuroi*), microconidial shape (ellipsoidal to falcate, rarely club-shaped in *F. elaeagni* vs ovoid or club-shaped in *F. fujikuroi*), and the type of aerial phialides (mono- or polyphialides in *F. elaeagni* vs polyphialides commonly in *F. fujikuroi*) (Nirenberg 1976, Leslie & Summerell 2006).

Fusarium hechiense M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842156; Fig. 15

Etymology. Named after the location of the type specimen, Hechi city.

Typus. China, Guangxi Zhuang Autonomous Region, Hechi city, Sanwang country, from *Musa nana*, June 2017, *M.M. Wang* (HMAS 351579, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20824 = LC13644 = GXHCSWL14-E1).

Colonies on PDA grown in the dark reaching 5.3–5.6 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin erose, surface white; reverse yellowish white (4A2) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense,

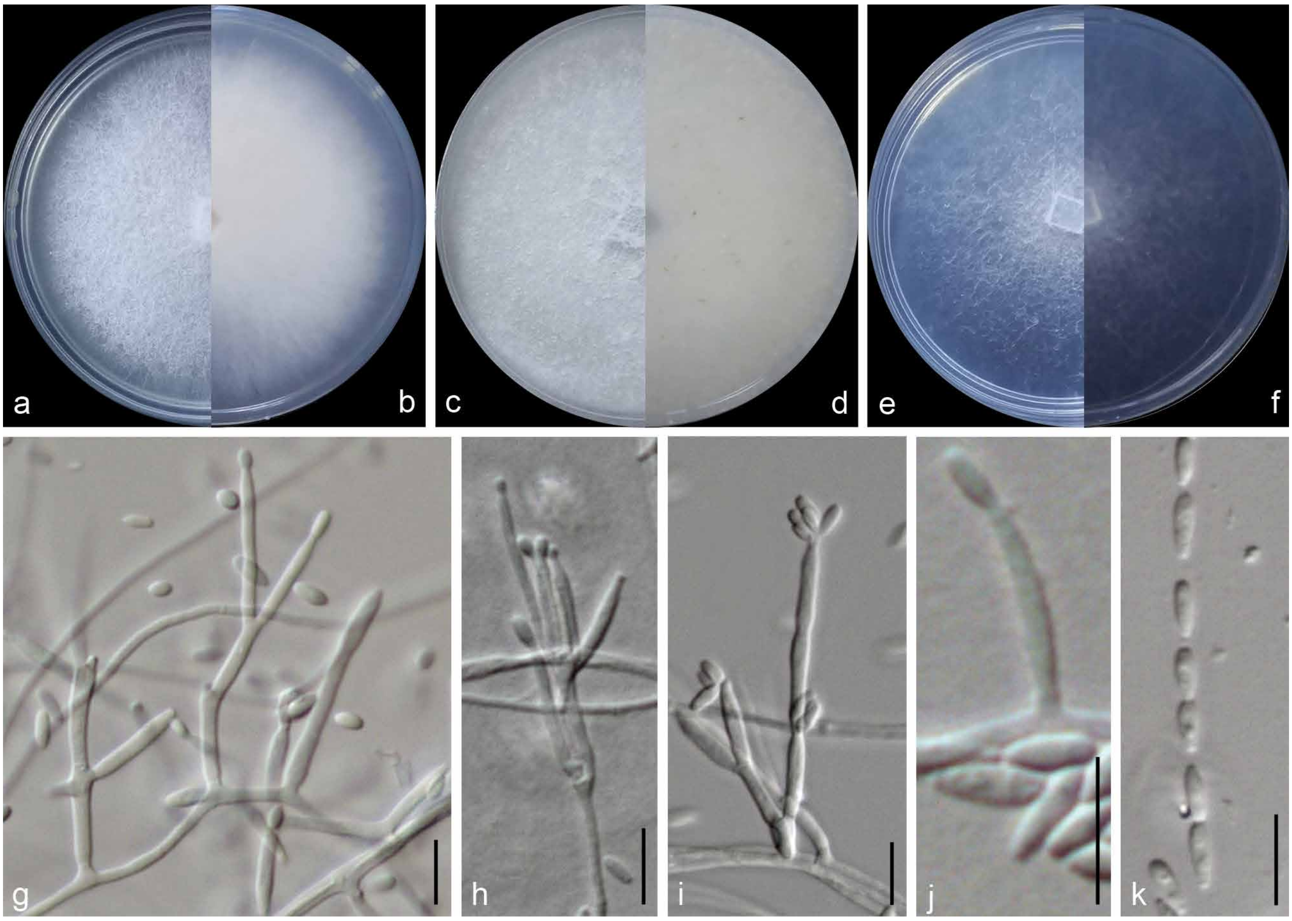


Fig. 15 *Fusarium hechiense* (ex-type culture LC13644). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g–j. conidiophores and phialides on aerial mycelium; k. aerial conidia. — Scale bars: g–k = 10 μm.

colony margin entire, surface and reverse white. Colonies on SNA grown in the dark reaching 5.5–5.8 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* not observed. *Conidiophores* borne on aerial mycelia 15–90 μm tall, unbranched or sparingly branched, bearing terminal or intercalary monophialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 15–21 × 2–4 μm, periclinal thickening inconspicuous or absent; *aerial microconidia* forming small false heads or chains on tips of monophialides, hyaline, subglobose, oval, reniform or obovoid with a truncate base, ellipsoidal, smooth- and thin-walled, 0–1-septate, (5–)5.2–10 × 1.8–3.5 μm (av. ± sd. 6.9 ± 1.2 × 2.6 ± 0.4 μm). *Chlamydospores* not observed.

Additional material examined. China, Guangxi Zhuang Autonomous Region, Hechi city, Sanwang country, from *Musa nana*, June 2017, *M.M. Wang*, LC13645 (= GXHCSWL14-E12; ibid., LC13646 (= GXHCSWL14-E13).

Notes — *Fusarium hechiense* is phylogenetically closely related to *F. annulatum* (Fig. 3), but differs by 143 bp in the five loci dataset. Morphologically, the two species are distinguished in the number of microconidial septa (0–1-septate in *F. hechiense* vs aseptate in *F. annulatum*) (Leslie & Summerell 2006).

Fusarium panlongense M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842157; Fig. 16

Etymology. Name refers to the location of the type specimen, Panlong country.

Typus. China, Guangxi Zhuang Autonomous Region, Guilin city, Panlong country, from *Musa nana*, June 2017, *M.M. Wang* (HMAS 351580, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20825 = LC13656 = GXGLPLL15E2).

Colonies on PDA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin filamentous, erose to filiform, surface white; reverse grey (3B1) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.0–5.5 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin entire, surface white; reverse orange grey (6B2) to brownish grey (6C2) in the centre, white at the margin. Colonies on SNA grown in the dark reaching 5.2–5.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* brownish orange (5C4), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed; *sporodochial phialides* subulate to subcylindrical, 9–17 × 3–4 μm, smooth- and thin-walled. *Sporodochial macroconidia* slender, falcate, slightly curved with almost parallel sides tapering slightly towards both ends, with a papillate to hooked, curved apical cell and a blunt to foot-like basal cell, (3–)4–5-septate, hyaline, smooth- and thin-walled; 3-septate conidia: (35–)37.4–49.7(–50.1) × 2.7–4.4 μm (av. ± sd. 41.7 ± 3.7 × 3.6 ± 0.5 μm); 4-septate conidia: (39.3–)40.3–53(–53.9) × 2.5–5.9 μm (av. ± sd. 48.4 ± 3.7 × 4 ± 0.6 μm); 5-septate conidia: (42.9–)46.1–57.5(–59.4) × 2.6–5.1 μm (av. ± sd. 51.4 ± 3.9 × 4 ± 0.6 μm). *Conidiophores* borne on aerial mycelia often reduced to single monophialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 10–50 × 2–4 μm, periclinal thickening inconspicuous or absent; *aerial microconidia* forming small false heads on tips of monophialides, hyaline, ovoid, reniform, ellipsoid, smooth- and thin-walled, 0–1-septate; aseptate conidia: (4.3–)4.8–7.6(–8) ×

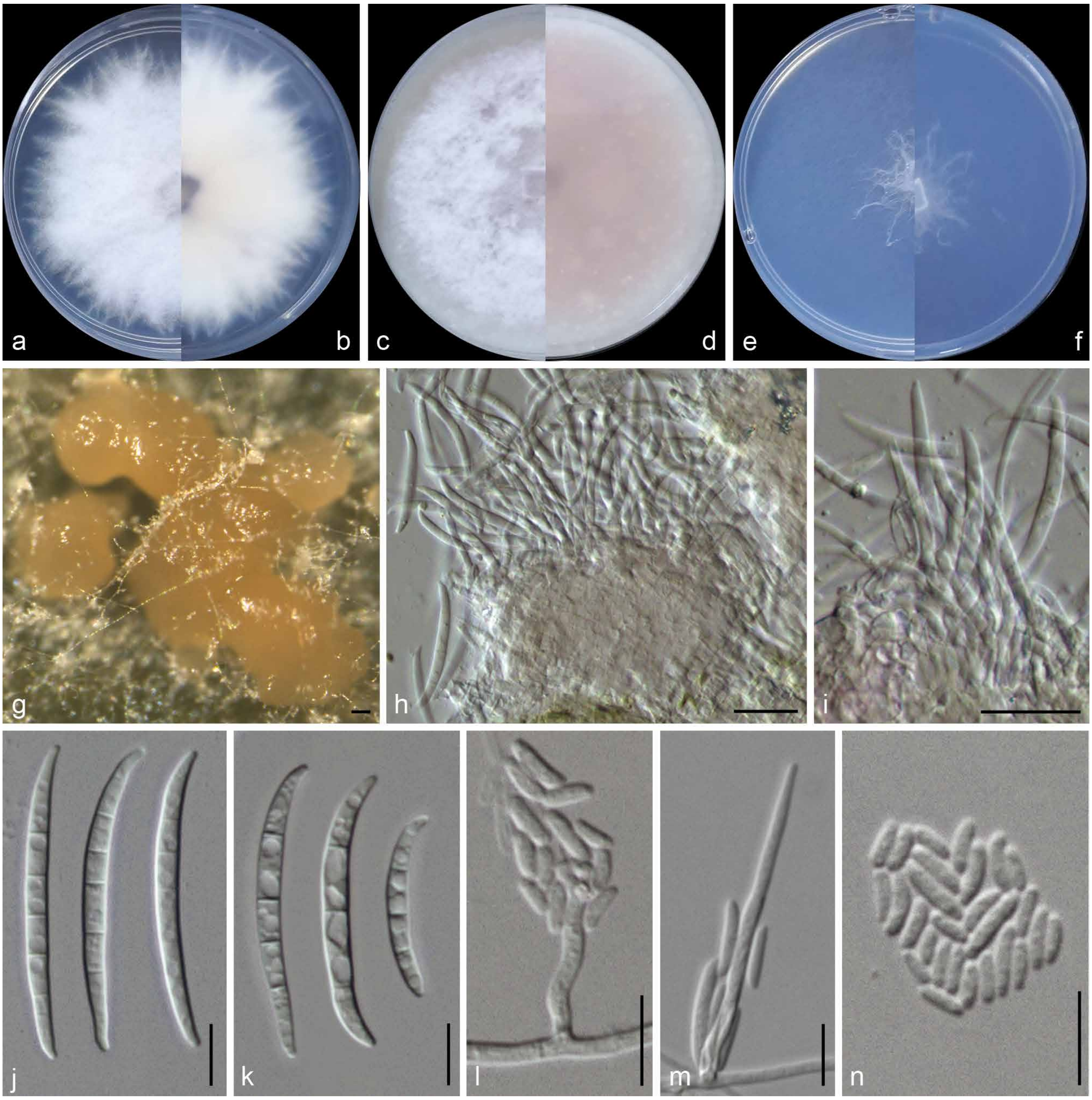


Fig. 16 *Fusarium panlongense* (ex-type culture LC13656). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochia on carnation leaves; h–i. conidiophores and phialides on sporodochia; j–k. sporodochial conidia (macroconidia); l–m. phialides on aerial mycelium; n. aerial conidia (microconidia). — Scale bars: g = 50 µm; h–i = 20 µm; j–n = 10 µm.

1.5–2.7 µm (av. ± sd. 6 ± 0.7 × 2.1 ± 0.3 µm); 1-septate conidia: (7.3–)8.2–14(–16.5) × 2–3.4 µm (av. ± sd. 10.7 ± 2 × 2.7 ± 0.3 µm). *Chlamydospores* not observed.

Notes — Phylogenetically, *F. panlongense* is well separated from known species in the FFSC, and clustered basally to several species in the Asian clade of the FFSC (Fig. 3). To date all known isolates of this species were isolated from *Musa* spp. in China (isolates MUCL 55954, MUCL 55958, and MUCL 55950 from Hainan Province), suggesting a possible preference in host and geography. Species in the FFSC are common in *Musa* spp. hosts, e.g., *F. concentricum*, *F. lumajangense*, *F. musae*, *F. sacchari*, and *F. verticillioides* were recovered from *Musa* spp. from Costa Rica, Guatemala, Honduras, Indonesia, Mexico (Yilmaz et al. 2021). *Fusarium panlongense* was distinguished from *F. concentricum* in the width of macroconidia, type of aerial phialides and shape of aerial microconidia (macroconidia width 2.7–5.9 µm, monophialides, microconidia oval, reniform, ellipsoidal in *F. panlongense* vs macroconidia width 3.5–4 µm mono- and polyphialides, microconidia obovoid or ovoid to allantoid in *F. concentricum*) (Nirenberg & O'Donnell 1998), from *F. lumajangense* in the size of microconidia (4.3–14 × 1.5–3.4 µm in *F. panlongense* vs 6–23 × 2–5 µm in *F. lumajangense*) (Maryani et al. 2019b), from *F. musae* in the presence of sporodochia and macroconidia (absent in *F. musae*) and shape and size of aerial microconidia (ovoid, reniform, ellipsoid, 4.3–14 × 1.5–3.4 µm in *F. panlongense* vs claviform or ellipsoid, often truncated, 5–17 × 1.5–4 µm in *F. musae*) (Van Hove et al. 2011), from *F. sacchari* in the septation of conidia (macroconidia 3–5-septate, microconidia 0–1-septate in *F. panlongense* vs macroconidia usually 3-septate, microconidia 0–2-septate in *F. sacchari*) (Leslie & Summerell 2006), and from *F. verticillioides* in the shape and septation of microconidia (oval, reniform, ellipsoidal, 0–1-septate in *F. panlongense* vs ovoid to club-shaped with a flattened base, usually aseptate in *F. sacchari*) (Leslie & Summerell 2006).

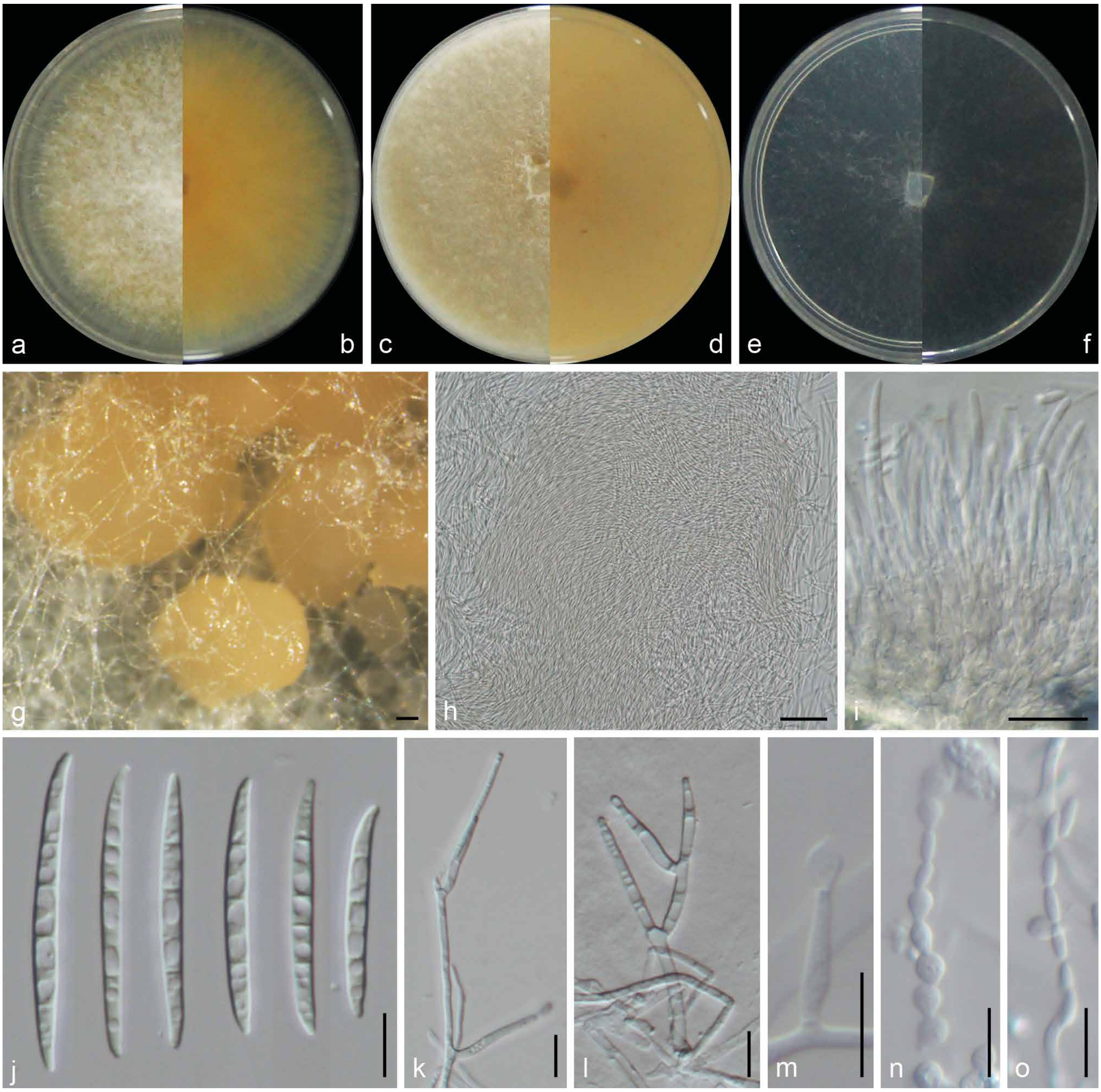


Fig. 17 *Fusarium paranisikadoi* (ex-type culture LC2800). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g–h. sporodochia on carnation leaves; i. conidiophores and phialides on sporodochia; j. aerial conidia (macroconidia); k–m. phialides on aerial mycelium (microconidia); n. aerial conidia (napiform microconidia); o. aerial conidia (ovoid microconidia). — Scale bars: g–h = 50 µm; i = 20 µm; j–o = 10 µm.

Fusarium nisikadoi species complex

Fusarium paranisikadoi M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842158; Fig. 17

Etymology. Named after its morphological similarity to *Fusarium nisikadoi*.

Typus. China, Beijing, Beijing Botanical Garden, from unidentified grass, July 2010, *W. Sun* (HMAS 351581, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20826 = LC2800).

Colonies on PDA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin erose, surface greyish orange (5B3) in the centre, white at the margin; reverse greyish orange (5B4) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.9–6.2 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin entire, surface orange grey (5B2) in the centre, white at the margin; reverse greyish orange (5B4) in the centre, white at the margin. Colonies on SNA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* greyish orange (5B3), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed, consisting of a short, smooth- and thin-walled stipe, 11–17 × 2–5 µm, bearing an apical pair or whorls of three monophialides; *sporodochial phialides* subulate to subcylindrical, 9.2–14.6 × 2.4–3.8 µm, smooth- and thin-walled, sometimes showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, slightly curved with almost parallel sides tapering slightly towards both ends, with a blunt to papillate, slightly curved apical cell and a blunt to distinctly notched basal cell, 3–4-septate, hyaline, smooth- and thin-walled; 3-septate conidia: (36.7–)39.4–50.3(–51.6) × 2.3–4.1 µm (av. ± sd. 45.7 ± 3.5 × 3.1 ± 0.4 µm); 4-septate conidia: (42.8–)43.1–56.3(–57.6) × 2.5–5.2 µm (av. ± sd.

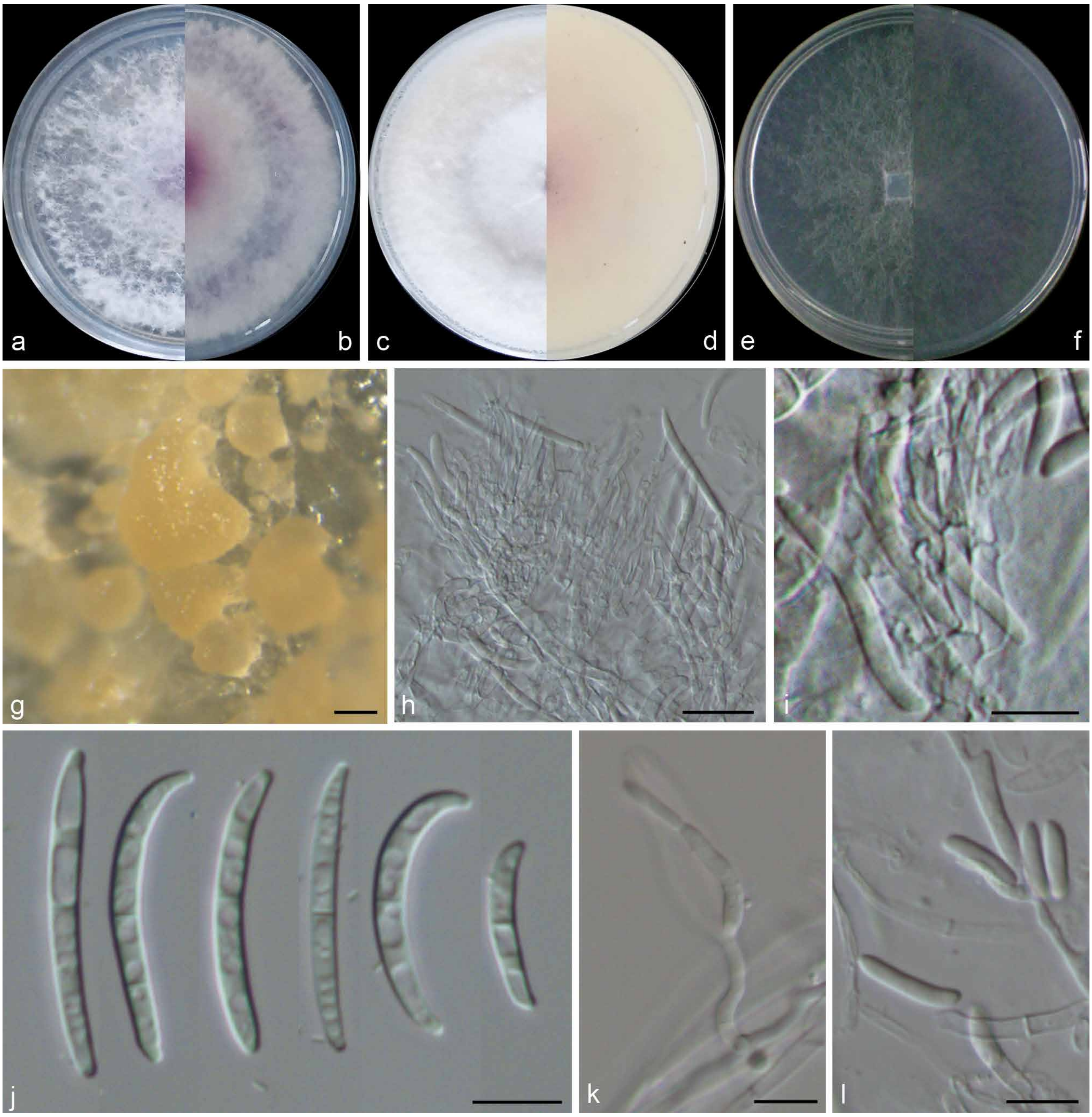


Fig. 18 *Fusarium alpinum* (ex-type culture LC6045). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochia on carnation leaves; h–i. conidiophores and phialides on sporodochia; j. sporodochial conidia (macroconidia); k. phialides on aerial mycelium; l. aerial conidia (microconidia). — Scale bars: g = 50 µm; h = 20 µm; i–l = 10 µm.

50.2 ± 3.5 × 3.8 ± 0.6 µm). *Conidiophores* borne on aerial mycelia, 15–80 µm tall, unbranched or sparingly branched, bearing terminal or intercalary monophialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 15–25 × 2–4 µm, periclinal thickening inconspicuous or absent; *aerial microconidia* forming chains on the tips of the monophialides, hyaline, oval, pyriform to napiform, smooth- and thin-walled, aseptate; ovoid conidia: (3.5–)4.5–7.2(–7.7) × 1.5–3.2 µm (av. ± sd. 5.8 ± 0.9 × 2.2 ± 0.4 µm); pyriform to napiform conidia: (4.7–)5.2–8(–8.1) × 3.4–6.3 µm (av. ± sd. 6.4 ± 0.8 × 4.5 ± 0.6 µm). *Chlamydospores* not observed.

Additional material examined. China, Beijing, Beijing Botanical Garden, from unidentified grass, July 2010, *Dimuthu*, LC2819; ibid., LC2824; Beijing, Beijing Botanical Garden, from *Pennisetum alopecuroides*, July 2010, *W. Sun*, LC2823.

Notes — *Fusarium paranisikadoi* is phylogenetically closest to *F. miscanthi* and *F. nisikadoi* (Fig. 2), but differs from the latter by 45 bp and 71 bp in the combined *tef1*, *rpb1*, and *rpb2* dataset, respectively. Morphologically, *F. paranisikadoi* differs from *F. miscanthi* in shape, septation, and size of their sporodochial macroconidia (slender, with a slightly foot-shaped basal cell and a curved and gradually tapering apical cell, 3–5-septate, 40–65(–75) × 2.5–4.5 µm in *F. miscanthi* vs falcate, slightly curved with almost parallel sides tapering slightly towards both ends, with a blunt to papillate, slightly curved apical cell and a blunt to distinctly notched basal cell, 3–4-septate, 36.7–57.6 × 2.3–5.2 µm in *F. paranisikadoi*) (Gams et al. 1999), and from *F. nisikadoi* in the size of their sporodochial macroconidia (56–92 × 3.5–4 µm in *F. nisikadoi* vs 36.7–57.6 × 2.3–5.2 µm in *F. paranisikadoi*) (Nirenberg & Aoki 1997).

Fusarium tricinctum species complex

Fusarium alpinum M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842159; Fig. 18

Etymology. Named after the special geographical reference of this species, 'alp'.

Typus. China, Tibet Autonomous Region, from species of *Fabaceae*, June 2015, *L. Cai* (HMAS 351582, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20818 = LC6045).

Colonies on PDA grown in the dark reaching 5.9–6.2 cm diam after 7 d at 25 °C, raised, punctiform, aerial mycelia dense, colony margin undulate, surface purplish grey (14C2) in the centre, white at the margin; reverse reddish lilac (14C5) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin entire, surface white; reverse dull red (9B3) in the centre, white at the margin. Colonies on SNA grown in the dark reaching 5.2–5.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* greyish yellow (4B4**)**, formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed, consisting of a short, smooth- and thin-walled stipe, 9–11 × 3–4 µm, bearing apical whorls of 3 or more monophialides or rarely as single lateral monophialides; *sporodochial phialides* subulate to subcylindrical, 9.3–19.7 × 2–4 µm (av. ± sd. 13.9 ± 2.2 × 3.3 ± 0.4 µm), smooth- and thin-walled, sometimes showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, curved slightly to dorsiventrally with almost parallel sides tapering slightly towards both ends, with a blunt to hooked, curved apical cell and a blunt to distinctly notched basal cell, 1- or 3-septate, hyaline, smooth- and thin-walled; 1-septate conidia: (15.6–)15.7–34.9(–35) × 2.4–4.6 µm (av. ± sd. 26.1 ± 6.3 × 3.3 ± 0.5 µm); 3-septate conidia: (29.2–)30.5–46.3(–48.2) × 2.7–5.1 µm (av. ± sd. 37.8 ± 4.8 × 3.7 ± 0.6 µm). *Conidiophores* borne on aerial mycelia 20–70 µm tall, unbranched or sparingly branched, bearing terminal or intercalary monophialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 16–23 × 2–3 µm, periclinal thickening inconspicuous or absent; *aerial microconidia* forming single on the tips of the monophialides, hyaline, ellipsoidal to falcate, smooth- and thin-walled, 0–1-septate; aseptate conidia: (6.8–)7.8–12.6(–12.8) × 2.2–4.7 µm (av. ± sd. 10.3 ± 1.2 × 3.9 ± 0.4 µm); 1-septate conidia: (12.7–)13.3–19.1(–20.8) × 3.1–5.5 µm (av. ± sd. 16.6 ± 1.8 × 4.4 ± 0.5 µm). *Chlamydospores* not observed.

Additional material examined. China, Yunnan Province, from unidentified plant, Sept. 2011, *F. Liu*, LC2853; ibid., LC2854; Tibet Autonomous Region, from species of *Fabaceae*, June 2015, *L. Cai*, LC6034; ibid., LC6037; ibid., LC6043.

Notes — *Fusarium alpinum* was collected from high altitude areas of Yunnan province and the Tibet Autonomous Region in this study. Phylogenetically, *F. alpinum* is closely related to *F. paeoniae* (Fig. 8), but differs by 44 bp in the three loci dataset. Morphologically, the two species are distinguished in the number of conidial septa (0–1(–3)-septate microconidia, 3–5-septate macroconidia in *F. paeoniae* vs 0–1-septate microconidia, 1- or 3-septate macroconidia in *F. alpinum*).

Fusarium chongqingense M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842160; Fig. 19

Etymology. Named after the location of the type specimen, Chongqing.

Typus. China, Chongqing, Jinfo Mountain, from *Bothrocaryum controversum*, Oct. 2012, *L. Cai* (HMAS 351583, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20821 = LC4957).

Colonies on PDA grown in the dark reaching 4.6–5.1 cm diam after 7 d at 25 °C, umbonate, aerial mycelia dense, colony margin erose, surface pale yellow (4A3) to dull red (8B3) in the centre, white at the margin; reverse brownish red (10C6) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, flat, aerial mycelia dense, colony margin entire, surface white to greyish yellow (4C3) in the centre, white at the margin; reverse brownish orange (5C4) in the centre, white at the margin. Colonies on SNA grown in the dark reaching 5.2–5.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* greyish orange (5B3), formed on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed, bearing apical pairs or whorls of three monophialides or single terminal monophialides; *sporodochial phialides* subulate to subcylindrical, 8–11 × 2–4 µm, smooth- and thin-walled, sometimes showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, curved slightly with almost parallel sides tapering slightly towards both ends, with a blunt apical cell and a blunt basal cell, 1- or 3-septate, hyaline, smooth- and thin-walled; 1-septate conidia: (5.8–)8.7–18.8(–19) × 1.5–4.4 µm (av. ± sd. 13.9 ± 3 × 3.1 ± 0.4 µm); 3-septate conidia: (21–)21.8–31.6(–31.8) × 2.6–5 µm (av. ± sd. 25.7 ± 2.5 × 4 ± 0.4 µm). *Conidiophores* borne on aerial mycelia not observed. *Chlamydospores* not observed.

Additional material examined. China, Chongqing, Jinfo Mountain, from *Bothrocaryum controversum*, Oct. 2012, *L. Cai*, LC13813; ibid., LC13814.

Notes — *Fusarium chongqingense* is phylogenetically closely related to *F. avenaceum*, *F. paeoniae*, and *F. alpinum* (Fig. 8). However, *F. chongqingense* differs by 67 bp from *F. paeoniae*, and 59 bp from *F. alpinum* in the three loci dataset, respectively. Morphologically, *F. chongqingense* is distinct based on the type of apical and basal cells of its macroconidia (blunt apical and basal cell in *F. chongqingense* vs long and tapering to a point to somewhat bent apical cell, and poorly to well-developed foot-shaped basal cell in *F. avenaceum*, blunt to papillate, curved apical cell and a blunt to foot-like basal cell in *F. paeoniae*; and blunt to hooked, curved apical cell and a blunt to distinctly notched basal cell in *F. alpinum*) (Wollenweber & Reinking 1935, Leslie & Summerell 2006).

Fusarium paeoniae M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842161; Fig. 20

Etymology. Named after the host genus of the type specimen, *Paeonia*.

Typus. China, Qinghai Province, from *Paeonia lactiflora*, Aug. 2019, *M.M. Wang* (HMAS 351584, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20817 = LC13817 = YZG12-2).

Colonies on PDA grown in the dark reaching 5.3–5.5 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin entire, surface greyish yellow (3B4) to bluish red (12A3) in the centre, white at the margin; reverse greyish ruby (12E4) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5–5.3 cm diam after 7 d at 25 °C, raised, aerial mycelia dense, colony margin entire, surface greyish yellow (3B4) in the centre, white at the margin; reverse golden brown (5D7) to greyish yellow (3B4) in the centre, white at the margin. Colonies on SNA grown in the dark reaching 4.8–5.3 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* pale orange (5A3) to brownish orange (5C4), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed, consisting of a short, smooth- and thin-walled stipe, 8–10 × 6–8 µm, bearing apical pairs or whorls of three monophialides, or as single lateral

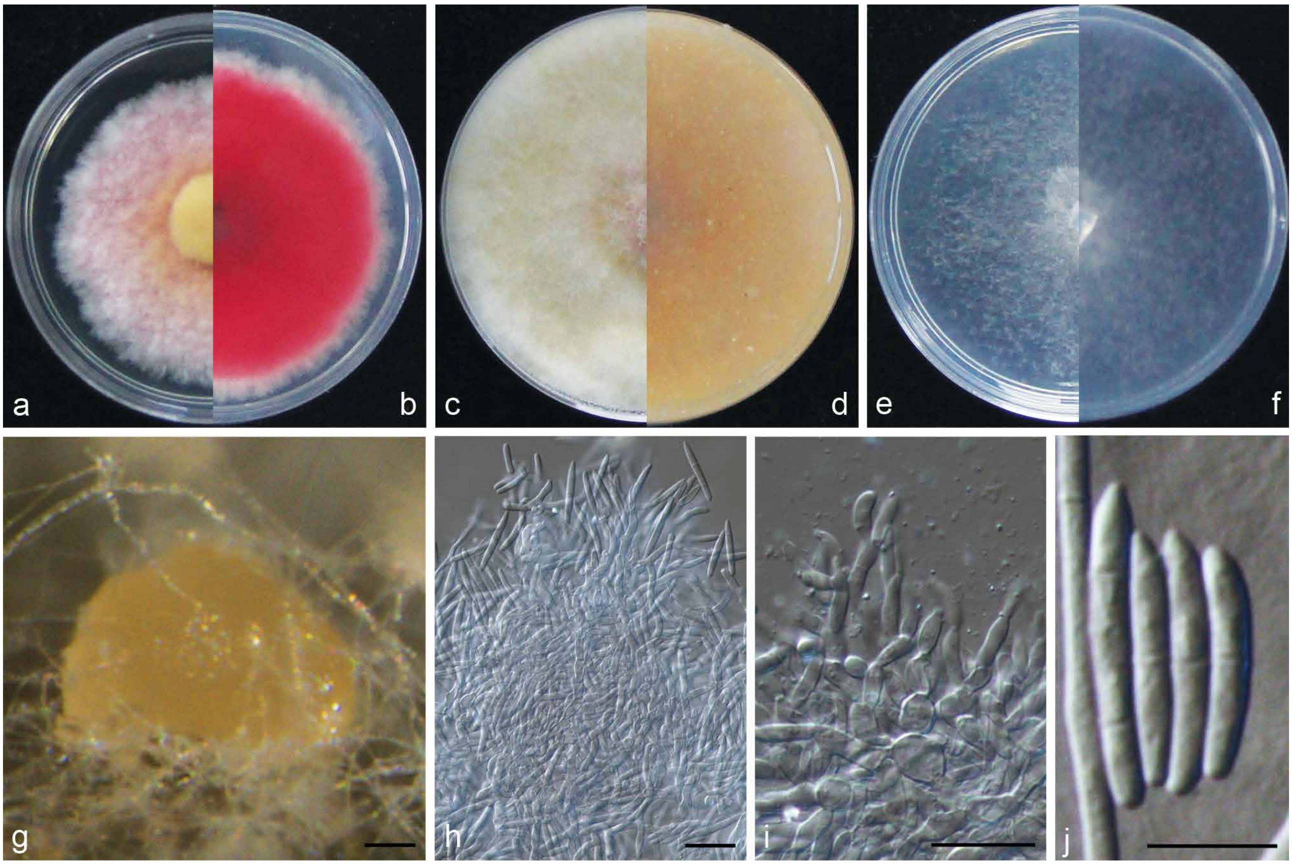


Fig. 19 *Fusarium chongqingense* (ex-type culture LC4957). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochium on carnation leaves; h–i. conidiophores and phialides on sporodochia; j. sporodochial conidia (macroconidia). — Scale bars: g = 50 μm; h–i = 20 μm; j = 10 μm.

monophialides; *sporodochial phialides* subulate to subcylindrical, 6.9–13.3 × 2.2–4.5 μm (av. ± sd. 9.6 ± 1.7 × 3.6 ± 0.5 μm), smooth- and thin-walled, sometimes showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, slightly curved, with a blunt to papillate, curved apical cell and a blunt to foot-like basal cell, 3–5-septate, hyaline, smooth- and thin-walled; 3-septate conidia: (27.6–)28.4–39(–39.4) × 3.8–5.8 μm (av. ± sd. 32.1 ± 3.3 × 4.5 ± 0.5 μm); 4-septate conidia: (30.3–)32.1–41.7(–43) × 3.6–7.1 μm (av. ± sd. 37.9 ± 2.7 × 5 ± 0.8 μm); 5-septate conidia: (39.5–)39.8–50.2(–52.2) × 3.2–5.8 μm (av. ± sd. 45.2 ± 2.8 × 4.7 ± 0.7 μm). *Conidiophores* borne on aerial mycelia often reduced to single phialides, mono- or polyphialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 5–20 × 3–5 μm, periclinal thickening inconspicuous or absent; *aerial microconidia* forming small false heads on the tips of the mono- and polyphialides, hyaline, ellipsoid to falcate, smooth- and thin-walled, 0–1(–3)-septate; aseptate conidia: (6–)7–10(–11) × 2.2–3.6 μm (av. ± sd. 8.6 ± 0.9 × 2.9 ± 0.4 μm); 1-septate conidia: (12.7–)13–15.8(–16.2) × 3.5–4.7 μm (av. ± sd. 14.2 ± 0.8 × 4.1 ± 0.3 μm); 3-septate conidia: (20.2–)21.3–25.2(–25.4) × 3.6–5.7 μm (av. ± sd. 23.4 ± 1.5 × 4.8 ± 0.6 μm). *Chlamydospores* not observed.

Additional material examined. China, Qinghai Province, from *Crataegus monogyna*, Sept. 2013, *Q. Chen*, LC5166; Qinghai Province, from *Elymus dahuricus*, Aug. 2019, *M. Gao*, LC13815 (= GM56); ibid., from *Plantago* sp., LC13807 (= GM123); ibid., from *Gentiana scabra*, LC13810 (= GM65); ibid., LC13812 (= GM85); Qinghai Province, from *Populus* sp., Aug. 2019. *M.M. Wang*, LC13816 (= YZG10-2); Tibet Autonomous Region, from species of *Poaceae*, June 2015, *F. Liu*, LC7358.

Notes — Phylogenetically *F. paeoniae* is closely related to *F. alpinum* (Fig. 8), but differs by 44 bp in the three loci dataset. Morphologically, the two species differ in the number of conidial septa (0–1(–3)-septate microconidia, 3–5-septate macroconidia in *F. paeoniae* vs 0–1-septate microconidia, 1- or 3-septate macroconidia in *F. alpinum*).

Bisifusarium L. Lombard et al., Stud. Mycol. 80: 223. 2015

Bisifusarium aseptatum M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842162; Fig. 21

Etymology. Refers to the aseptate sporodochial conidia.

Typus. China, Guangdong Province, Guangzhou city, from species of *Orchidaceae*, Mar. 2011, *Y.Y. Su* (HMAS 351585, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20816 = LC1075).

Colonies on PDA grown in the dark reaching 1.7–2.1 cm diam after 7 d at 25 °C, flat, aerial mycelia dense, colony margin erose, surface and reverse white. Colonies on OA grown in the dark reaching 0.9–1.1 cm diam after 7 d at 25 °C, flat, aerial mycelia dense, colony margin entire, surface and reverse white. Colonies on SNA grown in the dark reaching 1.2–1.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin filamentous, white; reverse white. Pigment and odour absent. *Sporodochia* white to yellowish white (4A3), formed on carnation leaves. *Conidiophores* in sporodochia forming a smooth- and thin-walled stipe, bearing apical whorls of mostly 3 monophialides; *sporodochial phialides* subulate to subcylindrical, 8–10 × 3–4 μm, smooth- and thin-walled. *Sporodochial macroconidia* oval, reniform, aseptate, hyaline, smooth- and thin-walled; (4.4–)4.5–7(–7.1) × 2.6–4.1 μm (av. ± sd. 5.7 ± 0.7 × 3.3 ± 0.3 μm). *Conidiophores* borne on aerial mycelia, 50–80 μm tall, unbranched, bearing terminal monophialides, sometimes reduced to single phialides; *aerial phialides* subulate to subcylindrical,

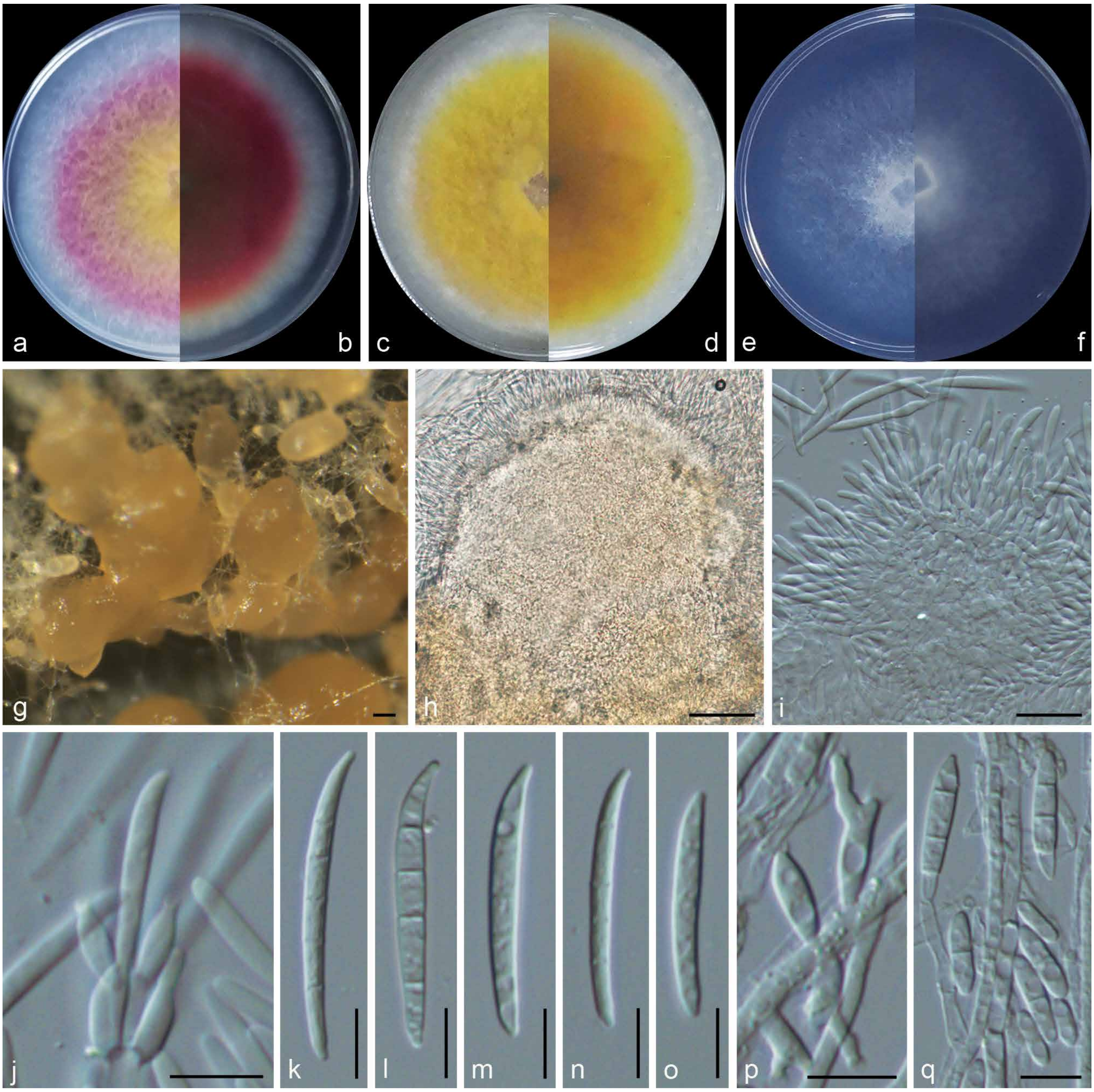


Fig. 20 *Fusarium paeoniae* (ex-type culture LC13817). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g–h. sporodochia on carnation leaves; i–j. conidiophores and phialides on sporodochia; k–o. sporodochial conidia (macroconidia); p. phialides on aerial mycelium; q. aerial conidia (microconidia). — Scale bars: g–h = 50 μm; i–j = 20 μm; k–q = 10 μm.

smooth- and thin-walled, 30–35 × 3–5 μm, periclinal thickening inconspicuous or absent; *aerial microconidia* single or forming small false heads on the tips of the monophialides, hyaline, ovoid, reniform, or obovoid with a truncate base, smooth- and thin-walled, aseptate, (5.2–)5.7–8.8(–9.7) × 2.1–3.8 μm (av. ± sd. 7 ± 0.9 × 2.7 ± 0.3 μm). *Chlamydospores* not observed.

Additional material examined. China, Guangdong Province, Guangzhou city, from species of *Orchidaceae*, Mar. 2011, *Y.Y. Su*, LC13607; ibid., LC13608.

Notes — The genus *Bisifusarium* was established to accommodate several fusarioid species previously included in the *F. dimerum* species complex, with *B. dimerum* as type species (Lombard et al. 2015). Prior to this study eight species were known from the genus (Lombard et al. 2015, Sun et al. 2017). *Bisifusarium aseptatum* is distinct from other *Bisifusarium* species in producing unicellular sporodochial conidia (Lombard et al. 2015).

Neocosmospora E.F. Sm., U.S.D.A. Div. Veg. Pathol. Bull. 17: 45. 1899

Neocosmospora lithocarpi M.M. Wang & L. Cai, *sp. nov.* — MycoBank MB 842163; Fig. 22

Etymology. Named after the host genus *Lithocarpus*, from which the holotype was isolated.

Typus. China, from *Lithocarpus glabra*, May 2011, *W. Sun* (HMAS 351586, holotype designated here, dried culture on SNA with carnation leaves; culture ex-type CGMCC 3.20827 = LC1113).

Colonies on PDA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, flat, aerial mycelia dense, colony margin filamentous to erose, filiform, surface white to greyish yellow (4B3) in the centre, white at the margin; reverse greyish orange (5B3) in the centre, white at the margin. Colonies on OA grown in the dark reaching 5.7–5.9 cm diam after 7 d at 25 °C, flat, aerial mycelia dense, colony margin entire, surface white to yellowish

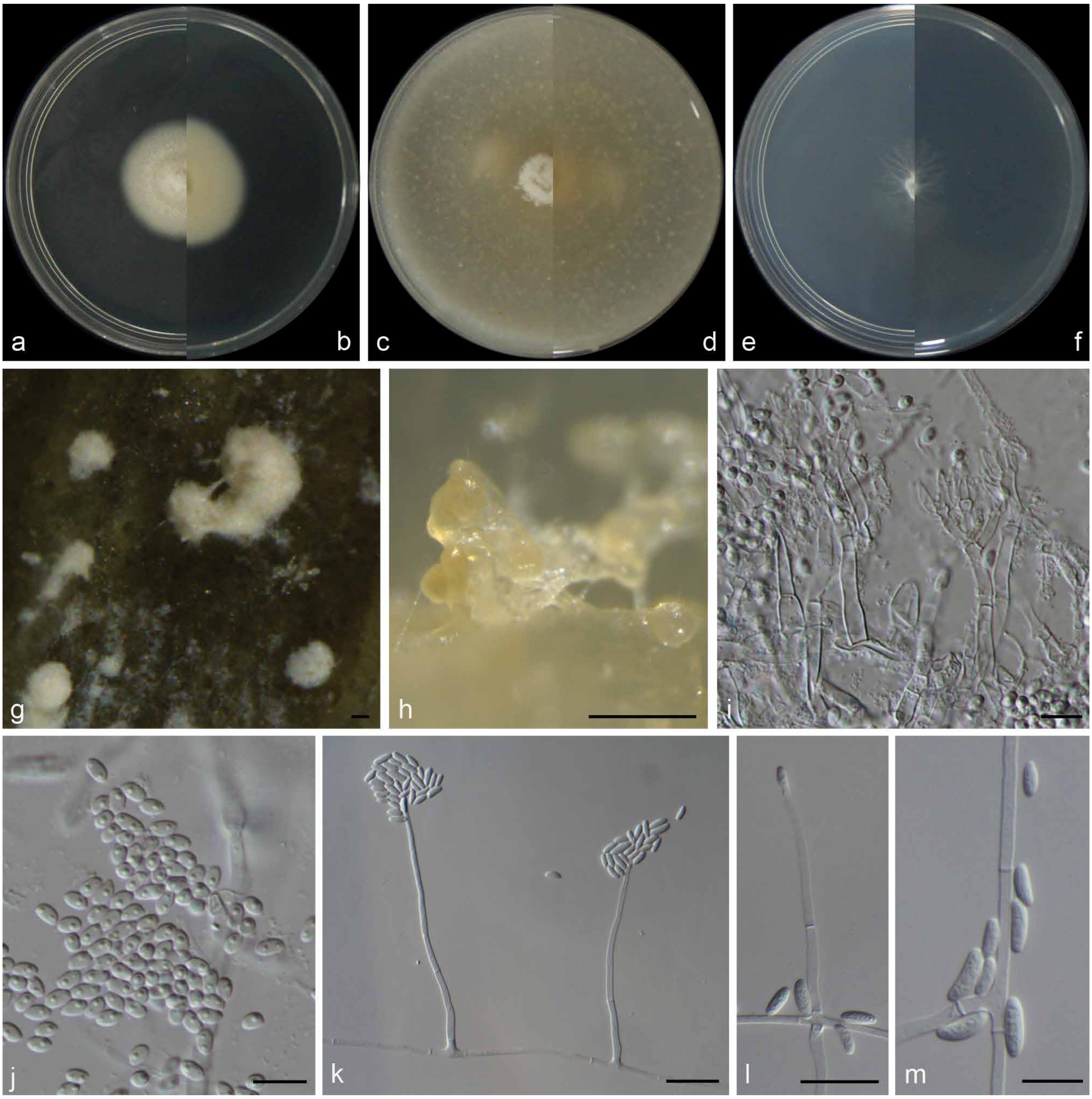


Fig. 21 *Bisifusarium aseptatum* (ex-type culture LC1075). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g–h. sporodochia on carnation leaves; i. conidiophores and phialides on sporodochia; j. sporodochial conidia (macroconidia); k–l. phialides on aerial mycelium; m. aerial conidia (microconidia). — Scale bars: g–h = 50 µm; i–j, m = 10 µm; k–l = 20 µm.

grey (4B2) in the centre, white at the margin; reverse yellowish grey (4B2) in the centre, white at the margin. Colonies on SNA grown in the dark reaching 5.2–5.5 cm diam after 7 d at 25 °C, flat, aerial mycelia scant, colony margin erose, white; reverse white. Pigment and odour absent. *Sporodochia* opaline green (25C6), formed abundantly on carnation leaves. *Conidiophores* in sporodochia verticillately branched and densely packed; *sporodochial phialides* subulate to subcylindrical, 9.9–23.3 × 2.8–6.3 µm (av. ± sd. 14.4 ± 2.7 × 4.0 ± 0.8 µm), smooth- and thin-walled, showing a reduced and flared collarette. *Sporodochial macroconidia* falcate, with a blunt apical and basal cell, 5-septate, hyaline, smooth- and thin-walled, 32.1–57.8 × 3.9–8.1 µm (av. ± sd. 49.6 ± 4.8 × 5.3 ± 0.9 µm). *Conidiophores* borne on aerial mycelia, 20–60 µm tall, unbranched or sparingly branched, bearing terminal or intercalary monophialides, often reduced to single phialides; *aerial phialides* subulate to subcylindrical, smooth- and thin-walled, 20–45 × 2–3 µm; *aerial microconidia* forming small false heads on the tips of the monophialides, hyaline, ellipsoid to falcate, smooth- and thin-walled, 0–1-septate; aseptate conidia: (7–)8.8–11.1(–12) × 3.5–3.9 µm (av. ± sd. 9.9 ± 1 × 3.7 ± 0.2 µm); 1-septate conidia: (12–)12.5–23.8(–24) × 3.6–7 µm (av. ± sd. 16.3 ± 2.8 × 5 ± 0.7 µm). *Chlamydospores* abundant, terminal, ellipsoid, rough, thick-walled, hyaline, aseptate, 6.1–8.7 × 5.3–7.3 µm (av. ± sd. 6.8 ± 0.9 × 5.8 ± 0.7 µm).

Additional material examined. China, from *Lithocarpus glabra*, May 2011, *W. Sun*, LC13831; ibid., LC13832.

Notes — *Neocosmospora lithocarpi* is phylogenetically closely related to *N. ambrosia*, *N. euwallaceae*, *N. kuroshio*, *N. oligoseptata*, and *N. pseudensiformis* (Fig. 10). Morphologically, this species is distinguished in the shape, septum number and length of its sporodochial macroconidia (falcate, 5-septate in *N. lithocarpi*, vs irregularly clavate and swollen conidia present, 3- or 5-septate in *N. ambrosia*, *N. euwallaceae*, *N. kuroshio*, *N. oligoseptata*; 5-septate, 32.1–57.8 µm in *N. lithocarpi*,

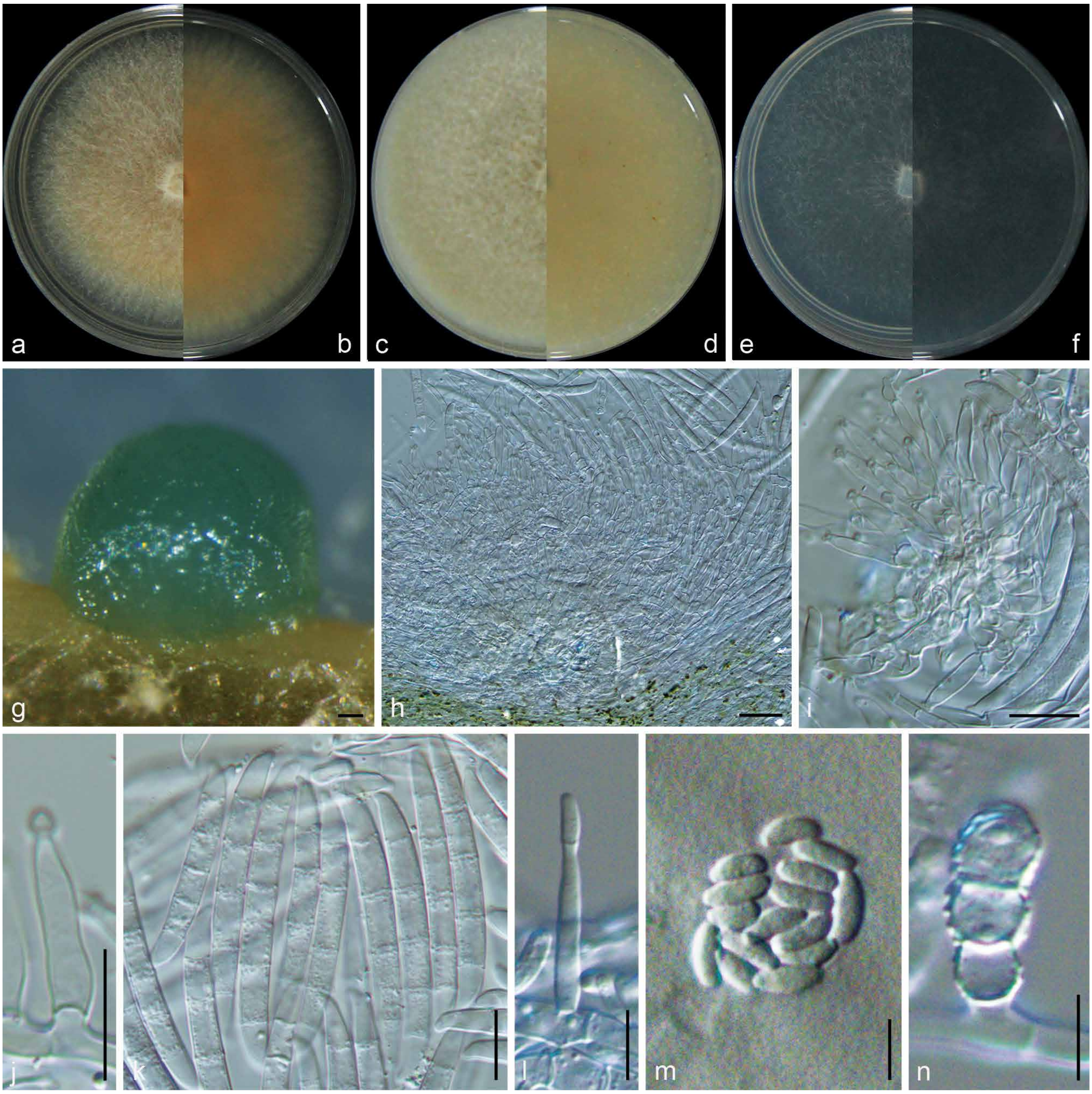


Fig. 22 *Neocosmospora lithocarpi* (ex-type culture LC1113). a–b. Colony on PDA: a. surface of colony on PDA after 7 d at 25 °C; b. reverse of colony on PDA; c–d. colony on OA: c. surface of colony on OA after 7 d at 25 °C; d. reverse of colony on OA; e–f. colony on SNA: e. surface of colony on SNA after 7 d at 25 °C; f. reverse of colony on SNA; g. sporodochium on carnation leaves; h–i. conidiophores and phialides on sporodochia; j. phialide on sporodochia; k. sporodochial conidia (macroconidia); l. phialides on aerial mycelium; m. aerial conidia (microconidia); n. chlamydospores. — Scale bars: g = 50 μm; h = 20 μm; i–n = 10 μm.

vs 2–8-septate, 49–63 μm in *N. pseudensiformis*) (Nalim et al. 2011, Aoki et al. 2018, Na et al. 2018, Sandoval-Denis et al. 2019).

DISCUSSION

In this study, 259 species belonging to four well-supported genera, including 12 new species were analysed using a combined *tef1*-*rpb1*-*rpb2* multi-locus phylogeny (Fig. 1). Within *Fusarium*, 196 species are categorised in nine species complexes, one of these complexes here renamed as the *F. falsibabinda* complex (previously incorrectly recognised as the *F. babinda* species complex) (Fig. 1, 2). One and four distinct clades in the FLSC (Fig. 5) and FOSC (Fig.6), respectively, were not described, awaiting more data for species delimitation. Seven loci were employed in this study, i.e., ITS, IGS, *tef1*, *cam*, *rpb1*, *rpb2* and *tub2* (Table 1). Among these seven loci, ITS failed to resolve any species in *Fusarium*, but recognized *B. aseptatum*, *B. penzigii* and *B. tonghuanum* from other known species in *Bisifusarium*. The IGS locus was amplified for the FOSC members, but its phylogenetic topology showed significant conflict with other loci. The *rpb2* locus appeared to be most effective in species recognition in several *Fusarium* complexes, e.g., the FFSC (Supplementary Fig. S2d), the FTSC (Supplementary Fig. S3d), and *Neocosmospora* (Supplementary Fig. S5c), followed by *tef1* (effective in the FOSC). The *rpb1* locus showed the best species recognition in the FNISSC (Supplementary Fig. S1b).

Employing morphological characters, multi-locus phylogenies and ecological preferences, 356 fusarioid isolates from China were identified to 72 species belonging to three genera (1 species with 3 isolates in *Bisifusarium*, 60 species with 321 isolates in *Fusarium* and 11 species with 32 isolates in *Neocosmospora*). Most of the previous studies on *Fusarium* in China focused on species associated with agricultural and cash crops, e.g., maize, rice, wheat, pepper, and tobacco (Yu 1955, Tai 1979, Wang et al. 2013a, b, Zhang et al. 2014a, b), and insects (Bai

Table 4 Species of fusarioid genera occurring in China, with information of their habitats, hosts and references.

Current name	Name of taxon	Host genera/habitats	Recorded reference/database
A. rigidiuscula	*F. decemcellulare*, *F. rigidiusculum*	Coccids; *Dianthus*, *Garuga*, *Idiocerus*, *Passiflora*, *Salix*, *Oxytropis*	Bai & Chen (1991); https://nmdc.cn/fungarium/fungi/chinadirectories
B. aseptatum	*B. aseptatum*	*Orchidaceae*	this study
B. delphinoides	*F. delphinoides*	Human	https://nmdc.cn/fungarium/fungi/chinadirectories
B. dimerum	*F. dimerum*	Soil; *Citrus*, *Musa*	Yu (1955), Tai (1979); https://nmdc.cn/fungarium/fungi/chinadirectories
C. cavisperma	*F. cavispermum*	*Pinus*	Yu (1955)
F. acaciae-mearnsii	*F. acaciae-mearnsii*	*Paederia*	this study
F. acuminatum	*F. acuminatum*, *F. caudatum*, *F. scirpi* var. *acuminatum*	Soil; *Acer*, *Brassica*, *Capsicum*, *Crotalaria*, *Cucumis*, *Eleocharis*, *Feijoa*, *Fritillaria*, *Glycine*, *Gossypium*, *Hordeum*, *Hylotelephium*, *Ipomoea*, *Prunus*, *Solanum*, *Triticum*	Yu (1955), Tai (1979), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. acutatum	*F. acutatum*	*Triticum*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. alpinum	*F. alpinum*	*Fabaceae*	this study
F. ananatum	*F. ananatum*	*Ananas*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. anguioides	*F. anguioides*	*Alocasia*, *Cordyline*, *Gossypium*, *Ipomoea*, *Pisum*, *Solanum*, *Vicia*	Yu (1955), this study
F. annulatum	*F. annulatum*	Submerged wood; human; bamboo, *Capsicum*, *Chamaerops*, *Glycine*, *Lithocarpus*, *Malus*, *Musa*, *Olea*, *Oryza*, *Sorghum*, *Vitis*, *Zea;* unidentified mushroom	https://nmdc.cn/fungarium/fungi/chinadirectories
F. annuum	*F. annuum*	*Capsicum*	Yu (1955); https://nmdc.cn/fungarium/fungi/chinadirectories
F. anthophilum	*F. anthophilum*, *F. moniliforme* var. *anthophilum*	Soil; *Gossypium*, *Oryza*, *Vicia*	Tai (1979); https://nmdc.cn/fungarium/fungi/chinadirectories
F. aquatilium	*F. aquatilium*	Water	this study
F. arcuatisporum	*F. arcuatisporum*	Soil; *Brassica*, *Nelumbo*, *Oryza*, *Panicum*, *Paspalum*, *Poa*	Wang et al. (2019), this study
F. armeniacum	*F. armeniacum*	Unidentified grass	this study
F. arthrosporioides	*F. arthrosporioides*	Soil; *Oryza*, *Vicia*	Yu (1955); https://nmdc.cn/fungarium/fungi/chinadirectories
F. asiaticum	*F. asiaticum*	*Musa*, *Triticum*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. avenaceum	*F. avenaceum*, *F. avenaceum* var. *fabae*, *F. avenaceum* var. *herbarum*, *F. avenaceum* f. *fabae*, *F. avenaceum* f. *fabalis*, *F. avenaceum* f. *fabarum*	Air, faeces, soil; *Allium*, *Atractylodes*, *Avena*, *Bidens*, *Brassica*, *Camellia*, *Chrysanthemum*, *Cicer*, *Citrus*, *Codonopsis*, *Coix*, *Cucumis*, *Cucurbita*, *Daucus*, *Dianthus*, *Dolichus*, *Equisetum*, *Fritillaria*, *Gentiana*, *Glycine*, *Gossypium*, *Halenia*, *Hordeum*, *Juglans*, *Lathyrus*, *Lycopersicum*, *Malus*, *Oryza*, *Panax*, *Papaver*, *Paspalum*, *Pinus*, *Pisum*, *Plantago*, *Prunus*, *Rosa*, *Salvia*, *Setaria*, *Solanum*, *Sorghum*, *Trifolium*, *Triticum*, *Vicia*, *Vitis*, *Zea*	Yu (1955), Tai (1979), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. bactridioides	*F. bactridioides*	*Cucumis*, *Narcissus*, *Pinus*	Yu (1955)
F. bambusacearum	*F. bambusacearum*	Bamboo	this study
F. bambusicola	*F. bambusicola*	*Sinocalamus*	Tai (1979)
F. brachygibbosum	*F. brachygibbosum*	*Zea*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. caeruleum	*F. coeruleum*, *F. solani* var. *caeruleum*, *F. solani* var. *coeruleum*	Soil; *Abies*, *Aconitum*, *Actinidia*, *Aloe*, *Amorphopha*, *Arachis*, *Artocarpus*, *Astragalus*, *Atrachylis*, *Atractylodes*, *Brassica*, *Camellia*, *Canna*, *Capsicum*, *Castanea*, *Chrysomphalus*, *Citrus*, *Cucumis*, *Cuminum*, *Cyamopsis*, *Cymbidium*, *Dendrobium*, *Dianthus*, *Dioscorea*, *Ditylenchus*, *Eleocharis*, *Ephedra*, *Epiphyllum*, *Eria*, *Fragaria*, *Fritillaria*, *Glycine*, *Gossypium*, *Haloxylon*, *Hcarites*, *Heleocharis*, *Helianthus*, *Heliothis*,*Helwingia*, *Heterodera*, *Hevea*, *Ipomoea*, *Jatropha*, *Juglans*, *Lablab*, *Lentinus*, *Ligusticum*, *Lilium*, *Lotus*, *Luffa*, *Lycium*, *Malus*, *Mangifera*, *Medicago*, *Momordica*, *Morus*, *Musa*, *Nicotiana*, *Nopalxochia*, *Onobrychis*, *Oryza*, *Paeonia*, *Panax*, *Paphiopedilum*, *Passiflora*, *Persica*, *Phaius*, *Phalaenopsis*, *Phaseolus*, *Phyllostachys*, *Pinus*, *Pisum*, *Pittosporum*, *Punica*, *Rabdosia*, *Ricinus*, *Robinia*, *Salvia*, *Schisandra*, *Simmondsia*, *Solanum*, *Triticum*, *Vicia*, *Vigna*, *Zanthoxylum*, *Zea*; coccids, human	Yu (1955), Tai (1979), Bai & Chen (1991), this study; https://nmdc.cn/fungarium/fungi/chinadirectories

Table 4 (cont.)

Current name	Name of taxon	Host genera/habitats	Recorded reference/database
F. camptoceras	*F. camptoceras*	Soil; *Cinnamomum*, *Clerodentron*, *Hordeum*, *Malus*, *Momordica*, *Musa*, *Phaseolus*, *Triticum*, *Vigna*, *Zea*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. cassiae	*F. cassiae*	*Coffea*	this study
F. chlamydosporum	*F. chlamydosporum*, *F. fusarioides*	*Aspidiotus*, *Auricularia*, *Glycine*, *Hordeum*, *Jacaranda*, *Juglans*, *Musa*, *Parlatoria*, *Triticum*, *Zea*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. chongqingense	*F. chongqingense*	*Bothrocaryum*	this study
F. citri	*F. citri*	*Amygdalus*, *Capsicum*, *Castanopsis*, *Citrus*, *Musa*, *Smilax*	Wang et al. (2019), this study
F. commune	*F. commune*	*Eleocharis*, *Musa*, *Oryza*, *Vigna*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. compactum	*F. compactum*, *F. scirpi* var. *compactum*	Soil; *Poa*, *Setaria*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. concentricum	*F. concentricum*	*Aglaonema*, *Hedera*, *Lablab*, *Maianthemum*, *Musa*, *Reineckia*, *Vitis*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. concolor	*F. concolor*, *F. polyphialidicum*	Soil; *Anacardium*, *Carica*, *Citrus*, *Ehretia*, *Gossypium*, *Hemerocallis*, *Hordeum*, *Lycium*, *Lygodium*, *Malva*, *Rhynchites*, *Setaria*, *Triticum*, *Vicia*, *Zea*	Yu (1955), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. cugenangense	*F. cugenangense*	*Poa*, *Smilax*, *Solanum*, *Zingiber*	this study
F. culmorum	*F. culmorum*	*Asparagus*, *Avena*, *Beta*, *Camellia*, *Cucumis*, *Cucurbita*, *Daucus*, *Dianthu*, *Diaphorina*, *Glycine*, *Helianthus*, *Hordeum*, *Ipomoea*, *Linum*, *Lycopersicum*, *Oryza*, *Pinus*, *Secale*, *Setaria*, *Solanum*, *Sorghum*, *Triticum*, *Vicia*, *Zea*	Yu (1955), Tai (1979); https://nmdc.cn/fungarium/fungi/chinadirectories
F. diversisporum	*F. diversisporum*	*Setaria*, *Zea*	Yu (1955)
F. duoseptatum	*F. duoseptatum*	*Musa*	this study
F. elaeagni	*F. elaeagni*	*Elaeagnus*	this study
F. elaeidis	*F. elaeidis*	*Caryota*	this study
F. equiseti	*F. equiseti*	Faeces, soil; aphids, cicadas, coccids; *Aphis*, *Atractylodes*, *Beta*, *Calotropis*, *Capsicum*, *Castanea*, *Citrus*, *Coix*, *Cucumis*, *Cucurbita*, *Cyamopsis*, *Cymbidium*, *Dendrobium*, *Dendrolimus*, *Eleocharis*, *Glycine*, *Gossypium*, *Helianthus*, *Henosepilachua*, *Hordeum*, *Icerya*, *Laccifer*, *Medicago*, *Momordica*, *Nicotiana*, *Oryza*, *Phaseolus*, *Pieris*, *Populus*, *Prunus*, *Pseudostellaria*, *Raphanus*, *Rhynchites*, *Rosa*, *Schisandra*, *Setaria*, *Simmondsia*, *Solanum*, *Spinacia*, *Triticum*, *Vicia*, *Vigna*, *Zea*	Yu (1955), Tai (1979), Bai & Chen (1991), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. flocciferum	*F. flocciferum*	Soil	https://nmdc.cn/fungarium/fungi/chinadirectories
F. fujikuroi	*F. fujikuroi*, *F. fujikuroi* var. *subglutinans*, *F. moniliforme*, *F. moniliforme* f. *subglutinans*, *F. moniliforme* var. *hangzhouense*, *F. moniliforme* var. *intermedium*, *F. moniliforme* var. *minus*, *F. moniliforme* var. *minus*, *F. moniliforme* var. *subglutinans*, *F. moniliforme* var. *subglutinans*	Faeces, putty, slug moths, soil, submerged wood; human, aphids, arachids, cicadas, coccids; *Aleurocanthus*, *Allium*, *Amygdalus*, *Anoplophora*, *Areca*, *Asparagus*, *Avena*, *Bamboo*, *Bombyx*, *Brassica*, *Camellia*, *Capsicum*, *Cedus*, *Celosia*, *Ceroplastes*, *Chilo*, *Chlorops*, *Citrullus*, *Citrus*, *Cnaphalocrocis*, *Cocos*, *Coffea*, *Coix*, *Cucumis*, *Cucurbita*, *Cymbidium*, *Dianthus*, *Dolichos*, *Elaeis*, *Eleocharis*, *Ephedra*, *Erigeron*, *Ficus*, *Gladiolus*, *Glycine*, *Gossypium*, *Helianthus*, *Hisbiscus*, *Hordeum*, *Hyphantria*, *Icerya*, *Inazuma*, *Ipomoea*, *Jasminum*, *Jatropha*, *Juglans*, *Laccifer*, *Lilium*, *Lycium*, *Lycopersicon*, *Lycopersicum*, *Lygodium*, *Malus*, *Mangifera*, *Melia*, *Musa*, *Mythimna*, *Nephotettix*, *Nilaparvata*, *Oryza*, *Ostrinia*, *Paeonia*, *Panax*, *Panicum*, *Papilio*, *Parlatoria*, *Parnara*, *Paulowine*, *Phaseolus*, *Phragmites*, *Pieris*, *Pinus*, *Pleurotus*, *Populus*, *Procera*, *Pseudaonidia*, *Raphanus*, *Rhododendron*, *Rhynchites*, *Ricinus*, *Rosa*, *Saccharum*, *Sanseviera*, *Saperda*, *Scirpophaga*, *Sesamia*, *Setaria*, *Simmondsia*, *Solanum*, *Sorghum*, *Spinacia*, *Taiwania*, *Taxus*, *Trifolium*, *Triticum*, *Tulipa*, *Unaspis*, *Vicia*, *Vigna*, *Zanthoxylum*, *Zea*	Yu (1955), Tai (1979), Bai & Chen (1991), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. graminearum	*F. graminearum*, *F. zeae*	Air, faeces, soil; coccids, psyllids; *Agropyron*, *Allium*, *Astragalus*, *Avena*, *Brassica*, *Capsicum*, *Carthamus*, *Castanea*, *Coix*, *Coriolus*, *Coronilla*, *Cucumis*, *Dactylis*, *Eleocharis*, *Glycine*, *Gossypium*, *Helianthus*, *Hordeum*, *Linum*, *Lolium*, *Lotus*, *Lycopersicum*, *Malus*, *Medicago*, *Melilotus*, *Melissitus*, *Onobrychis*, *Oryza*, *Phalaenopsis*, *Phaseolus*, *Pisum*, *S Populus*, *Roegneria*, *ecale*, *Setaria*, *Solanum*, *Sorghum*, *Spiraea*, *Triticum*, *Vicia*, *Vigna*, *Zea*	Yu (1955), Tai (1979), Bai & Chen (1991), this study; https://nmdc.cn/fungarium/fungi/chinadirectories

Table 4 (cont.)

Current name	Name of taxon	Host genera/habitats	Recorded reference/database
F. graminum	*F. graminum*	*Paspalum*, *Vicia*	Yu (1955); https://nmdc.cn/fungarium/fungi/chinadirectories
F. grosmichelii	*F. grosmichelii*	*Chamaerops*, *Musa*, *Oryza*	this study
F. guilinense	*F. guilinense*	*Musa*	Wang et al. (2019), this study
F. hainanense	*F. hainanense*	*Musa*, *Oryza*	Wang et al. (2019), this study
F. hechiense	*F. hechiense*	*Musa*	this study
F. heterosporum	*F. heterosporum*	Soil; *Phyllostachys*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. humuli	*F. humuli*	*Cedrela*, *Chimonanthus*, *Coriaria*, *Humulus*, *Ligustrum*, *Liquidambar*, *Megathyrsus*, *Musa*, *Osmanthus*, *Paederia*, *Rosa*, *Viburnum*, *Vinca*	Wang et al. (2019), this study
F. incarnatum	*F. incarnatum*, *F. semitectum*	Soil; *Juglans*, *Lycopersicum*, *Miscanthus*, *Pennisetum*, *Phragmites*, *Schoenoplectus*, *Solanum*	Tai (1979), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. ipomoeae	*F. ipomoeae*	Soil, submerged wood; *Agrostis*, bamboo, *Capsicum*, *Hibiscus*, *Hosta*, *Ipomoea*, *Lagenaria*, *Musa*, *Oryza*, *Rhododendron*, *Solanum*, *Vinca*	Wang et al. (2019), this study
F. iranicum	*F. iranicum*	*Lithocarpus*	this study
F. irregulare	*F. irregulare*	Bamboo, *Digitaria*, *Lithocarpus*, *Vigna*	Wang et al. (2019), this study
F. kyushuense	*F. kyushuense*	Submerged wood; *Chamaedaphne*, *Lithocarpus*, *Musa*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. lacertarum	*F. lacertarum*	*Capsicum*	Wang et al. (2019), this study
F. lactis	*F. lactis*	*Pisum*	Yu (1955)
F. langsethiae	*F. langsethiae*	Unknown	https://nmdc.cn/fungarium/fungi/chinadirectories
F. lateritium	*F. baccata*, *F. baccata* var. *moricola*, *F. lateritium*, *F. lateritium* f. sp. *celosiae*, *F. lateritium* f. *mori*, *F. lateritium* var. *mori*	Soil, wood; coccids; *Allium*, *Aralia*, *Brevicoryne*, *Callistephus*, *Capsicum*, *Celosia*, *Chlorops*, *Chrysomphalus*, *Cicadella*, *Citrus*, *Dendrobium*, *Diaspiaiotus*, *Eleutherococcus*, *Garuga*, *Ginkgo*, *Heterodera*, *Hordeum*, *Ilex*, *Laccifer*, *Icerya*, *Malus*, *Malva*, *Morus*, *Musa*, *Phynchites*, *Pinus*, *Prinsepia*, *Prunus*, *Pulvinaria*, *Pyrus*, *Taxus*, *Triticum*	Yu (1955), Tai (1979), Bai & Chen (1991), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. longipes	*F. equiseti* var. *longipes*, *F. longipes*	*Paspalum*, *Phaseolus*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. luffae	*F. luffae*	*Humulus*, *Luffa*, *Oryza*	Wang et al. (2019), this study
F. lumajangense	*F. lumajangense*	*Arenga*, *Musa*	this study
F. madaense	*F. madaense*	*Oryza*	this study
F. mangiferae	*F. mangiferae*	*Mangifera*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. meridionale	*F. meridionale*	*Carbonatite; Coffea*, *Musa*	this study
F. miscanthi	*F. miscanthi*	Water	this study
F. mundagurra	*F. mundagurra*	*Paspalum*	this study
F. nanum	*F. nanum*	*Musa*	this study
F. napiforme	*F. napiforme*	*Juglans*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. nepalense	*F. nepalense*	*Camellia*, *Musa*	this study
F. nirenbergiae	*F. nirenbergiae*	*Caryota*, *Musa*, *Setaria*	this study
F. odoratissimum	*F. odoratissimum*	*Musa*	this study
F. oxysporum	*F. bulbigenum*, *F. bulbigenum* var. *batatas*, *F. bulbigenum* var. *lycopersici*, *F. bulbigenum* var. *niveam*, *F. bulbigenum* var. *tracheiphilum*, *F. conglutinans*, *F. conglutinans* var. *batae*, *F. conglutinans* var. *callistephi*, *F. dianthi*, *F. lini*, *F. orthoceras*, *F. orthoceras* var. *longius*, *F. orthoceras* var. *longius*, *F. orthoceras* var. *pisi*, *F. oxysporum*, *F. oxysporum*	Faeces, gluten, soil, wood; *Acacia*, *Allium*, *Amygdalus*, *Apium*, *Apocynum*, *Arachis*, *Asparagus*, *Atractylodes*, *Avena*, *Benincasa*, *Beta*, *Brassica*, *Callistephus*, *Camptotheca*, *Capsicum*, *Cicer*, *Citrullus*, *Citrus*, *Coriolus*, *Cucumis*, *Cucurbita*, *Cyclamen*, *Datura*, *Delonix*, *Dendranthema*, *Dianthus*, *Dioscorea*, *Fragaria*, *Gladiolus*, *Glycine*, *Gossypium*, *Helianthus*, *Hibiscus*, *Iphigenia*, *Ipomoea*, *Iris*, *Jasminum*, *Larix*, *Lilium*, *Linum*, *Lupinus*, *Lycium*, *Lycopersici*, *Lycopersicon*, *Lycopersicum*, *Magnolia*, *Malus*, *Medicago*, *Momordica*, *Musa*, *Narcissus*, *Nelumbo*, *Onobrychis*,	Yu (1955), Tai (1979), Bai & Chen (1991), this study; https://nmdc.cn/fungarium/fungi/chinadirectories

Table 4 (cont.)

Current name	Name of taxon	Host genera/habitats	Recorded reference/database
F. oxysporum (cont.)	f. *apii*, *F. oxysporum* f. *betae*, *F. oxysporum* f. *callistephi*, *F. oxysporum* f. *ciceris*, *F. oxysporum* f. *conglutinans*, *F. oxysporum* f. *cubense*, *F. oxysporum* f. *cucumerinum*, *F. oxysporum* f. *cyclaminis*, *F. oxysporum* f. *dianthi*, *F. oxysporum* f. *gladioli*, *F. oxysporum* f. *lini*, *F. oxysporum* f. *lupini*, *F. oxysporum* f. *lycopersici*, *F. oxysporum* f. *medicaginis*, *F. oxysporum* f. *melonis*, *F. oxysporum* f. *niveum*, *F. oxysporum* f. *perniciosum*, *F. oxysporum* f. *phaseoli*, *F. oxysporum* f. *pisi*, *F. oxysporum* f. *spinaciae*, *F. oxysporum* f. *tracheiphilum*, *F. oxysporum* f. *tuberosi*, *F. oxysporum* f. *vasinfectum*, *F. oxysporum* f.sp. *batatas*, *F. oxysporum* f.sp. *benincasae*, *F. oxysporum* f.sp. *betae*, *F. oxysporum* f.sp. *conglutinans*, *F. oxysporum* f.sp. *cubense*, *F. oxysporum* f.sp. *cucumerinum*, *F. oxysporum* f.sp. *cumini*, *F. oxysporum* f.sp. *dioscoreae*, *F. oxysporum* f.sp. *fabae*, *F. oxysporum* f.sp. *glycines*, *F. oxysporum* f.sp. *lagenariae*, *F. oxysporum* f.sp. *lini*, *F. oxysporum* f.sp. *lycopersici*, *F. oxysporum* f.sp. *magnoliae*, *F. oxysporum* f.sp. *melonis*, *F. oxysporum* f.sp. *momordicae*, *F. oxysporum* f.sp. *mormodicae*, *F. oxysporum* f.sp. *narcissi*, *F. oxysporum* f.sp. *nelumbicola*, *F. oxysporum* f.sp. *niveum*, *F. oxysporum* f.sp. *phaseoli*, *F. oxysporum* f.sp. *pisi*, *F. oxysporum* f.sp. *vasinfectum*, *F. oxysporum* f. *fabae*, *F. oxysporum* var. *aurantiacum*, *F. oxysporum* var. *cubense*, *F. oxysporum* var. *gladioli*, *F. oxysporum* var. *orthoceras*, *F. vasinfectum*, *F. vasinfectum* var. *sesami*	*Phascolus*, *Phaseolus*, *Pinus*, *Piper*, *Pisum*, *Sechium*, *Sesamum*, *Setaria*, *Solanum*, *Spinacia*, *Tamarix*, *Trifolium*, *Triticum*, *Vanilla*, *Vicia*, *Vitrullus*, *Zea*	
F. paeoniae	*F. paeoniae*	*Crataegus*, *Elymus*, *Paeonia*, *Populus*	this study
F. panlongense	*F. panlongense*	*Musa*	this study
F. paranisikadoi	*F. paranisikadoi*	Unidentified grass	this study
F. pernambucanum	*F. pernambucanum*	Bamboo, *Capsicum*, *Chamaedorea*, *Cyperus*, *Gerbera*, *Heteropogon*, *Musa*, *Panicum*, *Zea*	this study
F. poae	*F. poae*	Soil; *Avena*, *Cucumis*, *Dianthus*, *Oryza*, *Setaria*, *Triticum*, *Zea*	Yu (1955), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. proliferatum	*F. proliferatum*	Human; *Celastrus*, *Citrullus*, *Cucumis*, *Dendrobium*, *Eleocharis*, *Glycyrrhiza*, *Juglans*, *Musa*, *Oryza*, *Oxytropis*, *Solanum*, *Vitis*	Yu (1955), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. pseudocircinatum	*F. pseudocircinatum*	*Syzygium*	this study
F. pseudograminearum	*F. pseudograminearum*	*Triticum*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. redolens	*F. oxysporum* var. *redolens*, *F. redolens*	Soil; arachnids, cicadas, coccids, scarabs, white flies; *Acaeia*, *Alaugium*, *Aleurocanthus*, *Allium*, *Ananas*, *Anthurium*, *Arachis*, *Astragalus*, *Atractylodes*, *Auricularia*, *Avicennia*, *Bambusoideae*, *Bauhinia*, *Benincasa*, *Brassica*, *Brevicoryne*, *Bupleurum*, *Callistephus*, *Camellia*, *Cannabis*, *Capsicum*, *Castanea*, *Catharanthus*, *Citrullus*, *Citrus*, *Coronilla*, *Cucumis*, *Cuminum*, *Cyamopsis*, *Cymbidium*, *Dendrobium*, *Dianthus*, *Dimocarpus*, *Ditylenchus*, *Dracaena*, *Elacis*, *Eleocharis*, *Ephedra*, *Excoecaria*, *Fragaria*, *Fritillaria*, *Gerbera*, *Ginkgo*, *Gladiolus*, *Glycine*, *Glycyrrhiza*, *Gossypium*, *Gymnospermae*, *Gynotemma*, *Haloxylon*, *Helianthus*, *Hevea*, *Hordeum*, *Jacaranda*, *Juglans*, *Juniporus*, *Lablab*, *Laccifer*, *Lagenaria*, *Larix*, *Lcerya*, *Lentinus*, *Ligusticum*, *Lilium*, *Linum*, *Llgusticum*, *Luffa*, *Lycium*, *Lycoperdon*, *Lycopersicon*, *Magnolia*, *Medicago*, *Melilotus*, *Momordica*, *Murraya*, *Musa*, *Myrica*, *Nelumbo*, *Nicotiana*, *Nopalxochia*, *Onobrychis*, *Oryza*, *Oxytropis*, *Paeonia*, *Panax*, *Parlatoria*, *Pennisetum*, *Phalaenopsis*, *Phaseolus*, *Pinus*, *Piper*, *Pisum*, *Pocockia*, *Populus*, *Rabdosia*, *Raphanus*, *Rheum*, *Rhodiola*, *Rhynchites*, *Robinia*, *Saccharum*, *Saperda*, *Schisandra*, *Simmondsia*, *Solanum*, *Sorghum*, *Spinacia*, *Spiraea*, *Stevia*, *Taxus*, *Trifolium*, *Triticum*, *Unaspis*, *Ustilago*, *Vernicia*, *Vicia*, *Vigna*, *Vitis*, *Zea*, *Zingiber*	Yu (1955), Tai (1979), Bai & Chen (1991); https://nmdc.cn/fungarium/fungi/chinadirectories
F. reticulatum	*F. pallidoroseum*, *F. semitectum* var. *majus*	*Beta*, *Cucumis*, *Cucurbita*	Yu (1955)
F. sacchari	*F. sacchari*	*Arundina*, *Musa*, *Poa*	this study

Table 4 (cont.)

Current name	Name of taxon	Host genera/habitats	Recorded reference/database
F. sambucinum	*F. pulicaris*, *F. roseum*, *F. sambucinum*	Soil; bamboo, *Ceroplastes*, *Citrug*, *Citrus*, *Dendrobium*, *Panax*, *Ricinus*, *Saccharum*, *Solanum*, *Triticum*, *Zanthoxylum*, *Zea*	Yu (1955), Tai (1979); https://nmdc.cn/fungarium/fungi/chinadirectories
F. sarcochroum	*F. sarcochroum*	*Populus*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. scirpi	*F. scirpi*	Soil; *Avena*, *Citrus*, *Gladiolus*, *Gossypium*, *Hordeum*, *Panax*, *Pinus*, *Setaria*	Yu (1955), Tai (1979); https://nmdc.cn/fungarium/fungi/chinadirectories
F. sinense	*F. sinense*	*Triticum*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. sporotrichioides	*F. solani* var. *martii* forma 3, *F. sporotrichioides*, *F. sporotrichiella* var. *sporotrichioides*, *F. sporotrichioides* var. *chlamydosporum*	Soil; *Arachis*, *Gossypium*, *Helianthus*, *Juglans*, *Phaseolus*, *Pisum*, *Pseudaonidia*, *Solanum*, *Zea*	Yu (1955); https://nmdc.cn/fungarium/fungi/chinadirectories
F. stilboides	*F. stilboides*	*Clausena*, *Coffea*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. subglutinans	*F. subglutinans*	*Chilo*, *Dianthus*, *Ephedra*, *Erigeron*, *Raphanus*, *Zea*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. sulawense	*F. sulawense*	*Acalypha*, *Alocasia*, *bamboo*, *Capsicum*, *Citrus*, *Colocasia*, *Ipomoea*, *Luffa*, *Musa*, *Oryza*, *Smilax*, *Syngonium*	Wang et al. (2019), this study
F. tanahbumbuense	*F. tanahbumbuense*	*Digitaria*, *Oryza*	Wang et al. (2019), this study
F. temperatum	*F. temperatum*	Unidentified lichen	this study
F. thapsinum	*F. thapsinum*	Human	https://nmdc.cn/fungarium/fungi/chinadirectories
F. tricinctum	*F. tricinctum*	*Dendrobium*, *Glycine*, *Hordeum*, *Hosta*, *Litsea*, *Pisum*, *Setaria*, *Solanum*, *Sophora*, *Triticum*, *Vicia*, *Zamia*, *Zea*	Yu (1955), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
F. udum	*F. udum*, *F. udum* f.sp. *crotalariae*	Soil, wood; *Amygdalus*, *Asarum*, *Citrullus*, *Coriolus*, *Gossypium*, *Salix*, *Schisandra*, *Solanum*	https://nmdc.cn/fungarium/fungi/chinadirectories
F. ussurianum	*F. ussurianum*	Air, carbonatite, soil; bamboo, *Musa*, *Oryza*, *Podocarpus*, *Prunus*, *Rhynchospora*	this study
F. verticillioides	*F. verticillioides*	Soil, submerged wood; *Anoplophora*, bamboo, *Brassica*, *Citrullus*, *Cucumis*, *Glycine*, *human*, *Hyphantria*, *Musa*, *Phaseolus*, *Physosfegia*, *Saperda*, *Solanum*, *Vigna*, *Zea*	this study; https://nmdc.cn/fungarium/fungi/chinadirectories
N. brevis	*N. brevis*	Submerged wood	this study
N. falciformis	*N. falciformis*	*Paspalum*, *Passiflora*, *Vitis*	this study
N. lithocarpus	*N. lithocarpus*	*Lithocarpus*	this study
N. metavorans	*N. metavorans*	Submerged wood	this study
N. oblonga	*N. oblonga*	*Carbonatite*	this study
N. paraeumartii	*N. paraeumartii*	*Castanopsis*	this study
N. petroliphila	*N. petroliphila*	*Lithocarpus*	this study
N. phaseoli	*N. phaseoli*	*Brassica*, *Vigna*	https://nmdc.cn/fungarium/fungi/chinadirectories
N. pseudensiformis	*N. pseudensiformis*	*Passiflora*	this study
N. silvicola	*N. silvicola*	Faeces	this study
N. solani	*F. eumartii*, *F. javanicum*, *F. javanicum* var. *radicicola*, *F. martii*, *F. solani*, *F. solani* f. *batatus*, *F. solani* f.sp. *aleuritidis*, *F. solani* f.sp. *fabae*, *F. solani* f.sp. *lilii*, *F. solani* f.sp. *pisi*, *F. solani* var. *eumartii*, *F. solani* var. *javanicum*, *F. solani* var. *martii*, *F. solani* var. *solani*	Compost, faeces, soil; coccids; *Allium*, *Amomum*, *Amygdalus*, *Benincasa*, *Callistephus*, *Capsicum*, *Chrysanthemum*, *Citrullus*, *Citrus*, *Colocasia*, *Cucumis*, *Dimocarpus*, *Dioscorea*, *Glycine*, *Gossypium*, *Ipomoea*, *Lilium*, *Lycopersicum*, *Musa*, *Oryza*, *Panax*, *Phaseolus*, *Pinus*, *Pisum*, *Polygatum*, *Polygonatum*, *Rehmannia*, *Robinia*, *Santalum*, *Solanum*, *Vernicia*, *Vicia*, *Zingiber*	Yu (1955), Tai (1979), this study; https://nmdc.cn/fungarium/fungi/chinadirectories
N. stercicola	*N. stercicola*	Soil	this study
R. ventricosum	*F. ventricosum*	Soil; sawfly pupae; *Camellia*, *Icerya*	Bai & Chen (1991); https://nmdc.cn/fungarium/fungi/chinadirectories
S. ciliatum	*F. ciliatum*	*Populus*	Yu (1955)

Note: *A.* = *Albonectria*, *B.* = *Bisifusarium*, *C.* = *Cosmospora*, *F.* = *Fusarium*, *N.* = *Neocosmospora*, *R.* = *Rectifusarium*, *S.* = *Scolecofusarium*.

& Chen 1991), with more than 250 species, subspecies, varieties, and formae specialis hitherto reported. Based on the current taxonomy, these records correlate to 87 species, as summarised in Table 4. Our results present a significant step towards understanding the species diversity and distribution of *Fusarium* in China (Table 1), which increased the number of species to 114 (11 new species and 16 new records from China (23.7 % increase)).

In this study, 321 isolates from China were characterised belonging to eight species complexes in *Fusarium*. The *F. fujikuroi* complex (FFSC) presented the widest geographic distribution (30 locations) and the second highest number of hosts/habitats (28 types; 20 plant genera). Members in this complex were well-known for their worldwide distribution, with wide host ranges, diverse habitats, and pathogenicity to many cereals and economically relevant plants (O'Donnell et al. 1998a, 2000b, Leslie & Summerell 2006). Hitherto about 73 species were accepted in this complex, and 17 of them (15 from China, two from the USA), including four novel species and four newly recorded species in China, were reported in this study. The *F. incarnatum-equiseti* complex (FIESC) presented the second widest geographic distribution (21 locations) and the highest number of hosts/habitats (50 types; 44 plant genera). This complex is well-known as pathogens of plants and animals, endophytes, and saprobes of various host substrates (Leslie & Summerell 2006, O'Donnell et al. 2009b, Villani et al. 2016). Currently about 38 species have been introduced in the FIESC (O'Donnell et al. 2009b, Wang et al. 2019, Xia et al. 2019). In this study, 15 species in the complex were reported from environmental habitats and 44 plant genera (29 families) in China (Table 1), suggesting a very wide host range of this complex. The *F. tricinctum* species complex (FTSC) is an important group in *Fusarium* which encompasses mycotoxin producing species (Leslie & Summerell 2006). Members of this complex are well-known as cereal grain inhabitants (Kulik 2008), smut and mushroom endophytes (Torbati et al. 2019), and saprobes in soil and other environmental habitats (Leslie & Summerell 2006). Previously four species in this complex were recorded from China, i.e., *F. acuminatum*, *F. avenaceum*, *F. flocciferum*, and *F. tricinctum* from cereals, pumpkin, and winter squash (Yu 1955, Tai 1979, Zhuang 2005, Zhang et al. 2015, Chang et al. 2018, Li et al. 2019). In this study, seven species were identified, including three new species and one species newly recorded from China (*F. iranicum*).

This study also investigated 66 strains isolated and intercepted at Ningbo Customs from various economically important plants of 12 countries over six years (2012–2017), e.g., cereals, ornamental plants, and fruits (Table 1). These strains were identified as 26 species, including 25 known and one new species (Table 1). Six known species were hereto undetected in China, and two of them, *F. curvatum* and *N. pisi*, were previously reported as pathogens of *Brassicaceae* and *Rubiaceae* plants and *Pisum sativum*, respectively (Lombard et al. 2019a, Sandoval-Denis et al. 2019). Interception of these species implies potential threats to biosafety and ecosystem stability of China in international trade.

The taxonomic framework of *Fusarium* and allied genera has undergone several significant changes since establishment. Despite controversial opinions that exist on the generic boundaries of *Fusarium* and allied genera, we favour separating *Fusarium* s.lat. into multiple genera including *Albonectria*, *Bisifusarium*, *Fusarium*, *Neocosmospora*, and *Rectifusarium* as proposed by Gräfenhan et al. (2011), Nalim et al. (2011), Schroers et al. (2011), Lombard et al. (2015), and Crous et al. (2021). Approximately 1800 *Fusarium* and allied species epithets are recorded in the Index Fungorum and MycoBank databases (accessed December 2021). However, presently less than 400 species are accepted and have been studied using multi-locus DNA data from type specimens (Aoki et al. 2014, O'Donnell et al. 2009a, b, Sandoval-Denis et al. 2018a, b, Lombard et al. 2019a, b, Wang et al. 2019, Xia et al. 2019, Crous et al. 2021, Yilmaz et al. 2021). The taxonomic status of many names remains unresolved because of the lack of type specimens and derived sequences, e.g., *F. caeruleum*. It is noteworthy that there is still an incredibly high number of undescribed *Fusarium* species, e.g., 256 phylogenetic clades recorded in *Fusarium*-ID database (http://isolate.fusariumdb.org/blast.php) vs hitherto only about 31 species introduced in the FOSC (Lombard et al. 2019a). Considering the huge number of fusarioid strains/specimens from diverse fungaria around the world, there are undoubtedly many as yet resolved new species. Significant effort is thus required to fully discern the complexity of such a diverse and important fungal group. It is hoped that with the epitypification and neotypification of old names, and description of cryptic species, the classification system of this fungal group would be more stable and less artificial and serve the needs of the users and community impacted by this fungal group in future.

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Supplementary material

Fig. S1 Fifty percent majority rule consensus trees from Bayesian analyses inferred from the *tef1* (a), *rpb1* (b), and *rpb2* (c), showing the phylogenetic relationships of five species complexes within the *Fusarium*, namely *F. concolor* (FCOSC), *F. falsibabinda* (FFBSC), and *F. nisikadoi* (FNISSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *Fusarium humuli* (CQ1039). Ex-type cultures are indicated with 'T'.

Fig. S2 Fifty percent majority rule consensus trees from Bayesian analyses inferred from the *tef1* (a), *cam* (b), *rpb1* (c), *rpb2* (d), and *tub2* (e), showing the phylogenetic relationships of species within the *Fusarium fujikuroi* species complex (FFSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). All the trees were rooted to *F. nirenbergiae* (CBS 744.97). Ex-type cultures are indicated with 'T', epi-type with 'ET', neotype with 'NT'.

Fig. S3 Fifty percent majority rule consensus trees from Bayesian analyses inferred from the ITS (a), *tef1* (b), *rpb1* (c), and *rpb2* (d) showing the phylogenetic relationships of species within the *Fusarium tricinctum* species complex (FTSC). The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *F. concolor* (NRRL 13994 T). Ex-type cultures are indicated with 'T', neotype with 'NT'.

Fig. S4 Fifty percent majority rule consensus trees from Bayesian analyses inferred from the ITS (a), *tef1* (b), *rpb2* (c), *cam* (d), and *tub2* (e), showing the phylogenetic relationships of species within the *Bisifusarium*. The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). All the trees were rooted to *Rectifusarium robinianum* (CBS 430.91 T). Ex-type cultures are indicated with 'T'.

Fig. S5 Fifty percent majority rule consensus trees from Bayesian analyses inferred from the ITS (a), *tef1* (b), and *rpb2* (c), showing the phylogenetic relationships of species within the genus *Neocosmospora*. The Bayesian posterior probabilities (PP > 0.9) and PhyML Bootstrap support values (BS > 50) are displayed at the nodes (PP/ML). The tree was rooted to *Geejayessia cicatricum* (CBS 125552) and *G. atrofusca* (NRRL 22316). Ex-type cultures are indicated with 'T', neo-type with 'NT'.