



Biodiversity of fungi on *Vitis vinifera* L. revealed by traditional and high-resolution culture-independent approaches

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Abstract

This study is unique as it compares traditional and high-resolution culture-independent approaches using the same set of samples to study the saprotrophic fungi on *Vitis vinifera*. We identified the saprotrophic communities of table grape (Red Globe) and wine grape (Carbanate Gernischet) in China using both traditional and culture-independent techniques. The traditional approach used direct observations based on morphology, single spore isolation and phylogenetic analysis yielding 45 taxa which 19 were commonly detected in both cultivars. The same set of samples were then used for Illumina sequencing which analyzed ITS1 sequence data and detected 226 fungal OTUs, of which 176 and 189 belong to the cultivars Carbanate Gernischet and Red Globe, respectively. There were 139 OTUs shared between the two *V. vinifera* cultivars and 37 and 50 OTUs were specific to Carbanate Gernischet and Red Globe cultivars respectively. In the Carbanate Gernischet cultivar, Ascomycota accounted for 77% of the OTUs and in Red Globe, almost all sequenced were Ascomycota. The fungal taxa overlap at the genus and species level between the traditional and culture-independent approach was relatively low. In the traditional approach we were able to identify the taxa to species level, while in the culture-independent method we were frequently able to identify the taxa to family or genus level. This is remarkable as we used the same set of samples collected in China for both approaches. We recommend the use of traditional techniques to accurately identify taxa. Culture-independent method can be used to get a better understanding about the organisms that are present in a host in its natural environment. We identified primary and secondary plant pathogens and endophytes in the saprotrophic fungal communities, which support previous observations, that dead plant material in grape vineyards can be the primary sources of disease. Finally, based on present and previous findings, we provide a worldwide checklist of 905 fungal taxa on *Vitis* species, which includes their mode of life and distribution.

Keywords Checklist · Grapevine · Mycobiome · Next generation sequencing · Pathogens · Saprotrophs

Introduction

Vitis (family *Vitaceae*) is a plant genus that includes the economically important grapes, and thus because of its importance, its pathogens have received a considerable

amount of attention during the past decade (Yan et al. 2015; Chethana et al. 2017). The importance of this fruit is associated with its multiple uses; as a source of nutrition, health and medicinal value, as well as its high economical significance (Dohadwala and Vita 2009; Bokulich et al. 2014). About 90% of cultivated grapes in the world are *V. vinifera*, which comprises wine, as well as table grapes. This genus comprises 79 accepted species of perennial woody and herbaceous vines. There are thousands of cultivars of *V. vinifera* that has been grown successfully around the globe (Terral et al. 2009). Species of *Vitis* are valued for their decorative foliage providing ornamental value for the genus. Their ability to cover walls and arches, as well as providing shade has made them important in domestic cultivation.

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Numerous diseases of grapes have been identified which reduce the yield and quality of this fruit crop (Úrbez-Torres et al. 2009). Among various pathogens known on grapevine, the damage caused by fungi is significant (Úrbez-Torres 2011). Most studies on fungal pathogens in grape have focused on their pathogenic phase, which relies on direct observation and isolations of fungal pathogens from infected grape material. Fungi that may live within the host tissue are known as endophytes and are considered to cause symptomless infections (Lane and Kirk 2012). Plant pathogenic fungi can survive by changing their biotrophic mode from pathogenic to saprotrophic or at least can remain dormant on the decaying plant materials and become active when suitable conditions for infection exist (Hoppe et al. 2016; Purahong et al. 2018). For example, *Botrytis cinerea* causing gray mold disease in grape is able to live as a parasite in green tissues and as a saprotroph in dead plant material (Armijo et al. 2016). Unfortunately, our knowledge on saprotrophic fungal community associated with *V. vinifera* is limited, especially those obtained by high-resolution culture-independent techniques. The percentage of potential fungal pathogens hidden in saprotrophic community is still unclear.

Saprotrophs are organisms that derive nourishment from dead or decaying organic matter (Hyde et al. 2007). Saprotrophs are heterotrophic organisms that break down the complex compounds of dead organisms (Deighton 2016). They play an important role as decomposers of dead organic matter in natural ecosystems by releasing enzymes from hyphal tips (Duarte et al. 2006; Bucher et al. 2004). Saprotrophic fungi can be either macrofungi (*Agaricus* sp., *Phallus* sp.) (García et al. 1998) or microfungi (*Aspergillus* sp., *Dothiorella* sp., *Mucor* sp., *Neomassaria* sp., *Rhizopus* sp.) (Vohník et al. 2011; Hyde et al. 2016). Hyde et al. (2007) and Purahong et al. (2018), provided evidence that some plants accommodate large numbers of saprotrophic taxa and that some might be host- or organ-specific. Other than being decomposers, saprotrophs can also provide other eco-system services, such as soil formation, defence against pathogens, as a food source and modification of pollutants (Deighton 2016). Promputtha et al. (2007, 2010) provided evidence that not only fungal pathogens, but also fungal endophytes, can switch lifestyles to saprotrophs. Thus, the study of saprotrophic fungal communities associated with *V. vinifera* can provide information on strict saprotrophism as well as potential endophytes and pathogens with saprotrophic ability.

Fungal species identification has traditionally been based on direct observation, microscope examination, culture dependent isolation and phylogenetic analysis (Cai et al. 2011; Hyde et al. 2010, 2017; Rastogi and Sani 2011; Fadrosch et al. 2014, Tibpromma et al. 2017). Such studies have investigated the microbial ecology of various

environments (Rastogi and Sani 2011). However, it has been recognized that the actual number of microbes in nature, often exceed the number of microbes identified by traditional methods (Fadrosch et al. 2014). Traditional approaches rely on growing the organisms in media, but many of the microbes in the environment may not be cultivatable (Stewart 2012). Artificial medium typically allows growth of only a small fraction of, often fast growing organisms. Therefore, traditional techniques do not provide a total community resolution (Hoppe et al. 2016).

During the past decade, microbial research made a shift from phylogenetic analyses to experimental characterization of communities through the use of complex experimental designs (Kozich et al. 2013). This shift focused on relatively inexpensive next-generation sequencing approaches (NGS) and powerful bio-informatics tools to analyse the microbial ecology (Carraro et al. 2011; Rastogi and Sani 2011). High-throughput DNA sequencing allows us to understand the presence of microbes and how their communities are structured in complex ecosystems. Microbiome analysis is a culture-independent technique which requires a low quantity of sample, but with a high sequencing depth. The term microbiome refers to the entire habitat including the microorganisms, their genomes and the surrounding environment. It is characterized by the application of one or combinations of metagenomics, metatranscriptomics and metaproteomics (Marchesi and Ravel 2015). Analysis of the plant microbiome involves linking microbial ecology and the plants biology and functions, and at the same time viewing microorganisms as a reservoir of additional genes and functions for their host (Vandenkoornhuysen et al. 2015). Mycobioime refers to the fungal component in a habitat (Underhill and Iliev 2014). However, these techniques may also have disadvantages. For example, the conditions that we select to do the PCR can give us biased results. Sometimes it is difficult to understand whether the fungi identified by this technique actually exist in the natural system (Mitchell and Zuccaro 2006). Therefore, in order to obtain a better resolution in species identification, richness and distribution patterns of microbes, a combination of both approaches (i.e. traditional and culture-independent) are needed. However, we are aware of no studies that have been conducted using both these approaches.

There have been many studies of major pathogens from *Vitis* using both morphology and phylogeny (Úrbez-Torres et al. 2012, 2013a, b; Dissanayake et al. 2015; Jayawardena et al. 2015, 2016a; Chethana et al. 2017). Even though a number of sexual and asexual fungi have been reported on *Vitis* species, updated information of the taxa present in this genus is lacking. Only some have good illustrations and gene sequence data. Our knowledge on saprotrophic

fungal communities associated with *V. vinifera* is limited and data based on high-resolution culture-independent technique is lacking. Besides the percentage of potential fungal pathogens hidden in saprotrophic community is still unknown.

In this study, we aim to (i) provide taxonomic information on the saprotrophic microfungi collected from China, Italy, Thailand and Russia, (ii) compare traditional and culture-independent approaches for characterizing the saprotrophic fungal communities associated with two cultivars of *V. vinifera* in China, (iii) quantify plant pathogens and endophytes hidden in the saprotrophic fungal community and (iv) provide a worldwide checklist for the fungi on *Vitis* species based on previous and current research.

Materials and methods

Study site, sampling and isolation of fungi

Fungal species associated with *Vitis* sp. were collected from China (Beijing, Sichuan and Yunnan Province), Italy (Province of Forlì-Cesena), Russia (Rostov Region) and Thailand (Chiang Sean) (Tables 1, 2). Shoots, leaves, inflorescences, bark and root samples of *Vitis vinifera* were used for isolation. The same set of samples from Beijing (Red Globe cultivar) and Yunnan Province (Carbanate Gernischet cultivar) were used for the mycobiome analysis to establish the fungal communities (Fig. 1). The sample sets were randomly split into two subsamples to employ the two approaches at the same time. Specimens were incubated in a moist chamber for 3–7 days at 25 °C, if they did not sporulate. Fungi were isolated by a modified single spore/conidial isolation method (Chomnunti et al. 2014) from the samples. Growth rate, colony characteristics and sexual/asexual morph morphology were determined from cultures grown on potato-dextrose agar (PDA) at 25 °C, under 12 h light/12 h dark. Fungal mycelia and spores were examined by differential interference contrast (DIC) and photographed with an axio Imager Z2 photographic Microscope (Carl Zeiss Microscopy, Germany) (Supplementary Figs. S1a–S1d, S2). Forty conidial measurements were taken for each isolate. All microscopic measurements were recorded with ZeM PRO 2012 software. Representative herbariums are deposited in the herbarium of Mae Fah Luang University, Chiang Rai, Thailand (MFU) and in Kunming, China (KIB). Representative cultures were deposited at Mae Fah Luang Culture Collection (MFLUCC), Beijing Academy of Agriculture and Forestry Sciences, China (JZB) and Kunming Culture Collection (KUMCC).

DNA extraction, PCR amplification, sequencing and phylogenetic analysis

The methods used are presented in detail in Jayawardena et al. (2018).

Culture-independent approach: mycobiome analysis

Two cultivars were selected for this analysis; Red Globe being the table grape cultivar and Carbanate Gernischet being the Wine grape cultivar. Samples of Red Globe (RG) were collected from Yanqin District of Beijing while samples of Carbanate Gernischet (CG) were collected from Yunnan Province were used for this analysis. For each cultivar, three representative grapevine plants were sampled. The root, bark, shoot, inflorescence and leaves were homogenized and sub-sampled. For culture-independent technique of fungal communities, total DNA extraction was performed using 1 g of ground specimens using 2× CTAB method. All the DNA samples were quantitated and quality checked with the NanoDrop ND-2000C spectrophotometer (ThermoFisher Scientific, Dreieich, Germany). DNA extracts were then stored at – 20 °C for further analysis. For fungal Illumina sequencing, we targeted the Internal Transcribed Spacer 1 (ITS1) region of ribosomal RNA gene cluster. ITS1 was amplified with the forward primer ITS5-1737 (GGAAGTAAAAGTCGTAACAAGG) and reverse primer ITS2-2043R (GCTCGCTTCTTCATCGATGC) (White et al. 1990). The PCR reaction was performed in a 50 µl volume that contained approximately 10 ng of DNA, ExTaq buffer, 0.2 mM of dNTPs, 0.2 mM of each primer, and 2 units of ExTaq DNA polymerase. The cycling consisted of an initial denaturing at 94 °C for 30 s, followed by 25 cycles of denaturing at 94 °C for 30 s, annealing at 54 °C for 1 min and extension at 72 °C for 2 min, and a final extension at 72 °C for 8 min. All PCR reactions were carried out with Phusion® High-Fidelity PCR Master Mix (New England Biolabs Inc. Ipswich, MA, USA). The PCR products were mixed with same volume of 1× loading buffer (contained SYB green) and then operated electrophoresis on 2% agarose gel for quality detection. Only samples with bright main strip between 400–450 bp were chosen for further experiments. The qualified PCR products were mixed in equidensity ratios. Then, mixture PCR products were purified with Qiagen Gel Extraction Kit (Qiagen, Germany) following the manufacturer's protocol.

Sequencing libraries were generated using TruSeq® DNA PCR-Free Sample Preparation Kit (Illumina, San Diego, CA, USA) following manufacturer's recommendations and index codes were added. The library quality was

Table 1 Taxa identified in China, Russia, Italy and Thailand by directly observing specimens

Family	Species	Country
<i>Amorosiaceae</i>	<i>Angustimassarina populi</i>	Italy
<i>Botryosphaeriaceae</i>	<i>Botryosphaeria dothidea</i>	China, Italy
<i>Botryosphaeriaceae</i>	<i>Diplodia seriata</i>	Italy
<i>Botryosphaeriaceae</i>	<i>Dothiorella iberica</i>	Italy
<i>Botryosphaeriaceae</i>	<i>Dothiorella sarmentorum</i>	China, Italy
<i>Botryosphaeriaceae</i>	<i>Neofusicoccum italicum</i>	Italy
<i>Botryosphaeriaceae</i>	<i>Neofusicoccum parvum</i>	Italy
<i>Cantharellales Incertae sedis</i>	<i>Minimedusa</i> sp.	China
<i>Chaetomiaceae</i>	<i>Chaetomium globosum</i>	Italy
<i>Chaetosphaeriaceae</i>	<i>Pseudolachnea hispidula</i>	Italy
<i>Cladosporiaceae</i>	<i>Cladosporium cladosporioides</i>	China, Italy
<i>Cladosporiaceae</i>	<i>Cladosporium cucumerinum</i>	Italy
<i>Diaporthaceae</i>	<i>Diaporthe ampelina</i>	Italy
<i>Diaporthaceae</i>	<i>Diaporthe rudis</i>	Italy
<i>Diaporthaceae</i>	<i>Diaporthe eres</i>	China
<i>Diatrypidae</i>	<i>Cryptovalsa ampelina</i>	Italy
<i>Didymellaceae</i>	<i>Didymella negriana</i>	Italy
<i>Didymellaceae</i>	<i>Didymella pomorum</i>	China
<i>Didymellaceae</i>	<i>Epicoccum nigrum</i>	Italy
<i>Didymosphaeriaceae</i>	<i>Pseudocamarosporium propinquum</i>	Italy
<i>Glomerellaceae</i>	<i>Colletotrichum dematium</i>	Russia
<i>Glomerellaceae</i>	<i>Colletotrichum godetiae</i>	Italy
<i>Glomerellaceae</i>	<i>Colletotrichum hebeiense</i>	China
<i>Glomerellaceae</i>	<i>Colletotrichum siamense</i>	Italy
<i>Glomerellaceae</i>	<i>Colletotrichum viniferum</i>	China
<i>Glomerellaceae</i>	<i>Colletotrichum truncatum</i>	China
<i>Hypocreaceae</i>	<i>Trichoderma atroviride</i>	China
<i>Hypocreaceae</i>	<i>Trichoderma lixii</i>	China
<i>Hypocreaceae</i>	<i>Trichoderma harzianum</i>	China
<i>Hypocreales genera insertae sedis</i>	<i>Alfaria cyperi-esculentii</i>	Italy
<i>Hypocreales genera insertae sedis</i>	<i>Alfaria vitis</i>	Italy
<i>Lophiostomataceae</i>	<i>Lophiostoma macrostomum</i>	Italy
<i>Massariaceae</i>	<i>Neomassaria fabacearum</i>	Italy
<i>Mucoraceae</i>	<i>Actinomucor elegans</i>	China
<i>Mucoraceae</i>	<i>Mucor racemosus</i>	China
<i>Mucoraceae</i>	<i>Mucor circinelloides</i>	China
<i>Mycosphaerellaceae</i>	<i>Pseudocercospora vitis</i>	Thailand
<i>Peniophoraceae</i>	<i>Peniophora</i> sp.	China
<i>Sporocadaceae</i>	<i>Neopestalotiopsis clavispora</i>	China
<i>Sporocadaceae</i>	<i>Neopestalotiopsis vitis</i>	China
<i>Sporocadaceae</i>	<i>Pestalotiopsis chamaeropsis</i>	Italy
<i>Sporocadaceae</i>	<i>Pestalotiopsis</i> sp.	Italy
<i>Sporocadaceae</i>	<i>Pseudopestalotiopsis camelliae-sinensis</i>	Italy
<i>Pleosporaceae</i>	<i>Alternaria alternata</i>	China, Italy
<i>Pleosporaceae</i>	<i>Alternaria italic</i>	Italy
<i>Pleosporaceae</i>	<i>Alternaria vitis</i>	China
<i>Pleosporaceae</i>	<i>Bipolaris maydis</i>	China
<i>Pythiaceae</i>	<i>Pythium</i> sp.	China
<i>Saccharotheciaceae</i>	<i>Aureobasidium pullulans</i>	Italy
<i>Schizoparmaceae</i>	<i>Coniella vitis</i>	China

Table 1 continued

Family	Species	Country
<i>Sclerotiniaceae</i>	<i>Botrytis cinerea</i>	China
<i>Sporocadaceae</i>	<i>Seimatosporium vitis</i>	Italy
<i>Stachybotryaceae</i>	<i>Albifimbria verrucaria</i>	China
<i>Stachybotryaceae</i>	<i>Albifimbria viridis</i>	China
<i>Teichosporaceae</i>	<i>Floricola viticola</i>	Italy
<i>Aspergillaceae</i>	<i>Aspergillus aculeatus</i>	China
<i>Aspergillaceae</i>	<i>Aspergillus niger</i>	China
<i>Aspergillaceae</i>	<i>Penicillium brevicompactum</i>	China
<i>Aspergillaceae</i>	<i>Penicillium citrinum</i>	China
<i>Aspergillaceae</i>	<i>Penicillium terrigenum</i>	China
<i>Rhizopodaceae</i>	<i>Rhizopus oryzae</i>	China
<i>Trichocomaceae</i>	<i>Talaromyces amestolkiae</i>	China
<i>Trichocomaceae</i>	<i>Talaromyces pinophilus</i>	China
<i>Trichocomaceae</i>	<i>Talaromyces purpureogenus</i>	China
<i>Xylariaceae</i>	<i>Neanthostomella viticola</i>	Italy

assessed on the Qubit[®] 2.0 Fluorometer (Thermo Scientific) and Agilent Bioanalyzer 2100 system. At last, the library was sequenced on an IlluminaHiSeq2500 platform and 250 bp paired-end reads were generated.

Paired-end reads were assigned to samples based on their unique barcode and truncated by cutting off the barcode and primer sequence. Paired-end reads were merged using FLASH (V1.2.7, <http://ccb.jhu.edu/software/FLASH/>) (Magoč and Salzberg 2011). Quality filtering on the raw tags was performed under specific filtering conditions to obtain the high-quality clean tags (Bokulich et al. 2013) according to the QIIME (V1.7.0, <http://qiime.org/index.html>) quality controlled process (Caporaso et al. 2010). The tags were compared with the reference database (Unite Database, <https://unite.ut.ee/>) using UCHIME algorithm (UCHIME Algorithm, http://www.drive5.com/usearch/manual/uchime_algo.html) to detect chimera sequences (Edgar et al. 2011), and then the chimera sequences were removed (Haas et al. 2011). Then the Effective Tags were finally obtained. Sequences analysis was performed by Uparse software (Uparse v7.0.1001, <http://drive5.com/uparse/>) (Edgar 2013). Sequences with $\geq 97\%$ similarity were assigned to the same OTUs. Representative sequence for each OTU was screened for further annotation. For each representative sequence, the Unite Database (<https://unite.ut.ee/>) (Kõljalg et al. 2013) was used to annotate taxonomic information based on Blast algorithm, which was calculated by QIIME software (Version 1.7.0) (http://qiime.org/scripts/assign_taxonomy.html). In order to study phylogenetic relationship of different OTUs, and the difference of the dominant species in different samples (groups), multiple sequence alignment were conducted using the MUSCLE software (Version 3.8.31, <http://www.drive5.com/muscle/>) (Edgar 2004).

All OTU abundance information was normalized using a standard of sequence number corresponding to the sample with the least sequences (45, 246 sequences). From the data set, rare OTUs (singletons), which could have potentially originated from sequencing errors (Kunin et al. 2010), were removed. We used a Mantel test based on Bray–Curtis distance measure with 999 permutations to assess the correlation between the whole matrix and a matrix excluding the rare OTUs (Hammer et al. 2001; Hoppe et al. 2016). The results indicated that the removal of rare OTUs from the fungal communities had no effect ($R_{\text{Mantel}} = 1.000$, $P = 0.002$). Subsequent analysis of alpha diversity and community composition were all performed basing on these normalized rare OTUs removal data. The fungal ITS rDNA genes Illumina sequencing data are deposited in the NCBI under the BioProject No PRJNA437133.

Statistical analysis

Mycobiome analysis

All datasets related to fungal OTU richness were tested for normality and equality of variances using the Jarque–Bera test. To assess the coverage of the sequencing depth, individual rarefaction analysis was performed for each sample using the “diversity” function in PAST (Hammer et al. 2001). In this work we used observed fungal OTU richness and Shannon diversity index as the measures for fungal diversity. The difference in fungal OTU richness between the two deadwood species was compared using a two-sample *t* test in PAST. To visualize the fungal community compositions, we used non-metric multidimensional scaling (NMDS) analysis based on the Bray–Curtis dissimilarity index calculated PAST. Similarity

Table 2 Taxa identified from the two grape cultivars and their life modes using the traditional approach

Species	Family	Life Mode	References
<i>Actinomyces elegans</i> var. <i>meitauzae</i>	<i>Mucoraceae</i>	Saprotroph	Zheng and Liu (2005)
<i>Albifimbria viridis</i>	<i>Stachybotryaceae</i>	Saprotroph	Lombard et al. (2016)
<i>Albifimbria verrucaria</i>	<i>Stachybotryaceae</i>	Saprotroph	Lombard et al. (2016)
<i>Alternaria alternata</i>	<i>Pleosporaceae</i>	Pathogen, endophyte, saprotroph	French (1989), Mulenko et al. (2008), Kakalikova et al. (2009), Gonzalez and Tello (2011)
<i>Alternaria vitis</i>	<i>Pleosporaceae</i>	Pathogen, endophyte, saprotroph	Zhang (2003), Zhuang (2005)
<i>Aspergillus aculeatus</i>	<i>Aspergillaceae</i>	Secondary pathogen, saprotroph	Jarvis and Traquair (1984)
<i>Aspergillus niger</i>	<i>Aspergillaceae</i>	Secondary pathogen, endophyte, saprotroph	Bobev (2009), Casieri et al. (2009), Gonzalez and Tello (2011)
<i>Bipolaris maydis</i>	<i>Pleosporaceae</i>	Saprotroph	Manamgoda et al. (2014)
<i>Botryosphaeria dothidea</i>	<i>Botryosphaeriaceae</i>	Pathogen, endophyte, saprotroph	Úrbez-Torres et al. 2012, 2013a, b
<i>Botrytis cinerea</i>	<i>Sclerotiniaceae</i>	Pathogen	Piqueras et al. (2014), Saito et al. (2016)
<i>Cladosporium cladosporioides</i>	<i>Cladosporiaceae</i>	Pathogen, endophyte, saprotroph	Swett et al. (2016)
<i>Cladosporium</i> sp.	<i>Cladosporiaceae</i>	Pathogen, endophyte, saprotroph	Swett et al. (2016)
<i>Clonostachys rosea</i>	<i>Bionectriaceae</i>	Pathogen, endophyte, saprotroph	Casieri et al. (2009)
<i>Colletotrichum hebeiense</i>	<i>Glomerellaceae</i>	Pathogen	Yan et al. (2015)
<i>Colletotrichum truncatum</i>	<i>Glomerellaceae</i>	Pathogen	Pan et al. (2016)
<i>Colletotrichum viniferum</i>	<i>Glomerellaceae</i>	Pathogen	Peng et al. (2013)
<i>Coniella vitis</i>	<i>Schizoparmaceae</i>	Pathogen	Chethana et al. (2017)
<i>Diaporthe eres</i>	<i>Diaporthaceae</i>	Pathogen	Bastide et al. (2017)
<i>Didymella pomorum</i>	<i>Didymellaceae</i>	Saprotroph	Cook and Dubé (1989)
<i>Dothiorella sarmentorum</i>	<i>Botryosphaeriaceae</i>	Pathogen	Carlucci et al. (2015)
<i>Epicoccum nigrum</i>	<i>Didymellaceae</i>	Saprotroph	Casieri et al. (2009)
<i>Exserohilum rostratum</i>	<i>Pleosporaceae</i>	Saprotroph	Ariyawansa et al. (2015)
<i>Fusarium oxysporum</i>	<i>Nectriaceae</i>	Pathogen	Gonzalez and Tello (2011)
<i>Fusarium</i> sp.	<i>Nectriaceae</i>	Pathogen	Gonzalez and Tello (2011)
<i>Minimedusa</i> sp.	<i>Cantharellales incertae sedis</i>	Saprotroph	Beale and Pitt (1990)
<i>Mucor racemosus</i>	<i>Mucoraceae</i>	Secondary pathogen	Gonzalez and Tello (2011)
<i>Mucor circinelloides</i>	<i>Mucoraceae</i>	Secondary pathogen	Gonzalez and Tello (2011)
<i>Neopestalotiopsis clavispora</i>	<i>Sporocadaceae</i>	Saprotroph	Maharachchikumbura et al. (2015)
<i>Neopestalotiopsis vitis</i>	<i>Sporocadaceae</i>	Pathogen	Jayawardena et al. (2015, 2016a, b)
<i>Paraphoma chrysanthemicola</i>	<i>Pleosporales incertae sedis</i>	Saprotroph	Hofstetter et al. (2012)
<i>Penicillium brevicompactum</i>	<i>Aspergillaceae</i>	Secondary pathogen	Kim et al. (2007)
<i>Penicillium citrinum</i>	<i>Aspergillaceae</i>	Secondary pathogen	Kim et al. (2007)
<i>Penicillium terrigenum</i>	<i>Aspergillaceae</i>	Secondary pathogen	Kim et al. (2007)
<i>Peniophora</i> sp.	<i>Peniophoraceae</i>	Saprotroph	Torrejón (2013)
<i>Phoma medicaginis</i>	<i>Didymellaceae</i>	Saprotroph	Weber et al. (2004)

Table 2 (continued)

Species	Family	Life Mode	References
<i>Pythium amasculinum</i>	Pythiaceae	Pathogen	Uzuhashi et al. (2010)
<i>Rhizopus oryzae</i>	Rhizopodaceae	Secondary pathogen	Gonzalez and Tello (2011)
<i>Septoriella allojunci</i>	Dothideomycetes <i>incetae sedis</i>	Saprotroph	Li et al. (2015)
<i>Stagonosporopsis</i> sp. 1	Didymellaceae	Saprotroph	Hofstetter et al. (2012)
<i>Stagonosporopsis</i> sp.2	Didymellaceae	Saprotroph	Hofstetter et al. (2012)
<i>Talaromyces pinophilus</i>	Trichocomaceae	Saprotroph	Yilmaz et al. (2014)
<i>Talaromyces purpurogenus</i>	Trichocomaceae	Saprotroph	Yilmaz et al. (2014)
<i>Talaromyces amestolkiae</i>	Trichocomaceae	Saprotroph	Yilmaz et al. (2014)
<i>Trichoderma atroviride</i>	Hypocreaceae	Saprotroph	Gonzalez and Tello (2011)
<i>Trichoderma harzianum</i>	Hypocreaceae	Saprotroph	Gonzalez and Tello (2011)
<i>Trichoderma lixii</i>	Hypocreaceae	Saprotroph	Gonzalez and Tello (2011)

Percentages (SIMPER) analysis using PAST was used to obtain the identity and relative abundances of the fungal taxa that contributed to 92.92% of the observed pair-wise variation in the fungal community composition due to different *V. vinifera* cultivars. To accounting for the effect of locations when compared the fungal community compositions of the two grape cultivars which were collected from different locations, we eliminated all location specific fungal OTUs (87 OTUs). We finally retained 139 OTUs for the community composition analysis using NMDS based on the Bray–Curtis dissimilarity. The results from these reduced datasets were highly consistent compared with the total datasets (Supplementary Fig. S3a, b). Potential fungal functional groups were identified using the online Guilds application tool: FUNGuildb (Nguyen et al. 2015). The ITS1 fragments were extracted from both the Sanger sequencing (traditional) and Illumina sequencing datasets using ITS1. The output showed that both datasets have the ITS1 region except culture sequences of the genus *Neopestalotiopsis* (9 sequences). The sequence similarity based comparison was performed using the cd-hit-est-2d algorithm at 90% similarity level for a genus level comparison.

Diversity analysis

Taxa were recorded as either present or absent from each sample. Occurrence of a fungus was designated based on the presence of a particular fungus on the host samples. Percentage occurrence of a taxon on one sample was calculated using the following formula (Tsui et al. 2001; Yanna and Hyde 2002; Wang et al. 2008):

Percent occurrence of a taxon A (%)

$$= \frac{\text{Occurrence of taxon A}}{\text{Occurrence of all taxa in one sample}} \times 100$$

Species richness

= the number of different species represented in an ecological community

Following diversity indices were calculated using the R software for the two cultivars and the habits.

$$(i) \text{ Shannon–Wiener's Index (H)} = \sum p_i \ln p_i,$$

where p_i is the frequency of fungal species I occurring on a specific sample (Begon et al. 1993; Wong and Hyde 2001; Wang et al. 2008).

$$(ii) \text{ Sørensen's index of similarity (S)} = 2c/(a + b),$$

where a is the total number of species on host A, b is the total number of species on host B and c is the number of species on both host. Similarity is expressed with values between 0 (no similarity) and 1 (absolute similarity) (Wang et al. 2008).

Compiling the checklist

The checklist is based on, articles in referred journals, Index to Saccardo's Sylloge fungorum, Petrak's Lists, Index of Fungi, graduate student theses, books, and web-based resources such as annual reports on this host and the SMML database (<https://nt.ars-grin.gov/fungalatabases/>)

Fig. 1 Dead *V. vinifera* samples at collection sites



(latest accessed 14-9-2017). The mode of life, such as pathogen, endophyte or saprotroph is listed. The checklist includes species names, family, life modes, disease name if any and locality. The current name is used according to Index Fungorum (2018) and Wijayawardene et al. (2017) and the classification follows Wijayawardene et al. (2018). Genera and species are listed in alphabetical order. Identification confirmed by molecular data is marked with an asterisk (*). In some cases, the host name given in the original citation was changed to be consistent with current taxonomy. In a few cases, neither the species cited nor a proper synonym was identified and the species name was used as originally cited.

Results

Species identified from fresh collections based on morphology and phylogeny (traditional method)

Fungal saprophytic diversity and community composition of the two grape cultivars: traditional method

Examination of decaying leaves, shoots, inflorescence, berries, root and bark of two cultivars of *V. vinifera* from China yielded 461 collections for the Red Globe variety and 180 collections for Carbanate Gernischet. The Red Globe variety

had higher species richness (41) than the Carbanate Gernischet variety (23), however the Shannon diversity was not significantly different (Table 3). The majority of the culturable saprotrophic fungi were ascomycetes. However, there were two species belonging to Agaricomycetes and one species belonging to *Oomycota incertae sedis*. Thirty genera and 45 taxa were identified based on morphology and phylogenetic sequence data. From the identified isolates, 32.6% were Sordariomycetes, 26.1% Dothideomycetes 19.7% Eurotiomycetes, 6.5% Mucoromycetes, 4.4% Agaricomycetes, 2.2% Leotiomycetes and 2.2% of *Oomycota incertae sedis*. There were four taxa belonging to *Zygomycota incertae sedis*, which we were unable to identify. The identified Sordariomycetes belonged to *Bionectriaceae* (6.7%), *Diaporthaceae* (6.7%), *Glomerellaceae* (20%), *Hypocreaceae* (20%), *Nectriaceae* (13.3%), *Schizoparmaceae* (6.7%), *Stachybotryaceae* (13.3%) and *Sporocadaceae* (13.3%). Dothideomycete isolates belonged to *Botryosphaeriaceae* (16.7%), *Cladosporiaceae* (16.7%), *Didymellaceae* (33.3%) and *Pleosporaceae* (33.3%). The rest of the isolates belong to *Mucoraceae* (6.5%), *Peniophoraceae* (2.2%), *Pythiaceae* (2.2%), *Rhizopodaceae* (2.2%), *Sclerotiniaceae* (2.2%) and *Trichocomaceae* (17.4%). Among those 45 taxa, we found 19 species that were common on both cultivars: *Actinomyces elegans*, *Alternaria alternata*, *Aspergillus niger*, *A. aculeatus*, *Cladosporium cladosporioides*, *Cladosporium* sp., *Clonostachys rosea*, *Coniella vitis*, *Diaporthe eres*, *Fusarium oxysporum*, *Mucor racemosus*, *Penicillium terrigenum*, *Phoma medicaginis*, *Rhizopus oryzae*, *Talaromyces amestolkiae*, *T. pinophilus*, *T. purpurogenus* and *T. harzianum*. The Sørensen's index of similarity of the two grape cultivars was 0.58. We have identified 45 taxa to species level, although in six cases the identification is only to genus level due to lack of enough molecular data. Taxa were identified using both morphology and molecular techniques. Identified species are listed in Tables 1 and 2 (Supplementary Figs. S1a–d, S2).

Fungal saprophytic diversity and community composition of the two grape cultivars: culture-independent technique

Bioinformatics processing of the sequence data sets

A total of 638,146 quality-filtered fungal ITS reads were obtained after removal of chimeric and the unique tag

Table 3 Richness and diversity (mean \pm SD, n = 3) of fungi detected in the two *Vitis vinifera* cultivars

	RG	CG
Species richness	41	23
Shannon	2.5433 \pm 0.251	2.4743 \pm 0.187

(3703 sequences) sequences. After normalizing all data sets to a smallest sequence read (45, 246 sequences) and removing all rare taxa, the final analyse data sets contained 226 fungal OTUs. Phylogenetic trees for the top 20 species in different samples of the two cultivars Carbanate Gernischet and Red Globe of *Vitis vinifera* are given in Fig. 2. With the high number of sequence reads per sample obtained in this study, the sample-based rarefaction curves almost reached saturation for all samples (Fig. 3a). We used the observed OTU richness and Shannon diversity directly for further analyses.

Fungal saprotrophic OTU diversity and distribution in the two cultivars of *Vitis vinifera*

Diverse fungi colonized the debris samples derived from Carbanate Gernischet and Red Globe cultivars. Fungal OTU richness was not significantly different between the two *V. vinifera* cultivars tested in this study, ranging from 122–137 (127.33 \pm 4.84 (mean \pm SD); Carbanate Gernischet) and 116–141 (126.33 \pm 7.54 (mean \pm SD); Red Globe) ($t = 0.11$, $P = 0.916$). Shannon diversity also showed a similar trend ranging from 1.98–2.35 (2.16 \pm 0.11 (mean \pm SD); Carbanate Gernischet) and 1.78–1.98 (1.86 \pm 0.06 (mean \pm SD); Red Globe) ($t = 2.41$, $P = 0.07$). In total we detected 226 fungal OTUs with 176 and 189 belonging to the cultivars Carbanate Gernischet and Red Globe, respectively. There were 139 Fungal OTUs shared between the two *V. vinifera* cultivars and 37 and 50 OTUs were specific to Carbanate Gernischet and Red Globe cultivars. When we took each replicate into account, we detected only moderate proportion of fungal OTUs shared across different replicates (31–44%, 51 OTUs, Fig. 3b). Distributions of fungal OTUs across replicates for the two cultivars and for each specific cultivar are shown in Fig. 3b–d.

Fungal saprophytic community composition: culture-independent technique

The NMDS ordination plot and SIMPER analysis revealed distinct fungal communities in the two cultivars of *V. vinifera* samples (Table 4 and Supplementary Fig. S3a, b). Overall, fungal community composition of the two cultivars had the overall average dissimilarity of 94.29% (based on Bray–Curtis distance measure) and 30 fungal OTUs mostly responsible for differences in fungal community composition were all together accounting for 94.41% of the overall average dissimilarity (Table 4). The difference in fungal community composition between the two cultivars of *V. vinifera* was detected across different taxonomic levels (Supplementary Figs. S4, S5).

In Carbanate Gernischet, members of Ascomycota were commonly detected accounting for 77% (46%

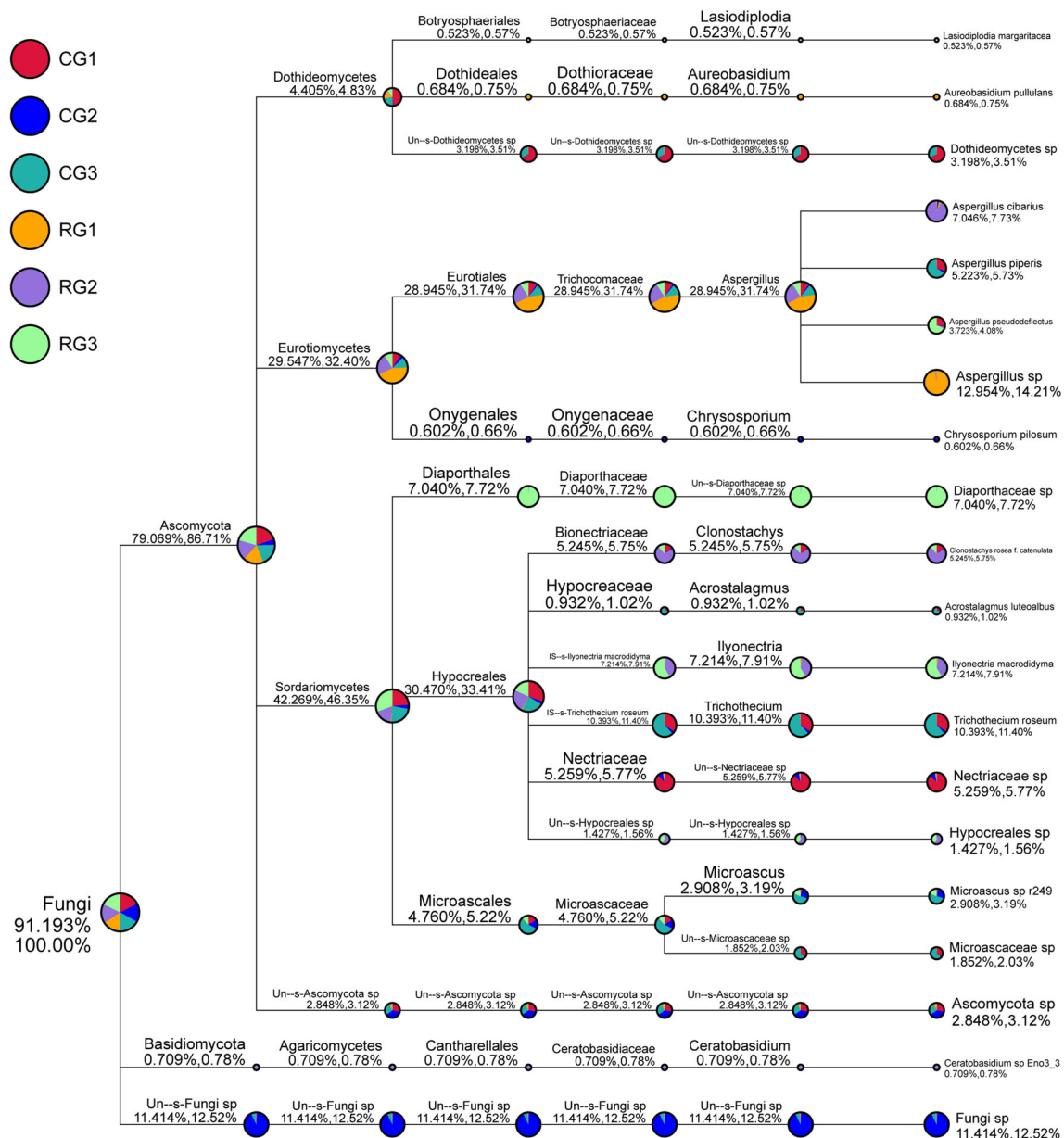


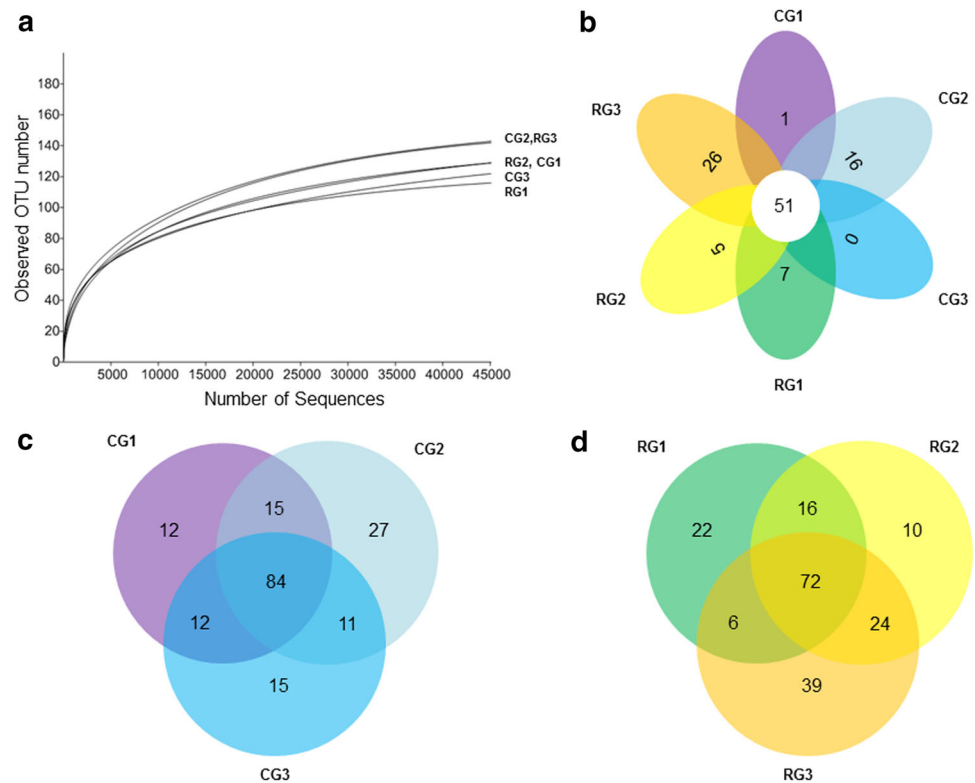
Fig. 2 Phylogenetic tree of top 20 species in different samples of the two cultivars Carbanate Gernischet and Red Globe of *Vitis vinifera*

Sordariomycetes, 19% Eurotiomycetes and 7% Dothideomycetes) of total sequences in this cultivar followed by unidentified phylum (23%; Fungal OTU-7) and Basidiomycota and Zygomycota (less than 0.1%). In Red Globe, almost all sequences were assigned to Ascomycota (97%; 51% Eurotiomycetes, 42% Sordariomycetes, and 3% Dothideomycetes) followed by Basidiomycota (3%; 1% Agaricomycetes and 1% Tremellomycetes) and unidentified phylum (Fungal OTU-7) and Zygomycota were negligible (altogether less than 0.5%). Phylogenetic tree for the abundance at genus level using the top 35 genera detected in the two cultivars are shown in Fig. 4. The difference between the fungal community composition of the two

cultivars of *V. vinifera* were clearly demonstrated at OTU level: *Trichothecium roseum* OTU-1, Fungal-OTU-7, *Aspergillus piperis* OTU-5 and *Nectriaceae* OTU-3 were commonly detected (10–20%) in Carbanate Gernischet, but almost absent in Red Globe (represented by *Aspergillus* OTU-11, *Ilyonectria macrodidyma* OTU-4, *Aspergillus cibarius* OTU-2 and *Diaporthaceae* OTU-10; Table 4).

Using presence/absence data, we found that for both *Vitis vinifera* cultivars Ascomycota (Carbanate Gernischet = 151 OTUs and Red Globe = 162 OTUs) was the richest OTU phylum followed by unidentified phylum, Basidiomycota (11–14 OTUs) and Zygomycota (2 OTUs).

Fig. 3 Rarefaction curves (a), and Venn diagrams show distribution of OTUs across different samples (1–3): (b) in both Carbanate Gernischet (CG) and Red Globe (RG) cultivars, (c) only Carbanate Gernischet and (d) only Red Globe



Patterns of the richest OTU classes and orders were similar for both cultivars: Sordariomycetes (Hypocreales (Carbanate Gernischet = 32 OTUs and Red Globe = 39 OTUs), Sordariales (Carbanate Gernischet = 13 OTUs and Red Globe = 13 OTUs), Microascales (Carbanate Gernischet = 10 OTUs and Red Globe = 11 OTUs)], Eurotiomycetes (Eurotiales, Carbanate Gernischet = 41 OTUs and Red Globe = 38 OTUs) and Dothideomycetes (Pleosporales, Carbanate Gernischet = 7 OTUs and Red Globe = 7 OTUs).

Comparing and matching of traditional and culture-independent approaches

Several commonly detected fungal genera (*Aspergillus*, *Clonostachys* and *Fusarium*) were detected in both approaches. However, there are many highly or frequently detected genera in the mycobiome that were not detected in the traditional method. These include *Acrostalagmus*, *Aureobasidium*, *Ceratobasidium*, *Chrysosporium*, *Ilyonectria*, *Lasiodiplodia*, *Microascus*, and *Trichothecium* (Supplementary Table S1). Some frequently isolated fungi, especially the fast growing ones (*Rhizopus* and *Mucor*) were not detected in mycobiome analysis.

ITS sequences obtained from both traditional and culture-independent methods were compared using the query and cluster cover. This showed that the saprotrophs detected from the two approaches are consistent in most

cases. However, in few cases we found inconsistent identifications which have arisen from the lower level of taxonomic assignment in the culture-independent (amplicon sequencing) as compared with traditional approaches. For example, *Diaporthe eres* and *Alternaria* identified via the traditional approach were identified as *Diaporthaceae* and *Pleosporaceae* in the culture-independent analyses. A mismatch was also found between *Albifimbria viridis* and *Myrothecium* sp., which are classified in the same order (Hypocreales). The sexual morph genus *Talaromyces* was matched with its potential asexual morph (*Penicillium*). We found that twelve taxa detected from traditional method form a cluster (91–100% similarity) with 25 fungal OTUs from the culture-independent methods (Table 5). We were able to assign 25 OTUs from NGS: 20 OTUs to genus and 5 OTUs (similarity 99–100%) to species level respectively (Table 5). We removed two OTUs as singletons (*Botryosphaeria* OTU-178 and Ascomycota OTU-213) as they were detected only once. However, in the direct matching of ITS sequences, these fungal OTUs showed 97 and 100% similarity to *Botryosphaeria dothidea* and *Coniella vitis*, respectively. The other fungi that we were able to identify to the species level are *Aspergillus niger*, *Clonostachys rosea*, *Botrytis cinerea*, and *Albifimbria viridis*. Most of the frequently detected genera in the traditional approach (i.e. with relative abundance higher than 5%; *Alternaria*, *Clonostachys*, *Fusarium*) were also detected in culture-independent approach. *Rhizopus* sp. and

Table 4 Similarity percentages (SIMPER) analysis showing the top 30 fungal OTUs mostly responsible for differences in fungal community composition between Carbanate Gernischet(CG) and Red Globe (RG) cultivars; OA Dissimilarity = overall average dissimilarity

Taxon	Contrib. %	Mean abund. CG	Mean abund. RG
<i>Trichothecium roseum</i> OTU_1	10.91	20.70	0.10
FungalOTU_7	10.82	20.60	0.22
<i>Aspergillus</i> OTU_11	9.99	0.07	18.90
<i>Ilyonectria macrodidyma</i> OTU_4	7.53	0.12	14.30
<i>Aspergillus cibarius</i> OTU_2	6.90	0.68	13.40
Diaporthaceae OTU_10	5.77	0.01	10.90
<i>Aspergillus piperis</i> OTU_5	5.42	10.30	0.12
Nectriaceae OTU_3	5.18	9.94	0.19
<i>Clonostachys rosea</i> OTU_9	4.37	1.76	8.73
Dothideomycetes OTU_8	3.27	6.27	0.11
<i>Aspergillus pseudodeflectus</i> OTU_13	3.02	2.10	5.27
<i>Microascus</i> OTU_12	2.12	4.54	1.10
<i>Aspergillus</i> OTU_21	1.88	0.01	3.55
Microascaceae OTU_18	1.86	3.53	0.02
<i>Aspergillus</i> OTU_30	1.80	0.01	3.39
Eurotiales OTU_208	1.68	1.31	2.91
Diaporthaceae OTU_16	1.64	0.08	3.11
Ascomycota OTU_14	1.45	2.76	0.04
Eurotiales OTU_27	1.30	0.01	2.46
<i>Acrostalagmus luteoalbus</i> OTU_15	0.98	1.85	0.01
FungalOTU_19	0.95	1.81	0.02
Hypocreales OTU_17	0.80	0.02	1.54
<i>Ceratobasidium</i> OTU_20	0.75	0.01	1.41
<i>Aureobasidium pullulans</i> OTU_29	0.72	0.00	1.36
Ascomycota OTU_23	0.63	1.21	0.02
<i>Chrysosporium pilosum</i> OTU_22	0.62	1.19	0.02
Hypocreales OTU_25	0.62	0.07	1.18
Ascomycota OTU_26	0.51	0.97	0.01
Eurotiales OTU_6	0.48	0.91	0.01
<i>Lasiodiplodia margaritacea</i> OTU_32	0.47	0.08	0.96
Summary (OA Dissimilarity = 94.29)	94.41	92.92	95.36

Talaromyces sp. were frequently detected in the traditional approach, but exhibited low relative abundances or disappeared in the culture-independent approach.

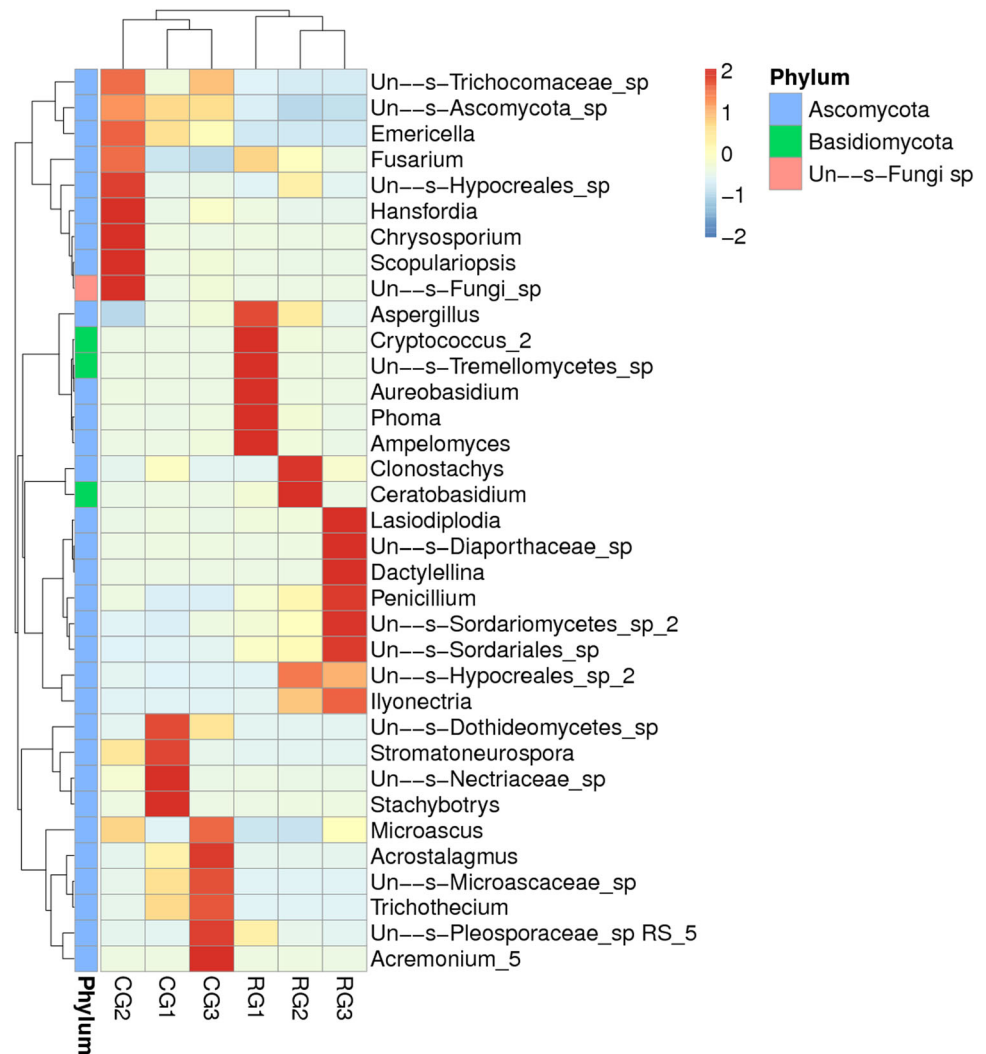
Fungal functional groups identified using traditional and culture-independent approaches

Among the 45 identified taxa based on traditional method, 17 are well known pathogens on *V. vinifera* causing severe yield as well as economic loss to viticulture around the

world (Table 2). Six species of secondary pathogens of *V. vinifera* were also identified in this study. Most of the pathogens tend to survive or overwinter on dead plant material as saprotrophs and act as the primary inoculums once the conditions are favourable (Armijo et al. 2016).

In total, 143 fungal OTUs (63% of total fungal OTUs) were successfully assigned for their functions (Supplementary Table S1). We identified six functional groups of fungi associated with dead materials of *V. vinifera*: saprotrophs, plant pathogens, endophytes, fungal parasites–

Fig. 4 Abundance phylogenetic tree at genus level (top 35 genera) in two cultivars [Carbanate Gernischet (CG1-3) and Red Globe (RG1-3)] of *Vitis vinifera*



saprotrophs (mycoparasites–saprotrophs), ectomycorrhizae and animal pathogens. The fungal community was dominated by saprotrophs (102 OTUs) and plant pathogens (22 OTUs), which accounted for 71% and 15% of the function assigned to fungal OTUs in this study. *Clonostachys*, *Lasiodiplodia* and *Trichothecium*, were the most commonly detected plant pathogen genera with relative abundances 1–10%. *Botrytis* sp., an important fungal pathogen in grape, was also detected with low relative abundance. Endophytes together with endophyte–saprotrophs and endophyte–plant pathogens (9 OTUs) contributed little and most OTUs were detected with low relative abundance, except, *Acrostalagmus luteoalbus*. All fungal OTUs with their potential functions are listed in Supplementary Table S1.

Checklist of fungi on *Vitis*

Nine-hundred and six fungal taxa have been reported on *Vitis* species and are listed in Table 6, although the actual number of fungal taxa associated with this host is likely much higher. It is not possible to reconfirm all previous reports by re-examining collections to confirm their identities. In many cases no fungarium material is linked to the reports, while examining nearly 900 specimens would be an almost impossible task. Even if it was were possible, it would most likely be futile, since molecular data would be needed to establish correct names. This is extremely difficult based on the presently available techniques and not permitted by many fungaria. Most of the 905 taxa reported from *Vitis* species do not have sequence data. Therefore, recollecting and sequencing these taxa are essential to establish an accurate species list associated with *Vitis* species.

Table 5 Matching of fungal isolates to the saprotrophic mycobiome of *Vitis vinifera*

Fungal taxon (culture)	Relative abundance in culture (%)	Fungal taxa (mycobiome)	Relative abundance in mycobiome (%)	Cluster identification (coverage) %	Number of OTUs in cluster
<i>Albifimbria viridis</i>	0.55	<i>Myrothecium</i>	0.010	99 (100)	1
<i>Alternaria</i> spp.	28.14	<i>Ampelomyces</i> , <i>Phoma</i> , <i>Pleosporaceae</i> OTU, Fungal OTU	0.636	92–100 (95–100)	4
<i>Aspergillus niger</i>	6.01	<i>Aspergillus</i>	3.683	99 (100)	1
<i>Botryosphaeria dothidea</i>	0.27	<i>Botryosphaeria</i>	Remove as singleton	97 (100)	1
<i>Botrytis cinerea</i>	2.73	<i>Botrytis</i>	0.002	100 (100)	1
<i>Clonostachys rosea</i>	2.19	<i>Clonostachys</i>	5.244	99 (100)	1
<i>Coniella vitis</i>	1.09	Ascomycota OTU	Remove as singleton	100 (100)	1
<i>Diaporthe eres</i>	1.37	<i>Diaportheaceae</i> OTUs	0.070	92–97 (98–100)	2
<i>Fusarium</i> sp.	25.41	<i>Fusarium</i> , <i>Nectriaceae</i> OTUs	5.368	93–100 (83–87)	8
<i>Penicillium</i> sp.	0.54	<i>Penicillium</i>	0.203	91–100 (81–100)	3
<i>Talaromyces amestolkiae</i>	5.46	<i>Penicillium</i>	0.001	96 (100)	1
<i>Tricoderma atroviride</i>	4.09	<i>Tricoderma</i>	0.008	97 (99)	1

Discussion

Before the advent of molecular data in taxonomy, studies on the fungi on *Vitis* were based on traditional methodology and have resulted in hundreds of records of fungi from this host genus (Table 6). Most recent studies have been related to pathogens that affect grape yield and production (Úrbez-Torres et al. 2012, 2013a, b; Dissanayake et al. 2015; Liang et al. 2016; Jayawardena et al. 2015, 2016a; Yan et al. 2015; Chethana et al. 2017) and have resulted in well-resolved taxonomy as they have used molecular data. However, studies on saprobes using molecular data and culture-independent techniques have not been used to identify the fungi on *Vitis* to date. In this study, we therefore provide the first work comparing saprobes on *Vitis* sp. using both traditional and culture-independent approaches, with well-resolved taxonomic identifications based on molecular analyses. The taxa derived from both approaches are compared as the same samples were used in the study. We have also established the saprotrophic communities associated with both wine and table grapevine cultivars and demonstrate cultivar specific communities for each grapevine cultivar. A checklist of fungi of *Vitis* is also provided which is an important resource for viticulture.

Microfungi collected from China, Italy, Russia and Thailand

Sixty-seven saprotrophic taxa from 46 genera were identified in this study (Table 1). Using traditional methodology and analyses of molecular data, we identified two new species, and 41 new host or distribution records for *V. vinifera*. Taxonomic details, descriptions, photographic plates and phylogenetic analyses are provided in Jayawardena et al. (2018). Some of these genera have a wide distribution. For example, botryosphaerious and *Colletotrichum* taxa have a wide distribution. These taxa are well-known pathogens and can be spread to other countries undetectable through the exportation of rootstocks. Some genera are only known from one or two countries. This may be due to the lack of data on the fungi associated with this host.

Comparisons of traditional and culture-independent approaches for characterizing the saprotrophic fungal communities associated with two cultivars of *Vitis vinifera*

Most previous studies on fungi on grapevine have relied on traditional approaches (Table 6). Some recent identification of isolated taxa have incorporated analyses of ITS sequence data (Guo et al. 2003; Prompttha et al. 2007),

Table 6 Check list of fungi on *Vitis* sp. (classification follows Wijayawardene et al. 2017, 2018)

Species	Family	Life mode	Disease caused	Locality	References
<i>Acronium acutatatum</i> W. Gams*	<i>Bionectriaceae</i>	P	Unknown	Korea	Oh et al. (2014)
<i>A. alternatum</i> Link*	<i>Bionectriaceae</i>	E		China, Greece, Spain	Pantidou (1973), Benavides et al. (2013), Dissanayake et al. (2018)
<i>Acronium</i> sp.*	<i>Bionectriaceae</i>	P, E	'Hoja de malvon'	Argentina, China, Iran, Italy, South Africa, Korea, Spain	Gatica et al. (2001), Halleen et al. (2003), Luque et al. (2009), Gonzalez and Tello (2011), Mohammadi and Banihashemi (2012), Mondello et al. (2013), Oh et al. (2014), This study
<i>Acrocalymma vagum</i> (D.F. Farr) P.W. Crous & T. Trakunyingcharoen*	<i>Acrocalymmaceae</i>	U		Spain	Trakunyingcharoen et al. (2014)
<i>Acrospermum viticola</i> Ikata & Hitomi	<i>Acrospermaceae</i>	U		China, Japan, Korea	Tai (1979), Cho and Shin (2004), Kobayashi (2007)
<i>Acrostalagmus luteoalbus</i> (Link) Zare, W. Gams & Schroers*	<i>Plectosphaerellaceae</i>	S		China	This study
<i>Actinomucor elegans</i> (Eidam) C.R. Benj. & Hesselt*	<i>Mucoraceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Agaricus viticola</i> Schulzer	<i>Agaricaceae</i>	S		Slavonia	Saccardo (1878)
<i>Albifimbria verrucaria</i> (Alb. & Schwein.) L. Lombard & Crous*	<i>Stachybotryaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>A. viridis</i> L. Lombard & Crous*	<i>Stachybotryaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Alfaria cyperi-esculenti</i> Crous, Montañó-Mata & García-Jim*	Hypocreales genera <i>incertae sedis</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>Alfaria vitis</i> Manawasinghe, Camporesi & K.D. Hyde*	Hypocreales genera <i>incertae sedis</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>Alternaria lternate</i> (Fr.) Keissl.*	<i>Pleosporaceae</i>	P, E, S	Fruit rot	Brunei, China, Italy, Poland, Slovakia, Spain, USA	Peregrine and Ahmad (1982), French (1987, 1989), Molenko et al. (2008), Kakalikova et al. (2009), Gonzalez and Tello (2011), Dissanayake et al. (2018), This study, Jayawardena et al. (2018)
<i>A. arborescens</i> E.G. Simmons*	<i>Pleosporaceae</i>	E		Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011)
<i>A. italica</i> J.F. Li, Camporesi & K.D. Hyde*	<i>Pleosporaceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>A. tenuissima</i> (Kunze) Wiltshire	<i>Pleosporaceae</i>	E		Malawi, Spain	Wiehe (1948), Peregrine and Siddiqi (1972), Gonzalez and Tello (2011)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>A. viticola</i> Brunaud	<i>Pleosporaceae</i>	P	Fruit rot	China	Tai (1979)
<i>A. vitis</i> Cavara*	<i>Pleosporaceae</i>	P, S	Leaf blight, Fruit rot	Chile, China, El Salvador, Greece, India, Italy, Romania, Russia, Thailand, Turkmenistan	Cavara (1888), Makovetz (1933), Stevenson and Wellman (1944), Mujica and Vergara (1945), Nasyrov (1964), Sarbhoy et al. (1971), Pantidou (1973), Giatgong (1980), Bechet and Sapta-Forda (1981), Zhang (2003), Zhuang (2005), This study, Jayawardena et al. (2018)
<i>A. viniferae</i> Yong Wang bis, Y.Y. Than, K.D. Hyde & Xing H. Li*	<i>Pleosporaceae</i>	P	On pedicels and rachis	China	Tao et al. (2014)
<i>Alternaria</i> sp.*	<i>Pleosporaceae</i>	P, E	On pedicels and rachis	Cuba, France, Italy, Poland, South Africa, Spain, Switzerland, USA	Preston (1945), Harvey (1955), Arnold (1986), Cook and Dubé (1989), Larignon and Dubos (1997), Halleen et al. (2003), Mullenko et al. (2008), Casieri et al. (2009), Gonzalez and Tello (2011), Mondello et al. (2013)
<i>Amerosporium concinnum</i> Petr.	Ascomycota genera <i>incertae sedis</i>	P	Excoriose and die back	Portugal	Phillips (2000)
<i>Ampelomyces quisqualis</i> Ces.	<i>Phaeosphaeriaceae</i>	M		South Africa	Doidge (1950)
<i>Ampelomyces</i> sp.*	<i>Phaeosphaeriaceae</i>	S		China	This study
<i>Amphisphaeria sylvan</i> Sacc. & Speg	<i>Amphisphaeriaceae</i>	S		Italy	Farr (1973)
<i>A. humuli</i> (Fautrey) Rudakov	<i>Amphisphaeriaceae</i>	M		Ukraine	Dudka et al. (2004)
<i>Angustimassarina populi</i> Thambug. & K.D. Hyde*	<i>Amorosiaceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>Aplosporella beaumontiana</i> S. Ahmad	<i>Aplosporellaceae</i>	S		India	Rajak and Pandey (1985)
<i>A. fabiformis</i> (Pass. & Thüm.) Petr. & Syd.	<i>Aplosporellaceae</i>	P	On stem	Italy, Pakistan, USA	Petrak and Sydow (1927), Anonymous (1960), Ahmad (1969)
<i>A. japonicas</i> Ellis & Everh.	<i>Aplosporellaceae</i>	P	On stem	China	Tai (1979)
<i>A. viticola</i> Cooke & Massee	<i>Aplosporellaceae</i>	P	On stem	UK	Saccardo (1878)
<i>Aplosporella</i> sp.*	<i>Aplosporellaceae</i>	S		China	This study
<i>Apodus</i> sp.*	<i>Lasiosphaeriaceae</i>	S		China	This study
<i>Arachnomycetes</i> sp.*	<i>Arachnomycetaceae</i>	S		China	This study
<i>Armillaria limonea</i> (G. Stev.) Boesew	<i>Physalacriaceae</i>	P	Root rot	New Zealand	Gadgil (2005)
<i>A. luteobubalina</i> Watling & Kile	<i>Physalacriaceae</i>	P	Root rot	Australia	Cook and Dubé (1989)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>A. mellea</i> (Vahl) P. Kumm.	<i>Physalacriaceae</i>	P	Root rot	Australia, Greece, Italy, Japan, Scotland, USA	Anonymous (1960), Foister (1961), Simmonds (1966), French (1989), Zervakis et al. (1998), Holevas et al. (2000), Kobayashi (2007), Bobev (2009), Prodorutti et al. (2009)
<i>A. novae-zelandiae</i> (G. Stev.) Boesew	<i>Physalacriaceae</i>	P	Root rot	New Zealand	Gadgil (2005)
<i>Armillaria</i> sp.	<i>Physalacriaceae</i>	P	Root rot	Australia, New Zealand	Pennycook (1989), Shivas (1989)
<i>Arthrotrrys</i> sp.*	<i>Orbiliaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Arthrographis</i> sp.*	<i>Eremomycetaceae</i>	S		China	This study
<i>Arthrimum arundinis</i> * (Corda) Dyko & B. Sutton	<i>Apiosporaceae</i>	E		Switzerland	Casieri et al. (2009)
<i>A. phaeospermum</i> (Corda) M.B. Ellis	<i>Apiosporaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>A. rasikravindrae</i> Shiv M. Singh, L.S. Yadav, P.N. Singh, Rah. Sharma & S.K. Singh*	<i>Apiosporaceae</i>	E		China	Dissanayake et al. (2018)
<i>Arthrimum</i> sp.	<i>Apiosporaceae</i>	U		Russia	Melnik and Popushoi (1992)
<i>Arxiomyces vitis</i> (Fuckel) P.F. Cannon & D. Hawksw.	<i>Ceratostomataceae</i>	U		Europe, Poland	von Arx and Mueller (1954), Mullenko et al. (2008)
<i>Ascochyta ampelina</i> Sacc.	<i>Didymellaceae</i>	P	On leaves	Greece, Pakistan, Romania, UK, USA	Saccardo (1878), Anonymous (1960), Pantidou (1973), Ahmad et al. (1997), Jones and Baker (2007)
<i>Ascorhizoctonia</i> sp.*	<i>Pyronemataceae</i>	E		China	Dissanayake et al. (2018)
<i>Aspergillus aculeatus</i> Iizuka*	<i>Aspergillaceae</i>	P, S	Bunch rot	Canada, China	Jarvis and Traquair (1984), This study, Jayawardena et al. (2018)
<i>A. carbonarius</i> (Bainier) Thom*	<i>Aspergillaceae</i>	P	Bunch rot	South Africa, USA	Setati et al. (2015), Rooney-Latham et al. (2008)
<i>A. cibarius</i> S.B. Hong & Samson*	<i>Aspergillaceae</i>	S		China	This study
<i>A. flavus</i> Link	<i>Aspergillaceae</i>	P	Bunch rot	Italy	Greuter et al. (1991)
<i>A. glaucus</i> (L.) Link	<i>Aspergillaceae</i>	U		Dominican Republic	Ciferri (1929, 1961)
<i>A. aponicas</i> Saito*	<i>Aspergillaceae</i>	E		China	Dissanayake et al. (2018)
<i>A. niger</i> Tiegh.*	<i>Aspergillaceae</i>	P, E, S	Bunch rot, Canker	Australia, Bulgaria, China, Cyprus, Italy, Japan, Spain, South Africa, Switzerland, USA, Zimbabwe	Georghiou and Papadopoulos (1957), Whiteside (1966), Cook and Dubé (1989), Setati et al. (2015), Michailides et al. (2002), Kobayashi (2007), Vitale et al. (2008), Bobev (2009), Casieri et al. (2009), Gonzalez and Tello (2011), Dissanayake et al. (2018), This study, Jayawardena et al. (2018)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>A. terreus</i> Thom*	<i>Aspergillaceae</i>	E, S		Spain, China	Gonzalez and Tello (2011), This study
<i>A. tubingensis</i> Mosseray*	<i>Aspergillaceae</i>	P	Canker	Spain	Garcia-Benavides et al. (2013)
<i>A. piperis</i> Samson & Frisvad*	<i>Aspergillaceae</i>	S		China	This study
<i>A. pseudodeflectus</i> Samson & Mouch.*	<i>Aspergillaceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>A. pseudoglaucus</i> Blochwitz*	<i>Aspergillaceae</i>	E		China	Dissanayake et al. (2018)
<i>A. ustus</i> (Bainier) Thom & Church	<i>Aspergillaceae</i>	U		Italy	Greuter et al. (1991)
<i>Aspergillus</i> sp.*	<i>Aspergillaceae</i>	P, E, S	Bunch rot, canker, sour rot	China, France, Italy, Korea, South Africa, Spain, Switzerland	Larignon and Dubos (2001), Halleen et al. (2003), Casieri et al. (2009), Gonzalez and Tello (2011), Mondello et al. (2013), Oh et al. (2014), Dissanayake et al. (2018), This study
<i>Asperisporium minutulum</i> (Sacc.) Deighton	<i>Mycosphaerellaceae</i>	E		USA	Schubert and Braun (2005)
<i>A. vitiphyllum</i> (Speschnew) Deighton	<i>Mycosphaerellaceae</i>	E		China, Europe, Russia, Uzbekistan	Elenkin (1909), Gaponenko (1965), Sutton (1975), Zhuang (2005)
<i>Athelia rolfsii</i> (Curzi) C.C. Tu & Kimbr.	<i>Atheliaceae</i>	P, S	Sour rot	Mauritius, New Zealand, Taiwan	Orieux and Felix (1968), Anonymous (1979), Pennycook (1989)
<i>Aureobasidium pullulans</i> (de Bary) G. Arnaud.*	<i>Sacrotheciaceae</i>	E, S		Australia, China, France, Germany, Greece, Italy, South Africa, Spain, Poland, USA	Setati et al. (2015), Morgan and Michailides (2004), Mullenko et al. (2008), Gonzalez and Tello (2011), Sanoamuang et al. (2013), Fischer et al. (2016), Dissanayake et al. (2018), This study, Jayawardena et al. (2018)
<i>Aureobasidium</i> sp.*	<i>Sacrotheciaceae</i>	S		China	This study
<i>Bactrodesmium pallidum</i> M.B. Ellis	Dothideomycetes genera incertae sedis	S		Russia	Melnik and Popushoi (1992)
<i>Bartalinia robillardoides</i> Tassi	<i>Sporocadaceae</i>	S		India	Mathur (1979)
<i>Beauveria bassiana</i> (Bals.-Criv.) Vuill*	<i>Cordycipitaceae</i>	P, E	U	Spain	Gonzalez and Tello (2011), Garcia-Benavides et al. (2013)
<i>Bertia vitis</i> Schulzer	<i>Bertiaceae</i>	S		Croatia, Portugal	Schulzer (1870), Unamuno (1941)
<i>Bionectria ochroleuca</i> (Schwein.) Schroers & Samuels*	<i>Bionectriaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Bipolaris maydis</i> (Y. Nisik. & C. Miyake) Shoemaker*	<i>Pleosporaceae</i>	S		China	This study, Jayawardena et al. (2018)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>B. sorokiniana</i> (Sacc.) Shoemaker*	<i>Pleosporaceae</i>	E		China	Dissanayake et al. (2018)
<i>Biscogniauxia capnodes</i> (Berk.) Y.M. Ju & J.D. Rogers	<i>Boliniaceae</i>	S		Taiwan	Ju and Rogers (1999)
<i>B. mediterranea</i> (De Not.) Kuntze	<i>Boliniaceae</i>	S		USA	Anonymous (1960)
<i>Boeremia exigua</i> var. <i>exigua</i> (Desm.) Aveskamp*	<i>Didymellaceae</i>	P	Black spot	Italy	Balmas et al. (2005)
<i>Botryodiplodia palmarum</i> (Cooke) Petr. & Syd.	<i>Botryosphaeriaceae</i>	P	Canker	India	Mathur (1979)
<i>B. vitis</i> Sousa da Câmara	<i>Botryosphaeriaceae</i>	P	Canker	Pakistan, Portugal	Sousa da Câmara (1950), Ahmad et al. (1997)
<i>Botryodiplodia</i> sp.	<i>Botryosphaeriaceae</i>	P	Canker	Argentina, Brazil	Mendes et al. (1998), Gatica et al. (2001)
<i>Botryosphaeria bondarzewii</i> L. A. Kantsch.	<i>Botryosphaeriaceae</i>	S		Russia, USA	Kantschaveli (1928), Nagorny (1930)
<i>B. dothidea</i> (Moug. ex Fr.) Ces. & De Not.*	<i>Botryosphaeriaceae</i>	P, E, S	Botryosphaeria die back, Macrophoma rot	Argentina, Australia, Brazil, Canda, Chile, China, France, Germany, Iran, Italy, Japan, South Africa, Portugal, Spain, USA, New Zealand, Tunisia, Turkey, Uruguay	Milholland (1994), Phillips (1998, 2000), Slippers et al. (2007a, b), Larignon and Dubos (2001), Halleen et al. (2003), van Niekerk et al. (2006), Kobayashi (2007), Luque et al. (2009), Pitt et al. (2010), Qiu et al. (2011), Úrbez-Torres (2011), Úrbez-Torres et al. (2012, 2013a, b), Abreo et al. (2012), Arzanlou et al. (2012), Baskarathevan et al. (2012), Yan et al. (2012), Akgul et al. (2014a), Chebil et al. (2014), Carlucci et al. (2015), Fischer et al. (2016), Dissanayake et al. (2018), This study, Jayawardena et al. (2018)
<i>B. vitis</i> Niessl	<i>Botryosphaeriaceae</i>	P	Die back	Czech Republic	Niessl (1871)
<i>Botryosphaeria</i> sp.*	<i>Botryosphaeriaceae</i>	P, E	Botryosphaeria die back, Macrophoma rot	Australia, China, Japan, South Africa, Spain	Fourie and Halleen (2002), Halleen et al. (2003), Gimenez-Jaime et al. (2006), Kobayashi (2007), Martin and Cobos (2007), Sosnowski et al. (2007), Dissanayake et al. (2018)
<i>Botrytis ampelophila</i> Speg.	<i>Sclerotiniaceae</i>	S		Argentina	Farr (1973)
<i>B. californica</i> S. Saito & C.L. Xiao*	<i>Sclerotiniaceae</i>	P	Botrytis bunch rot, Leaf blight	California, USA	Saito et al. (2016)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>B. cinerea</i> Pers.*	<i>Sclerotiniaceae</i>	P, E, S	Botrytis bunch rot, Leaf blight	Australia, Brazil, Bulgaria, Chile, China, France, Greece, Germany, Hawaii, Italy, Korea, Libya, New Zealand, Pakistan, Poland, Portugal, Scotland, Spain, Switzerland, USA, Zimbabwe	Foister (1961), Whiteside (1966), El-Buni and Rattan (1981), Raabe et al. (1981), Lee et al. (1991), Mendes et al. (1998), Holevas et al. (2000), Phillips (2000), Gadgil (2005), Mullenko et al. (2008), Bobev (2009), Casieri et al. (2009), Gao et al. (2009), Gonzalez and Tello (2011), Walker et al. (2011), Fournier et al. (2013), Piqueras et al. (2014), Saito et al. (2016), Dissanayake et al. (2018), Javed et al. (2017), This study, Jayawardena et al. (2018)
<i>B. pseudocinerea</i> A.S. Walker, A. Gautier*	<i>Sclerotiniaceae</i>	P	Botrytis bunch rot, Leaf blight	France, Germany, New Zealand, USA	Walker et al. (2011), Saito et al. (2016)
<i>B. sinoviticola</i> J. Zhang, Y. J. Zhou & G. Q. Li*	<i>Sclerotiniaceae</i>	P	Botrytis bunch rot, Leaf blight	China	Zhou et al. (2014)
<i>Botrytis</i> sp.*	<i>Sclerotiniaceae</i>	P, E, S		Chile, China, Italy, Japan, Mexico, USA	Mujica and Vergara (1945), Anonymous (1960), Alvarez (1976), Kobayashi (2007), Liu et al. (2016a), Dissanayake et al. (2018), Jayawardena et al. (2018)
<i>Briosia ampelophaga</i> Cavara	Ascomycota genera <i>incertae sedis</i>	P	Brown Zonate Spot of Grape/Leaf blotch	Japan, Russia, USA	Greene (1955), Anonymous (1960), Melnik and Popushoi (1992), Nakagiri et al. (1994), Kobayashi (2007)
<i>Cadophora fastigiata</i> Lagerb. & Melin*	<i>Ploettnerulaceae</i>	P, S	Wood pathogen	Germany, Switzerland,	Casieri et al. (2009), Fischer et al. (2016)
<i>C. luteo-olivacea</i> (J.F.H. Beyma) T.C. Harr. & McNew*	<i>Ploettnerulaceae</i>	P	Wood pathogen	Germany, Japan, Switzerland, Uruguay	Casieri et al. (2009), Abreo et al. (2012), Fischer et al. (2016), Nakaune et al. (2016)
<i>C. novi-eboraci</i> R Travadon, DP Lawrence, S Rooney-Latham, WD Gubler, PE Rolshausen & K Baumgartner*	<i>Ploettnerulaceae</i>	P	Wood pathogen	North America	Travadon et al. (2015)
<i>C. orientoamericana</i> R Travadon, DP Lawrence, S Rooney-Latham, WD Gubler, PE Rolshausen & K Baumgartner*	<i>Ploettnerulaceae</i>	P	Wood pathogen	North America	Travadon et al. (2015)
<i>C. spadici</i> R Travadon, DP Lawrence, S Rooney-Latham, WD Gubler, PE Rolshausen & K Baumgartner*	<i>Ploettnerulaceae</i>	P	Wood pathogen	North America	Travadon et al. (2015)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>C. viticola</i> D. Gramaje, L. Mostert & Armengol*	<i>Ploettnerulaceae</i>	P, S	Wood pathogen	Spain	Crous et al. (2015)
<i>Cadophora</i> sp.*	<i>Ploettnerulaceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>Calonectria kytensis</i> Terash.	<i>Nectriaceae</i>	P	Black foot disease	New Zealand	Pennycook (1989)
<i>C. macrospora</i> Sacc. & Speg.	<i>Nectriaceae</i>	P	Black foot disease	Italy	Saccardo (1878), Farr (1973)
<i>Calycella sarmentorum</i> (De Not.) Boud.	<i>Helotiaceae</i>	S		Italy, Portugal	Kuntze (1898), Unamuno (1941)
<i>Camarosporium viniferum</i> S. Ahmad	<i>Camarosporiaceae</i>	E		Central Asia, Pakistan	Ahmad (1969), Koshkelova and Frolov (1973), Ahmad et al. (1997)
<i>C. viticola</i> (Cooke & Harkn.) Sacc.	<i>Camarosporiaceae</i>	E		USA	Saccardo (1878)
<i>Camillea tinctor</i> (Berk.) Læssøe, J.D. Rogers & Whalley	<i>Graphostromataceae</i>	S		USA	Hanlin (1963)
<i>Campylocarpon fasciculare</i> Schroers, Halleen & Crous*	<i>Nectriaceae</i>	P	Wood canker, Black foot disease	Brazil, Italy, South Africa, Turkey	Halleen et al. (2003), Abreo et al. (2010), Petit et al. (2011), Correia et al. (2013), Akgul et al. (2014b), Úrbez-Torres et al. (2014), Carlucci et al. (2017), Gonzalez and Chaverri (2017)
<i>C. pseudofasciculare</i> Halleen, Schroers & Crous*	<i>Nectriaceae</i>	P	Black foot	Brazil, South Africa, Uruguay	Abreo et al. (2010, 2012), Petit et al. (2011), Correia et al. (2013), Úrbez-Torres et al. (2014), Gonzalez and Chaverri (2017)
<i>Capnodium citri</i> Berk. & Desm.	<i>Capnodiaceae</i>	P	Bunch rot	Italy, Greece, Portugal, Spain	Pantidou (1973), Greuter et al. (1991), Checa (2004)
<i>Capnodium</i> sp.	<i>Capnodiaceae</i>	P	Bunch rot	Brazil, Venezuela	Urriaga (1986), Mendes et al. (1998)
<i>Cephalosporium</i> sp.	<i>Hypocreales incertae sedis</i>	P	Black measles	Greece, Mexico, Greece, USA	Chiarappa (1959), Pantidou (1973), Alvarez (1976), Holevas et al. (2000)
<i>Ceratobasidium cornigerum</i> (Bourdot) D.P. Rogers	<i>Ceratobasidiaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Ceratobasidium</i> sp.*	<i>Ceratobasidiaceae</i>	E, S		China, Switzerland	Casieri et al. (2009), This study
<i>Cercospora coryneoides</i> Savul. & Rayss	<i>Mycosphaerellaceae</i>	P	Leaf spot	Palestine	Savulescu and Rayss (1935)
<i>C. fuckelii</i> (Thüm.) Jacz.	<i>Mycosphaerellaceae</i>	P	Leaf spot	Asia	Chupp (1953)
<i>C. judaica</i> Rayss	<i>Mycosphaerellaceae</i>	P	Leaf spot	Palestine	Chupp (1953)
<i>C. roesleri</i> (Catt.) Sacc.*	<i>Mycosphaerellaceae</i>	P	Leaf spot	China, Cyprus, Egypt, France, Scotland	Chupp (1953), Georghiou and Papadopoulos (1957), Foister (1961), Tai (1979), Soliman et al. (2016)
<i>C. sessilis</i> Sorokin	<i>Mycosphaerellaceae</i>	P	Leaf spot	Russia	Pollack (1987)
<i>C. vitiphylla</i> (Speschnew) Barbarin	<i>Mycosphaerellaceae</i>	P	Leaf spot	Palestine	Savulescu and Rayss (1935)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>C. zebrina</i> Pass.*	<i>Mycosphaerellaceae</i>	P	Leaf spot	Iran	Bakhshi et al. (2012)
<i>Cercospora</i> sp.	<i>Mycosphaerellaceae</i>	P	Leaf spot	Cuba, Hawaii, Mexico, USA	Denaree and Runner (1942), Greene (1956), Raabe (1966), Alvarez (1976), Grand (1985), Urtiaga (1986)
<i>Chaetomium globosum</i> Kunze ex Fr.*	<i>Chaetomiaceae</i>	E, S		China, Italy, Spain, Switzerland,	Casieri et al. (2009), Gonzalez and Tello (2011), Dissanayake et al. (2018), This study, Jayawardena et al. (2018)
<i>C. nigricolor</i> L.M. Ames*	<i>Chaetomiaceae</i>	E		India, Switzerland	Pande (2008), Casieri et al. (2009)
<i>Chaetomium</i> sp.*	<i>Chaetomiaceae</i>	E, S		Spain, Switzerland, China	Casieri et al. (2009), Gonzalez and Tello (2011), This study
<i>Chaetothrium javanicum</i> (Zimm.) Boedijn	<i>Chaetothriaceae</i>	P	Sooty mold	China, Taiwan	Tai (1979)
<i>Chalastospora gossypii</i> (Jacz.) U. Braun & Crous*	<i>Pleosporaceae</i>	E		USA	Crous et al. (2009)
<i>Cheilymenia theleboides</i> (Alb. & Schwein.) Boud.	<i>Pyronemataceae</i>	S		Chile	Mujica and Vergara (1945)
<i>Chrysosporium pilosum</i> Gené, Guarro & Ulfig*	<i>Onygenaceae</i>	S		China	This study
<i>Chrysosporium</i> sp.*	<i>Onygenaceae</i>	S		China	This study
<i>Cladochytrium viticola</i> Prunet	<i>Cladochytriaceae</i>	P	Wood	Algeria, Gaul, Tunisia, USA	Saccardo (1878)
<i>Cladosporium aggregatocaticratum</i> Bensch, Crous & U. Braun*	<i>Cladosporiaceae</i>	P	Fruit rot	USA	Bensch et al. (2015)
<i>C. ampelinum</i> Pass.	<i>Cladosporiaceae</i>	P	Leaf spot	Austria, Germany, France, Italy, Portugal	Passerini (1872)
<i>C. asperulatum</i> Bensch, Crous & U. Braun	<i>Cladosporiaceae</i>	P	Fruit rot	USA	Bensch et al. (2015)
<i>C. autumnale</i> Kübler	<i>Cladosporiaceae</i>	E		Switzerland	Dugan et al. (2004)
<i>C. baccae</i> Verwoerd & Dippen.	<i>Cladosporiaceae</i>	P	Fruit rot	South Africa	Braun et al. (2003), Dugan et al. (2004)
<i>C. cladosporioides</i> (Fresen.) G.A. de Vries*	<i>Cladosporiaceae</i>	P, E, S	Fruit rot	Chile, China, Italy, Japan, Switzerland, USA	Briceno and Latorre (2007), Kobayashi (2007), Casieri et al. (2009), Bensch et al. (2015), Swett et al. (2016), Dissanayake et al. (2018), This study, Jayawardena et al.(2018)
<i>C. cucumerinum</i> Ellis & Arthur*	<i>Cladosporiaceae</i>	S		Italy	This study, Jayawardena et al.(2018)
<i>C. fasciculatum</i> Corda	<i>Cladosporiaceae</i>			Russia, Spain, Uzbekistan	Gonzalez Fragoso (1921), Nagorny (1930)
<i>C. herbarum</i> (Pers.) Link	<i>Cladosporiaceae</i>	P, E	Fruit rot	Australia,Chile, Spain	Cook and Dubé (1989), Briceno and Latorre (2007), Gonzalez and Tello (2011)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>C. limoniforme</i> Bensch, Crous & U. Braun*	<i>Cladosporiaceae</i>	P	Fruit rot	USA	Bensch et al. (2015), Swett et al. (2016)
<i>C. longipes</i> Sorokin	<i>Cladosporiaceae</i>	E		Caucasus	Dugan et al. (2004)
<i>C. macrocarpum</i> Preuss	<i>Cladosporiaceae</i>	P	Fruit rot	China	Zhang (2003)
<i>C. oxysporum</i> Berk. & M.A. Curtis	<i>Cladosporiaceae</i>	P	Fruit rot	India	Sarbhoy et al. (1971)
<i>C. pestis</i> Thüm	<i>Cladosporiaceae</i>	E		Austria	Dugan et al. (2004)
<i>C. ramotenellum</i> K. Schub., Zalar, Crous & U. Braun*	<i>Cladosporiaceae</i>	P	Fruit rot	China, USA	Swett et al. (2016), Dissanayake et al. (2018)
<i>C. rectoides</i> Bensch, H.D. Shin, Crous & U. Braun*	<i>Cladosporiaceae</i>	E		Korea	Bensch et al. (2015)
<i>C. roesleri</i> Catt.	<i>Cladosporiaceae</i>	E		Austria, France, Cyprus, Pakistan	Georghiou and Papadopoulos (1957), Ahmad (1969), Ahmad et al. (1997)
<i>C. silences</i> Crous*	<i>Cladosporiaceae</i>	P	Fruit rot	China	Dissanayake et al. (2018)
<i>C. sphaerospermum</i> Penz.*	<i>Cladosporiaceae</i>	P, S	Fruit rot	Switzerland	Casieri et al. (2009)
<i>C. tenellum</i> K. Schub., Zalar, Crous & U. Braun*	<i>Cladosporiaceae</i>	P	Fruit rot	USA	Swett et al. (2016), Dissanayake et al. (2018)
<i>C. tenuissimum</i> Cooke*	<i>Cladosporiaceae</i>	P, E	Fruit rot	China	Zhang (2003), Dissanayake et al. (2018)
<i>C. uvarum</i> McAlpine	<i>Cladosporiaceae</i>	S		Australia, China	Zhang (2003), Dugan et al. (2004)
<i>C. viride</i> (Fresen.) Z.Y. Zhang & T. Zhang	<i>Cladosporiaceae</i>	P	Fruit rot	China	Dugan et al. (2004)
<i>C. vitis-frutigeni</i> Herb.	<i>Cladosporiaceae</i>	E		USA	Dugan et al. (2004)
<i>Cladosporium</i> sp.*	<i>Cladosporiaceae</i>	P, E, S	Fruit rot	Chile, China, Italy, Korea, USA, Venezuela	Mujica and Vergara (1945), Anonymous (1960), Briceno and Latorre (2008), Mondello et al. (2013), Oh et al. (2014), Dissanayake et al. (2018), This study
<i>Clathrospora turkestanica</i> Domashova	<i>Pleosporaceae</i>	E		Central Asia	Koshkelova and Frolov (1973)
<i>Claviceps</i> sp.*	<i>Clavicipitaceae</i>	S		China	This study
<i>Clonostachys rosea</i> (Link) Schroers, Samuels, Seifert & W. Gams*	<i>Bionectriaceae</i>	P, E, S	Wood decay, Root rot	China, Switzerland	Casieri et al. (2009), This study, Jayawardena et al. (2018)
<i>Clonostachys</i> sp.*	<i>Bionectriaceae</i>	P, E, S	Wood decay, Root rot	China, South Africa	Halleen et al. (2003), This study
<i>Cochliobolus geniculatus</i> R.R. Nelson	<i>Pleosporaceae</i>	P	Leaf spot	Brunei	Peregrine and Ahmad (1982)
<i>Colletotrichum acutatum</i> J.H. Simmonds*	<i>Glomerellaceae</i>	P	Ripe rot	Australia, Japan, New Zealand, USA	Miller (1991), Kummung et al. (1996), Guerber et al. (2003), Kobayashi (2007), Shivas et al. (2016)
<i>C. aenigma</i> B.S. Weir & P.R. Johnston*	<i>Glomerellaceae</i>	P	Ripe rot	China	Yan et al. (2015)
<i>C. ampelinum</i> Cavara	<i>Glomerellaceae</i>	E		China, Italy	Cavara (1889), Tai (1979)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>C. clidemia</i> B.S. Weir & P.R. Johnston*	<i>Glomerellaceae</i>	P	Ripe rot	USA	Weir et al. (2012)
<i>C. dematium</i> (Pers.) Grove*	<i>Glomerellaceae</i>	E, S		Russia, South Africa	Damm et al. (2009), This study, Jayawardena et al. (2018)
<i>C. fiorinae</i> Marcelino & Gouli ex R.G. Shivas & Y.P. Tan*	<i>Glomerellaceae</i>	P	Ripe rot	Italy, Portugal	Faemma et al. (2011), Damm et al. (2012)
<i>C. fructicola</i> Prihastuti, L. Cai & K.D. Hyde*	<i>Glomerellaceae</i>	P	Ripe rot, Leaf spot, Sunken shoot and stem canker	China	Peng et al. (2013)
<i>C. gloeosporioides</i> (Penz.) Penz. & Sacc.*	<i>Glomerellaceae</i>	P	Ripe rot	Australia, Barbados, Brazil, Brunei, China, Cuba, India, Japan, Korea, Myanmar, New Zealand, South Africa, Taiwan, USA	Chandra (1974), Norse (1974), Anonymous (1979), Tai (1979), Peregrine and Ahmad (1982), Urriaga (1986), Pennycook (1989), Mendes et al. (1998), Cho and Shin (2004), Lubbe et al. (2004), Gadgil (2005), Kobayashi (2007), Thaung (2008c), Weir et al. (2012)
<i>C. godetiae</i> Neerg.*	<i>Glomerellaceae</i>	P, S	Ripe rot	Italy, UK	Baroncelli et al. (2014), Zapparata et al. (2017), This study, Jayawardena et al. (2018)
<i>C. hebeiense</i> XH Li, Y Wang, KD Hyde, MMRS* Jayawardena, JY Yan	<i>Glomerellaceae</i>	P	Twig anthracnose, Ripe rot	China	Yan et al. (2015), This study, Jayawardena et al. (2018)
<i>C. nymphaeae</i> (Pass.) Aa*	<i>Glomerellaceae</i>	P	Ripe rot	China	Liu et al. (2016b)
<i>C. siamense</i> Prihastuti, L. Cai & K.D. Hyde*	<i>Glomerellaceae</i>	P, S	Ripe rot	Italy, USA	Weir et al. (2012), This study, Jayawardena et al. (2018)
<i>C. truncatum</i> (Schwein.) Andrus & W.D. Moore*	<i>Glomerellaceae</i>	P	Ripe rot	China, India, Italy, Switzerland	Farr (1973), Casieri et al. (2009), Sawant et al. (2012), Pan et al. (2016), This study, Jayawardena et al. (2018)
<i>C. viniferum</i> L.J. Peng, L. Cai, K.D. Hyde & Zi Y. Ying*	<i>Glomerellaceae</i>	P, S	Ripe rot	China	Peng et al. (2013), Yan et al. (2015), This study, Jayawardena et al. (2018)
<i>Colletotrichum</i> sp.	<i>Glomerellaceae</i>	P	Ripe rot, Wood necrosis	Cuba, Mexico, Spain	Alvarez (1976), Arnold (1986), Gonzalez and Tello (2011)
<i>Collophorina paarla</i> (Damm & Crous) Damm & Crous*	Leotiomycetes genera <i>incertae sedis</i>	P	Wood necrosis	Germany	Fischer et al. (2016)
<i>C. rubra</i> (Damm & Crous) Damm & Crous*	Leotiomycetes genera <i>incertae sedis</i>	P	Wood necrosis	Spain	Garcia-Benavides et al. (2013)
<i>Coniella castaneicola</i> (Ellis & Everh.) B. Sutton	<i>Schizoparmaceae</i>	P	White rot	Japan, USA	Nag Raj (1993), Kobayashi (2007)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>C. diplodiella</i> (Speg.) Petr. & Syd.*	Schizoparmaceae	P	White rot	Africa, Australia, Bulgaria, China, France, Germany, Greece, India, Italy, South Africa	Sutton (1969), Pantidou (1973), Mathur (1979), Zhuang (2001), van Niekerk et al. (2004b), Bobev (2009), Chethana et al. (2017)
<i>C. diplodiopsis</i> (Crous & Van Niekerk) L.V. Alvarez & Crous*	Schizoparmaceae	P	White rot	France, Germany, Italy, South Africa, Switzerland	van Niekerk et al. (2004b), Chethana et al. (2017)
<i>C. fragariae</i> (Oudem.) B. Sutton	Schizoparmaceae	P	White rot	Germany, Japan	van Niekerk et al. (2004b), Kobayashi (2007)
<i>C. granati</i> (Sacc.) Petr. & Syd.*	Schizoparmaceae	P	White rot	Italy	van Niekerk et al. (2004b), Chethana et al. (2017)
<i>C. petrakii</i> B. Sutton*	Schizoparmaceae	P, S	White rot	France, India	Nag Raj (1993), Chethana et al. (2017)
<i>C. vitis</i> Chethana, Yan, Li & K. D. Hyde*	Schizoparmaceae	P	White rot	China	Chethana et al. (2017), This study, Jayawardena et al. (2018)
<i>Coniella</i> sp.*	Schizoparmaceae	P	Wood necrosis	India	Chethana et al. (2017)
<i>Coniocessia</i> sp.*	Conioceciaceae	S		China	This study
<i>Coniochaeta hoffmannii</i> (J.F.H. Beyma) Z.U. Khan, Gené & Guarro*	Coniochaetaceae	P	Bunch rot	Germany, Switzerland	Casieri et al. (2009), Fischer et al. (2016)
<i>Coniolaria</i> sp.*	Xylariaceae	S		China	This study
<i>Coniothecium viticola</i> Cooke & Masee	Helotiales incertae sedis	S		UK	Saccardo (1878)
<i>Coniothyrium ampelinum</i> Cooke	Coniothyriaceae	E		USA	Cooke (1878)
<i>C. berlandieri</i> Viala & Sauv.	Coniothyriaceae	P	Leaf spot	Cambodia, USA	Anonymous (1960), Litzenberger et al. (1962)
<i>C. iranicum</i> Esfand.	Coniothyriaceae	E		Central Asia	Koshkelova and Frolov (1973)
<i>C. vitivorum</i> Miura	Coniothyriaceae	E		China	Tai (1979)
<i>Cophinforma mamane</i> (D.E. Gardner) A.J.L. Phillips & A. Alves*	Botryosphaeriaceae	P	Canker, Die back	Brazil	Correia et al. (2013)
<i>Coprinellus radians</i> (Desm.) Vilgalys, Hopple & Jacq. Johnson*	Psathyrellaceae	S		Switzerland	Casieri et al. (2009)
<i>Corticium appalachiense</i> (Burds. & M.J. Larsen) M.J. Larsen	Corticaceae	P, S	Wood decay	USA	Burdsall (1976)
<i>C. centrifugum</i> (Weinm.) Fr.	Corticaceae	P, S	Wood decay	China	Tai (1979)
<i>Corticium</i> sp.	Corticaceae	S		USA	Anonymous (1960)
<i>Coryneopsis microsticta</i> (Berk. & Broome) Grove	Discosiaceae	P	Stem lesions	Poland, Portugal	de Sousa Dias and Lucas (1972), Mulencko et al. (2008)
<i>Corynespora cassiicola</i> (Berk. & M.A. Curtis) C.T. Wei	Corynesporascaceae	P	Leaf spot	USA	Alfieri Jr. et al. (1984, 1994)
<i>Coryneum viticola</i> Ellis & Everh.	Pseudovalsaceae	S		USA	Anonymous (1960)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Crepidotus viticola</i> S. Imai	<i>Inocybaceae</i>	S		Japan	Petrak (1953)
<i>Cryptocline cinerascens</i> (Bubák) Arx	Ascomycota genera <i>incertae sedis</i>	E		Japan	Kobayashi (2007)
<i>Cryptococcus</i> sp.*	<i>Tremellaceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>Cryptophaeella trematosphaeriicola</i> Frolov	<i>Montagnulaceae</i>	E		Central Asia	Koshkelova and Frolov (1973)
<i>Cryptosphaeria pullmanensis</i> Glawe*	<i>Diatrypaceae</i>	P	Canker	USA	Trouillas and Gubler (2010), Trouillas et al. (2010), Úrbez-Torres et al. (2012)
<i>Cryptosporella viticola</i> Shear	<i>Valsaceae</i>	P	Fruit rot, Dead arm	China, Greece, Korea, USA	Hewitt (1951), Tai (1979), Holevas et al. (2000), Cho and Shin (2004)
<i>Cryptovalsa ampelina</i> Abbado*	<i>Diatrypaceae</i>	P	Eutypa dieback	Australia, Austria, Chile, France, Hungary, Italy, Portugal, South Africa, Spain, USA	Unamuno (1941), Petrak (1953), Mostert et al. (2004), Lardner et al. (2005), Sosnowski et al. (2007), Luque et al. (2009), Martin et al. (2009), Trouillas and Gubler (2010), Trouillas et al. (2010, 2011), Diaz et al. (2011), White et al. (2011), Úrbez-Torres et al. (2012), Pitt et al. (2013), Li et al. (2016-designated reference specimen), This study, Jayawardena et al. (2018)
<i>C. protracta</i> (Pers.) De Not.	<i>Diatrypaceae</i>	P	Eutypa dieback	Greece	Pantidou (1973)
<i>C. rabenhorstii</i> (Nitschke) Sacc.*	<i>Diatrypaceae</i>	P	Eutypa dieback	Australia	Trouillas et al. (2011), Pitt et al. (2013)
<i>Cryptovalsa</i> sp.*	<i>Diatrypaceae</i>	P	Eutypa dieback	New Zealand	Lardner et al. (2005)
<i>Curvularia americana</i> Da Cunha, Madrid, Gené & Cano*	<i>Pleosporaceae</i>	E		China	Dissanayake et al. (2018)
<i>Curvularia</i> sp.*	<i>Pleosporaceae</i>	E		China	Dissanayake et al. (2018)
<i>Cylindrocarpon destructans</i> (Zinssm.) Scholten*	<i>Diatrypaceae</i>	P, E	Black foot	Argentina, Canada, France, Iran, Italy, Portugal, Spain, Tasmania, Uruguay	Gerlach and Ershad (1970), Grasso (1984), Maluta and Larignon (1991), Rego et al. (2000), Gatica et al. (2001), Seifert et al. (2003), Casieri et al. (2009), Abreo et al. (2010), Gonzalez and Tello (2011)
<i>C. lichenicola</i> (C. Massal.) D. Hawksw.	<i>Diatrypaceae</i>	P	Black foot	India	Booth (1966)
<i>C. ntricatea</i> J.D. MacDon. & E.E. Butler*	<i>Diatrypaceae</i>	P	Black foot	Australia, Canada, France, Iran, Portugal, Spain, Switzerland, Uruguay, USA	Alaniz et al. (2007, 2009), Petit and Gubler (2007), Whitelaw-Weckert et al. (2007), Casieri et al. (2009), Luque et al. (2009), Abreo et al. (2010, 2012), Petit et al. (2011), Mohammadi et al. (2013a)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Cylindrocarpon</i> sp.*	<i>Diatrypaceae</i>	P, S	Black foot	Canda, China, Lebanon, Portugal, South Africa, Spain, Switzerland, Tasmania, USA	Halleen et al. (2003), Gimenez-Jaime et al. (2006), Martin and Cobos (2007), Whitelaw-Weckert et al. (2007), Casieri et al. (2009), Choueiri et al. (2009), This study
<i>Cylindrocladiella lageniformis</i> Crous, M.J. Wingf. & Alfenas*	<i>Nectriaceae</i>	P	Black foot	South Africa, USA	Victor et al. (1998), Boesewinkel (1982), Koike et al. (2016)
<i>C. parva</i> (P.J. Anderson) Boesew.*	<i>Nectriaceae</i>	P	Black foot	New Zealand, South Africa, Spain	Van Coller et al. (2005), Gadgil (2005), Agusti-Brisach et al. (2012)
<i>C. peruviana</i> (Bat., J.L. Bezerra & M.P. Herrera) Boesew.*	<i>Nectriaceae</i>	P	Black foot	South Africa, USA	Boesewinkel (1982), Koike et al. (2016)
<i>C. pseudoparva</i> L. Lombard & Crous*	<i>Nectriaceae</i>	S		New Zealand	Boesewinkel (1982)
<i>C. viticola</i> Crous & Van Coller*	<i>Nectriaceae</i>	P	Cutting rot of grapevines, Black foot	South Africa, USA	Hirooka et al. (2013)
<i>C. vitis</i> Crous & Thangavel*	<i>Nectriaceae</i>	P	Black foot	New Zealand	Crous et al. (2017)
<i>Cylindrocladiella</i> sp.*	<i>Nectriaceae</i>	S		New Zealand	Boesewinkel (1982)
<i>Cytospora ampelina</i> Sacc.	<i>Valsaceae</i>	P	Canker	Pol2and	Mulenko et al. (2008)
<i>C. chrysosperma</i> (Pers.) Fr.*	<i>Valsaceae</i>	E		Spain	Gonzalez and Tello (2011), Garcia-Benavides et al. (2013)
<i>C. cincta</i> Sacc.*	<i>Valsaceae</i>	P	Canker	Iran	Fotouhifar et al. (2010)
<i>C. leucostoma</i> (Pers.) Sacc.*	<i>Valsaceae</i>	P	Canker	Iran	Fotouhifar et al. (2010)
<i>C. vinacea</i> D.P. Lawr., Travadon & Pouzoulet*	<i>Valsaceae</i>	P	Canker	USA	Lawrence et al. (2017a)
<i>C. viticola</i> D.P. Lawr., Travadon & Pouzoulet*	<i>Valsaceae</i>	P	Canker	Canada, USA	Lawrence et al. (2017a)
<i>C. vitis</i> Mont.	<i>Valsaceae</i>	P	Canker	Central Asia, Greece, Portugal, USA	Montagne (1856), Koshkelova and Frolov (1973), Pantidou (1973), Anonymous (1960), Phillips (2000)
<i>Dacrymyces viticola</i>	<i>Dacrymycetaceae</i>	S		USA	Saccardo (1878)
<i>Dactylellina</i> sp.*	<i>Orbiliaceae</i>	S		China	This study
<i>Dactylonectria alcacerensis</i> (A. Cabral, Oliveira & Crous)*	<i>Nectriaceae</i>	P	Black foot	Portugal, Spain	Agusti-Brisach et al. (2016), Carlucci et al. (2017)
<i>D. estremocensis</i> (A. Cabral, Nascimento & Crous) L. Lombard & Crous*	<i>Nectriaceae</i>	P	Black foot	Portugal	Agusti-Brisach et al. (2016), Carlucci et al. (2017)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>D. macrodidyma</i> (Halleen, Schroers & Crous)*	<i>Nectriaceae</i>	P, S	Black foot	Australia, Brazil, Canada, New Zealand, Portugal, Slovenia, South Africa, Switzerland, USA	Casieri et al. (2009), Abreo et al. (2010), Santos et al. (2014), Úrbez-Torres et al. (2014), Agusti-Brisach et al. (2016), Carlucci et al. (2017), This study
<i>D. novozelandica</i> (A. Cabral & Crous) L. Lombard & Crous*	<i>Nectriaceae</i>	P	Black foot	New Zealand, South Africa, USA	Úrbez-Torres et al. (2014), Carlucci et al. (2017)
<i>D. pauciseptata</i> (Schroers & Crous) L. Lombard & Crous*	<i>Nectriaceae</i>	P, S	Root rot, Black foot	Brazil, Canada, New Zealand, Portugal, Slovenia, Spain, Uruguay	Abreo et al. (2010), Agusti-Brisach et al. (2011), Martin et al. (2011a), Petit et al. (2011), Úrbez-Torres et al. (2014), Santos et al. (2014)
<i>D. pinicola</i> L. Lombard & Crous*	<i>Nectriaceae</i>	P	Black foot	Portugal	Carlucci et al. (2017),
<i>D. torresensis</i> (A. Cabral, Rego & Crous) L. Lombard & Crous*	<i>Nectriaceae</i>	P	Black foot	Australia, Canada, Italy, New Zealand, Portugal, South Africa, Spain, USA	Úrbez-Torres et al. (2014), Agusti-Brisach et al. (2016), Carlucci et al. (2017), Gonzalez and Chaverri (2017)
<i>D. vitis</i> (A. Cabral, Rego & Crous) L. Lombard & Crous*	<i>Nectriaceae</i>	P	Black foot	Portugal	Úrbez-Torres et al. (2014), Carlucci et al. (2017)
<i>Deconica horizontalis</i> (Bull.) Noordel.	<i>Hymenogastraceae</i>	S		South Africa	Doidge (1950)
<i>Dendrophoma</i> sp.	<i>Chaetosphaeriaceae</i>	S		Japan	Kobayashi (2007)
<i>Desarmillaria tabescens</i> (Scop.) R. A. Koch & Aime	<i>Physalacriaceae</i>	P	Root rot	Japan	Kobayashi (2007)
<i>Devriesia</i> sp.*	<i>Teratosphaeriaceae</i>	S		China	This study
<i>Desmazierella</i> sp.	<i>Chorioactidaceae</i>	S		Pakistan	Ahmad et al. (1997)
<i>Diaporthe ambigua</i> Nitschke*	<i>Diaporthaceae</i>	P	Canker	USA, South Africa	van Niekerk et al. (2005), White et al. (2011), Úrbez-Torres et al. (2013a, b), Lawrence et al. (2015)
<i>D. ampelina</i> (Berkeley & M.A. Curtis) R.R. Gomes, C. Glienke & Crous*	<i>Diaporthaceae</i>	P, E, S	Excortiose, Dead arm, Canker	Australia, Bulgaria, China, France, India, Italy, Japan, New Zealand, Poland, South Africa, Spain, Switzerland, Turkey, USA	Phillips (2000), Zhuang (2005), Kobayashi (2007), Casieri et al. (2009), Gonzalez and Tello (2011), Garcia-Benavides et al. (2013), Gomes et al. (2013), Kepley et al. (2015), Lawrence et al. (2015), Du et al. (2016), This study, Jayawardena et al. (2018)
<i>D. mnivore</i> (Delacr.) Udayanga, P.W.Crous & K.D.Hyde*	<i>Diaporthaceae</i>	P	Canker	South Africa	van Niekerk et al. (2005), Udayanga et al. (2011), Gomes et al. (2013)
<i>D. australafricana</i> Crous & Van Niekerk*	<i>Diaporthaceae</i>	P	Canker	Australia, South Africa, USA	van Niekerk et al. (2005), Mostert et al. (2001), Udayanga et al. (2012, 2014), Gomes et al. (2013), Lawrence et al. (2015), Du et al. (2016)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>D. chamaeropsis</i> (Cooke) R.R. Gomes, C. Glienke & Crous	<i>Diaporthaceae</i>	P	Canker	USA	Lawrence et al. (2015)
<i>D. eres</i> Nitschke*	<i>Diaporthaceae</i>	P, S	Canker	Bulgaria, China, France, Germany, Italy, Japan, Switzerland, USA	Kobayashi (2007), Casieri et al. (2009), Stoykov (2012), Baumgartner et al. (2013), Úrbez-Torres et al. (2013a, b), Lawrence et al. (2015), Cinelli et al. (2016), Fischer et al. (2016), Bastide et al. (2017), This study, Jayawardena et al. (2018)
<i>D. foenicula</i> Niessl*	<i>Diaporthaceae</i>	P	Canker	South Africa, Portugal, USA	Luongo et al. (2011), Úrbez- Torres et al. (2013a, b), Udayanga et al. (2014a, b), Lawrence et al. (2015)
<i>D. helianthi</i> Munt.- Cvetk., Mihaljc. & M. Petrov*	<i>Diaporthaceae</i>	P	Canker	South Africa	van Niekerk et al. (2005), Udayanga et al. (2011)
<i>D. hongkongensis</i> R.R. Gomes, C. Glienke & Crous*	<i>Diaporthaceae</i>	P	Canker	China	Dissanayake et al. (2015)
<i>D. kyushuensis</i> Kajitani & Kanem.	<i>Diaporthaceae</i>	P	Canker	Japan	Kanematsu et al. (2000), Kobayashi (2007)
<i>D. longiparaphysata</i> (Uecker & K.C. Kuo) Udayanga & Castl.*	<i>Diaporthaceae</i>	P	Canker	Taiwan	Uecker and Kuo (1992), Udayanga et al. (2011)
<i>D. nobilis</i> Sacc. & Speg.*	<i>Diaporthaceae</i>	P	Canker	California	Lawrence et al. (2015)
<i>D. novem</i> M. Santos, Vrandecic & A.J.L. Phillips*	<i>Diaporthaceae</i>	P	Canker	California	Lawrence et al. (2015)
<i>D. perijuncta</i> Niessl	<i>Diaporthaceae</i>	P	Canker	Australia, Portugal, South Africa	Phillips (1999), Mostert et al. (2001)
<i>D. pernicioso</i> Marchal & É.J. Marchal	<i>Diaporthaceae</i>	P	Canker	Bulgaria	Stoykow and Denchev (2006)
<i>D. phaseolorum</i> (Cooke & Ellis) Sacc.*	<i>Diaporthaceae</i>	P	Canker	China, Switzerland	Casieri et al. (2009), Dissanayake et al. (2015)
<i>D. rudis</i> (Fr.) Nitschke*	<i>Diaporthaceae</i>	P, S	Canker	Australia, Germany, Italy, Portugal	Scheper et al. (2000), Úrbez- Torres et al. (2012), Gomes et al. (2013), Udayanga et al. (2014a, b), Huang et al. (2015), This study, Jayawardena et al. (2018)
<i>D. sojae</i> Lehman*	<i>Diaporthaceae</i>	P	Canker	China	Dissanayake et al. (2015)
<i>D. vitimegaspora</i> (K.C. Kuo & L.S. Leu) Rossman & Udayanga*	<i>Diaporthaceae</i>	P	Canker	Japan, Thailand, Thaiwan	Kuo and Leu (1998), van Niekerk et al. (2005), Udayanga et al. (2011)
<i>Diaportha</i> sp.*	<i>Diaporthaceae</i>	P	Canker	Bulgaria, France, Italy, Japan, Portugal, South Africa, Spain Switzerland, USA	Kanematsu et al. (2000), Mostert et al. (2001), van Niekerk et al. (2005), Bobev (2009), Casieri et al. (2009), Santos et al. (2010), Luongo et al. (2011), Úrbez-Torres et al. (2013a, b)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Diatrype nigerrima</i> Ellis & Everh.	<i>Diatrypaceae</i>	P	Eutypa dieback	USA	Ellis and Everhart (1904), Cash (1952)
<i>D. oregonensis</i> Wehm.) Rappaz*	<i>Diatrypaceae</i>	P	Eutypa dieback	USA	Trouillas and Gubler (2010), Trouillas et al. (2010), Úrbez-Torres et al. (2013a, b)
<i>D. stigma</i> (Hoffm.) Fr.*	<i>Diatrypaceae</i>	P	Eutypa dieback	Spain, USA	Unamuno (1941), Trouillas et al. (2010), Úrbez-Torres et al. (2013a, b)
<i>D. utahensis</i> Rehm	<i>Diatrypaceae</i>	P	Eutypa dieback	India	Pande (2008)
<i>D. whitmanensis</i> J.D. Rogers & Glawe*	<i>Diatrypaceae</i>	P	Eutypa dieback	USA	Trouillas and Gubler (2010), Trouillas et al. (2010), Úrbez-Torres et al. (2013a, b)
<i>Diatrype</i> sp.*	<i>Diatrypaceae</i>	P	Eutypa dieback	Australia, USA	Trouillas et al. (2010, 2011), Pitt et al. (2013), Úrbez-Torres et al. (2012, 2013a, b)
<i>Diatrypella verrucaeformis</i> (Ehrh.) Nitschke*	<i>Diatrypaceae</i>	P	Eutypa dieback	USA	Trouillas and Gubler (2010), Trouillas et al. (2010)
<i>D. vitis</i> Ellis & Everh.	<i>Diatrypaceae</i>	P	Eutypa dieback	China, USA	Cash (1952), Teng (1996)
<i>D. vulgaris</i> Trouillas, W.M. Pitt & Gubler*	<i>Diatrypaceae</i>	P	Eutypa dieback	Australia	Trouillas et al. (2011), Pitt et al. (2013)
<i>Diatrypella</i> sp.*	<i>Diatrypaceae</i>	P	Eutypa dieback	USA	Trouillas and Gubler (2010), Trouillas et al. (2010), Úrbez-Torres et al. (2012)
<i>Dictyosporium elegans</i> Corda	<i>Dictyosporiaceae</i>	P	Canker	Portugal	de Sousa Dias et al. (1987)
<i>D. toruloides</i> (Corda) Guég.	<i>Dictyosporiaceae</i>	P	Canker	Russia	Melnik and Popushoi (1992)
<i>Didymella glomerata</i> (Corda) Q. Chen & L. Cai*	<i>Didymellaceae</i>	E		Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011)
<i>D. negriana</i> (Thümen) Q. Chen & L. Cai*	<i>Didymellaceae</i>	P, S	Black rot, Canker	Germany, Italy	Chen et al. (2015), This study, Jayawardena et al. (2018)
<i>D. pomorum</i> (Thümen) Q. Chen & L. Cai*	<i>Didymellaceae</i>	S		Australia, China	Cook and Dubé (1989), This study, Jayawardena et al. (2018)
<i>Didymosphaeria bacchans</i> Pass.	<i>Didymosphaeriaceae</i>	S		Italy	Greuter et al. (1991)
<i>D. sarmenti</i> (Cooke & Harkn.) Berl. & Voglino	<i>Didymosphaeriaceae</i>	P	Shoot lesions	Japan, Portugal, USA	Unamuno (1941), French (1989), Kobayashi (2007)
<i>Dinemasporium pleurospora</i> (Sacc.) Shkarupa	<i>Chaetosphaeriaceae</i>	S		Pakistan, Poland	Ahmad (1969), Ahmad et al. (1997), Mulencko et al. (2008)
<i>Diplodia ampelina</i> Cooke	<i>Botryosphaeriaceae</i>	P	Canker	Portugal, USA	Cooke (1878), Saccardo and Traverso (1903)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>D. bacchii</i> Pass. & Thüm	<i>Botryosphaeriaceae</i>	P, S	Canker	Belgium, Italy, Portugal	Cooke (1878)
<i>D. corticola</i> A.J.L. Phillips, A. Alves & J. Luque*	<i>Botryosphaeriaceae</i>	P	Canker	Italy, Mexico, Spain, USA	Carlucci and Frisullo (2009), Úrbez-Torres et al. (2010a, b, c), Pintos et al. (2011), Úrbez-Torres (2011), Carlucci et al. (2015)
<i>D. intermedia</i> A.J.L. Phillips, J. Lopes & A. Alves*	<i>Botryosphaeriaceae</i>	P	Canker	France	Comont et al. (2016)
<i>D. mutila</i> (Fr.) Mont.*	<i>Botryosphaeriaceae</i>	P, E	Canker	Australia, Canada, France, Hungary, Italy, New Zealand, Portugal, Spain, USA	Phillips (1998, 2000), Taylor et al. (2005), Úrbez-Torres et al. (2006), van Niekerk et al. (2006), Martin and Cobos (2007), Baskarathevan et al. (2008, 2012), Pitt et al. (2010), Gonzalez and Tello (2011), Qiu et al. (2011), Úrbez-Torres (2011), Whitelaw-Weckert et al. (2013), Alves et al. (2014), Carlucci et al. (2015)
<i>D. nematospora</i> Sacc.	<i>Botryosphaeriaceae</i>	S		Eritrea	Castellani and Ciferri (1937)
<i>D. seriata</i> (Fr.) Mont.*	<i>Botryosphaeriaceae</i>	P, E, S	Canker	Australia, Bulgaria, Canada, Chile, China, France, Germany, Greece, Iran, Italy, Lebanon, New Zealand, Portugal, South Africa, Spain, Switzerland, Tunisia Uruguay, USA	Pantidou (1973), Castillo-Pando et al. (2001), Larignon and Dubos (2001), Halleen et al. (2003), Auger et al. (2004a), Choueiri et al. (2006), van Niekerk et al. (2006), Slippers et al. (2007a, b), Baskarathevan et al. (2008), Epstein (2008), Casieri et al. (2009), Luque et al. (2009), Úrbez-Torres (2011), Yan et al. (2011a, b), Abreo et al. (2012), Garcia-Benavides et al. (2013), Mohammadi et al. (2013b), Mondello et al. (2013), Chebil et al. (2014), Fischer et al. (2016), This study, Jayawardena et al. (2018)
<i>Diplodia</i> sp.*	<i>Botryosphaeriaceae</i>	P	Canker	Belgium, Bulgaria, Cuba, Mexico, South Africa	Greuter et al. (1991), van Niekerk et al. (2004a), Bobev (2009), Casieri et al. (2009)
<i>Diplodina vitis</i> Brunaud	<i>Gnomoniaceae</i>	P	Root stock disease	Central Asia	Koshkelova and Frolov (1973)
<i>Discohainesia oenotherae</i> (Cooke & Ellis) Nannf.	<i>Dermateaceae</i>	P	Leaf spot	USA	Anonymous (1960)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Discosia artocreas</i> (Todd) Fr.	<i>Sporocadaceae</i>	P	Leaf spot	USA	Gilman (1932), Maneval (1937), Cooke (1983)
<i>D. vitis</i> Schulzer	<i>Sporocadaceae</i>	P	Leaf spot	Hungary	Nag Raj (1993)
<i>Discostroma corticola</i> (Fuckel) Brockmann	<i>Sporocadaceae</i>	P	Cane blight	New Zealand	Pennycook (1989)
<i>Doratomyces stemonitis</i> (Pers.) F.J. Morton & G. Sm.	<i>Microascaceae</i>	S		Argentina, Russia	Melnik and Popushoi (1992), Carmaran and Novas (2003)
<i>Dothiorella americana</i> Úrbez-Torres, Peduto & Gubler*	<i>Botryosphaeriaceae</i>	P	Die back, Canker	USA	Úrbez-Torres (2011), Úrbez-Torres et al. (2012)
<i>D. iberica</i> A.J.L. Phillips, J. Luque & A. Alves*	<i>Botryosphaeriaceae</i>	P, S	Die back, Canker	Australia, Italy, New Zealand, Spain, USA	Úrbez-Torres et al. (2007), Baskarathevan et al. (2008, 2012), Úrbez-Torres and Gubler (2009), Qiu et al. (2011), Úrbez-Torres (2011), Pitt et al. (2010), McDonald and Eskalen (2011), Carlucci et al. (2015), Martin and Cobos (2007), This study, Jayawardena et al. (2018)
<i>D. neclivora</i> W.M. Pitt & J.R. Úrbez-Torres*	<i>Botryosphaeriaceae</i>	P	Die back, Canker	Australia	Pitt et al. (2015)
<i>D. mnivore</i> B. T. Linaldeddu, A. Deidda & B. Scanu*	<i>Botryosphaeriaceae</i>	P	Die back, Canker	Australia	Linaldeddu et al. (2016)
<i>D. reinformis</i> (Viala & Ravaz) Petr. & Syd	<i>Botryosphaeriaceae</i>	P, S	Die back, Canker	Italy, Portugal, South Africa	Petrak and Sydow (1927), Doidge (1950), Costa and Camara (1952)
<i>D. sarmentorum</i> (Fr.) A.J.L. Phillips, Alves & Luque*	<i>Botryosphaeriaceae</i>	P, S	Die back, Canker	China, Italy, New Zealand, Spain	Martin and Cobos (2007), Baskarathevan et al. (2012), Carlucci et al. (2015), This study, Jayawardena et al. (2018)
<i>D. vidmadera</i> W.M. Pitt, J.R. Úrbez-Torres, Trouillas*	<i>Botryosphaeriaceae</i>	P	Die back, Canker	Australia	Pitt et al. (2013), Linaldeddu et al. (2016), Lawrence et al. (2017b)
<i>D. vinea-gemmae</i> W.M. Pitt & J.R. Úrbez-Torres*	<i>Botryosphaeriaceae</i>	P	Die back, Canker	Australia	Pitt et al. (2015)
<i>D. viticola</i> A.J.L. Phillips & J. Luque	<i>Botryosphaeriaceae</i>	P, S	Die back, Canker	Spain	Luque et al. (2005)
<i>Dothiorella</i> sp.*	<i>Botryosphaeriaceae</i>	P	Die back, Canker	Australia, Mexico, USA	Úrbez-Torres et al. (2010a, b, c), Pitt et al. (2015), Lawrence et al. (2017b)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Elsinoe ampelina</i> Shear	<i>Elsinoaceae</i>	P	Grape antracnose	Barbados, Brazil, Bulgaria, Cambodia, Chile, China, Cuba, Haiti, Hong Kong, India, Italy, Jamaica, Kenya, Mauritius, Mexico, Myanmar, New Zealand, Poland, South Africa, Spain, Tanzania, Trinidad and Tobago, Thailand, USA, Venezuela, Zimbabwe	Gilman and Archer (1929), Jenkins and Bitancourt (Jenkins and Bitancourt 1940–1963), Mujica and Vergara (1945), Baker and Dale (1951), Riley (1960), Natrass (1961), Litzenberger et al. (1962), Whiteside (1966), Orioux and Felix (1968), Benjamin and Slot (1969), Dennis (1970), Norse (1974), Alvarez (1976), Tai (1979), Alfieri Jr. et al. (1984), Grand (1985), Arnold (1986), Pennycook (1989), Greuter et al. (1991), Mendes et al. (1998), Lu et al. (2000), Zhuang (2001), Mulenko et al. (2008), Thaug (2008a, b, c), Bobev (2009)
<i>Emericella</i> sp.*	<i>Aspergillaceae</i>	S		China	This study
<i>Endobasidium clandestinum</i> Speschnew	<i>Exobasidiaceae</i>	P	Root rot	Uzbekistan	Gaponenko (1965)
<i>Endoconidioma populi</i> Tsuneda, Hambl. & Currah*	<i>Dothideaceae</i>	P	Necrotic twigs	Iran	Mirzaei et al. (2015)
<i>Epicoccum granulatum</i> Penz.	<i>Didymellaceae</i>	S		USA	Shaw (1973)
<i>E. nigrum</i> Link*	<i>Didymellaceae</i>	E, S		China, Italy, Spain, Switzerland	Phillips (2000), Casieri et al. (2009), Gonzalez and Tello (2011), This study, Jayawardena et al. (2018)
<i>E. plurivorum</i> (P.R. Johnston) Q. Chen & L. Cai	<i>Didymellaceae</i>	S		New Zealand	Gadgil (2005)
<i>Epicoccum</i> sp.	<i>Didymellaceae</i>	S		France	Larignon and Dubos (1997), Halleen et al. (2003)
<i>Eriocercospora vitis-heterophyllae</i> (Henn.) U. Braun	Ascomycota genera incertae sedis	P	Leaf spot	Japan	Chupp (1953), Watson (1971)
<i>Eriosphaeria oenotria</i> Sacc. & Speg.	<i>Trichosphaeriaceae</i>	S		Italy	Farr (1973)
<i>Erysiphe necator</i> Schwein.	<i>Erysiphaceae</i>	P	Powdery mildew	Australia, Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Korea, Netherlands, Peru, Poland, Romania, Russia, Spain, Sweden, Switzerland, Turkey, UK, Yugoslavia	Greuter et al. (1991), Nomura et al. (2003), Bolay (2005), Ruskiewicz-Michalska and Michalski (2005), Amrani and Corio-Costet (2006), Paul and Thakur (2006), Rusanov and Bulgakov (2008), Voytyuk et al. (2009), Park et al. (2010), Bendezu-Euribe and Alvarez (2012)
<i>E. tuckeri</i> Berk.	<i>Erysiphaceae</i>	P	Powdery mildew	Spain	Unamuno (1941)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Erythricium salmonicolor</i> (Berk. & Broome) Burds.	Corticaceae	P	Sour rot	Thailand	Giatgong (1980)
<i>Eucasphaeria capensis</i> Crous*	Niessliaceae	P	Eutypa dieback	Germany	Fischer et al. (2016)
<i>Eutypa lata</i> (Pers.) Tul. & C. Tul.*	Diatrypaceae	P	Eutypa dieback	Australia, Brazil, Bulgaria, Europe, France, Germany, Greece, Italy, New Zealand, Serbia, South Africa, Spain, Switzerland, USA	Moller et al. (1974), Pennycook (1989), Shivas (1989), Carter (1991), Larignon and Dubos (1997), Mendes et al. (1998), Péros et al. (1999), Holevas et al. (2000), Rolshausen et al. (2004, 2014), Lardner et al. (2005), Sosnowski et al. (2007), Bobev (2009), Luque et al. (2009), Trouillas et al. (2010, 2011), White et al. (2011), Úrbez-Torres et al. (2012), Živkovic et al. (2012), Garcia-Benavides et al. (2013), Travadon and Baumgartner (2015), Mayorquin et al. (2016)
<i>E. laevata</i> (Nitschke) Sacc.*	Diatrypaceae	P	Eutypa dieback	Canada, USA	Rappaz (1987), Rolshausen et al. (2004, 2014)
<i>E. ludibunda</i> Sacc.	Diatrypaceae	P	Eutypa dieback	USA	Tiffany and Gilman (1965)
<i>E. leptoplaca</i> (Durieu & Mont.) Rappaz*	Diatrypaceae	P	Eutypa dieback	Spain, South Africa, USA	Luque et al. (2009), Trouillas and Gubler (2004, 2010), Úrbez-Torres et al. (2012)
<i>Eutypa</i> sp.*	Diatrypaceae	P	Eutypa dieback	Bulgaria, USA	Bobev (2009), Rolshausen et al. (2014)
<i>Eutypella aequilinearis</i> (Schwein.) Starbäck	Diatrypaceae	P	Eutypa dieback	Japan, USA	Rappaz (1987), Kobayashi (2007)
<i>E. aulacostroma</i> (Kunze) Berl.	Diatrypaceae	P	Eutypa dieback	Taiwan	Rappaz (1987)
<i>E. citricola</i> Speg.*	Diatrypaceae	P	Eutypa dieback	Australia, USA	Trouillas et al. (2011), Pitt et al. (2013), Mayorquin et al. (2016)
<i>E. fraxinicola</i> (Cooke & Peck) Sacc.	Diatrypaceae	P	Eutypa dieback	USA	Hanlin (1963)
<i>E. leprosa</i> (Pers.) Berl.	Diatrypaceae	P	Eutypa dieback	Chile, Spain, Switzerland, USA	Rappaz (1987), Diaz et al. (2011)
<i>E. microtheca</i> Trouillas, W.M. Pitt & Gubler*	Diatrypaceae	P	Eutypa dieback	Australia, Mexico, USA	Trouillas et al. (2011), Pitt et al. (2013), Paolinelli-Alfonso et al. (2016), Mayorquin et al. (2016)
<i>E. vitis</i> (Schwein.) Ellis & Everh.*	Diatrypaceae	P	Eutypa dieback	Italy, Pakistan, South Africa, Spain, Uruguay, USA	Greuter et al. (1991), Ahmad et al. (1997), Luque et al. (2009), White et al. (2011), Úrbez-Torres et al. (2012), Abreo et al. (2012), Mayorquin et al. (2016)
<i>Eutypella</i> sp.*	Diatrypaceae	P	Eutypa dieback	USA	Trouillas et al. (2010), Úrbez-Torres et al. (2012), Mayorquin et al. (2016)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Excipula viticola</i> Schwein	<i>Dermateaceae</i>	P	On leaves	USA	Saccardo (1878)
<i>Exosporium sultanae</i> du Plessis	Ascomycota genera <i>incertae sedis</i>	S		South Africa	Gorter (1977)
<i>Exophiala</i> sp.*	<i>Herpotrichiellaceae</i>	E		China	Dissanayake et al. (2018)
<i>Exserohilum rostratum</i> (Drechsler) K.J. Leonard & Suggs*	<i>Pleosporaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Floricola viticola</i> (Phukhamsakda, Camporesi & K.D. Hyde) Jaklitsch & Voglmayr*	<i>Teichosporaceae</i>	S		Italy	Ariyawansa et al. (2015), This study, Jayawardena et al. (2018)
<i>Fomes fomentarius</i> (L.) Fr.	<i>Polyporaceae</i>	P	Esca	China	Tai (1979)
<i>F. ignarius</i> (L.) Fr.*	<i>Polyporaceae</i>	P	Esca	France, USA	Chiarappa (1959), Cloete et al. (2015)
<i>Fomitiporia australiensis</i> M. Fisch., J. Edwards, Cunningt. & Pascoe*	<i>Hymenochaetaceae</i>	P	Esca	Australia	Fischer et al. (2005), Cloete et al. (2015)
<i>F. capensis</i> M. Fisch., M. Cloete, L. Mostert, F. Halleen*	<i>Hymenochaetaceae</i>	P	Esca	South Africa	Cloete et al. (2014)
<i>F. mediterranea</i> M. Fisch.*	<i>Hymenochaetaceae</i>	P	Esca	Europe, Germany, Iran, Italy, Spain, Turkey	Fischer et al. (2005), Martin and Cobos (2007), Luque et al. (2009), Mohammadi and Banihashemi (2012), Garcia-Benavides et al. (2013), Mondello et al. (2013), Akgul et al. (2015), Cloete et al. (2015)
<i>F. polymorpha</i> M. Fisch.*	<i>Hymenochaetaceae</i>	P	Esca	USA	Cloete et al. (2015)
<i>F. punctata</i> (P. Karst.) Murrill*	<i>Hymenochaetaceae</i>	P	Esca	Australia, France, Iran, Italy	Larignon and Dubos (1997), Pascoe and Cottral (2000), Karimi et al. (2001), Cloete et al. (2015)
<i>Fomitiporia</i> sp.*	<i>Hymenochaetaceae</i>	P	Esca	Italy, South Africa	White et al. (2011), Mondello et al. (2013)
<i>Fusarium acuminatum</i> Ellis & Everh.*	<i>Nectriaceae</i>	P	Wilt	Spain	Garcia-Benavides et al. (2013)
<i>F. anthophilum</i> (A. Braun) Wollenw.	<i>Nectriaceae</i>	P	Wilt	Brazil	Mendes et al. (1998)
<i>F. avenaceum</i> (Fr.) Sacc.	<i>Nectriaceae</i>	P	Wilt	China, Italy	Tai (1979), Greuter et al. (1991)
<i>F. equiseti</i> (Corda) Sacc.	<i>Nectriaceae</i>	P	Wilt	Brazil	Mendes et al. (1998)
<i>F. fujikuroi</i> Nirenberg	<i>Nectriaceae</i>	P	Wilt	Brazil	Mendes et al. (1998)
<i>F. oxysporum</i> Schltdl.*	<i>Nectriaceae</i>	P, E, S	Wilt	Australia, Brazil, China, South Africa, Spain	Gorter (1977), Mendes et al. (1998), Castillo-Pando et al. (2001), Gonzalez and Tello (2011), This study, Jayawardena et al. (2018)
<i>F. poae</i> (Peck) Wollenw.	<i>Nectriaceae</i>	P	Wilt	USA	Shaw (1973)
<i>F. proliferatum</i> (Matsush.) Nirenberg*	<i>Nectriaceae</i>	P, E	Wilt	China, Spain	Gonzalez and Tello (2011), Wang et al. (2015)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>F. schweinitzii</i> Ellis & Harkn.	<i>Nectriaceae</i>	P, E	Wilt	USA	Sumstine (1949), Cash (1952)
<i>F. solani</i> (Mart.) Sacc.*	<i>Nectriaceae</i>	P	Wilt	Brazil, India, Switzerland	Sarbhoy and Agarwal (1990), Mendes et al. (1998), Casieri et al. (2009)
<i>F. viticola</i> Thüm.	<i>Nectriaceae</i>	S		USA	Saccardo (1878)
<i>F. volutella</i> Ellis & Everh.	<i>Nectriaceae</i>	P	Wilt	USA	Cash (1952)
<i>Fusarium</i> sp.*	<i>Nectriaceae</i>	P, S	Wilt	Australia, China, Germany, Italy, South Africa, Switzerland, Spain, Uruguay	Cook and Dubé (1989), O'Donnell et al. (1998), Halleen et al. (2003), Casieri et al. (2009), Luque et al. (2009), Abreo et al. (2010), Mondello et al. (2013), This study, Jayawardena et al. (2018)
<i>Fusicladium viticis</i> M.B. Ellis	<i>Sympoventuriaceae</i>	P	Leaf spot	China	Zhang (2003)
<i>Geomyces pannorum</i> (Link) Sigler & J.W. Carmich.*	<i>Myxotrichaceae</i>	E		Switzerland	Casieri et al. (2009)
<i>Geomyces</i> sp.	<i>Myxotrichaceae</i>	S		China	This study
<i>Geotrichum candidum</i> Link	<i>Dipodascaceae</i>	E		Japan	Kobayashi (2007)
<i>Geotrichum</i> sp.	<i>Dipodascaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Gloniopsis praelonga</i> (Schwein.) Underw. & Earle	<i>Hysteriaceae</i>	S		Germany	Lotz-Winter et al. (2011)
<i>Glonium lineare</i> (Fr.) De Not.	<i>Gloniaceae</i>	S		Rhode Island	Goos (2010)
<i>G. macrosporium</i> Tracy & Earle	<i>Gloniaceae</i>	S		USA	Parris (1959)
<i>Glonium</i> sp.	<i>Gloniaceae</i>	S		USA	Hanlin (1963)
<i>Golovinomyces biocellatus</i> (Ehrenb.) V.P. Heluta	<i>Erysiphaceae</i>	P	Powdery mildew	India	Paul and Thakur (2006)
<i>Gonatobotrys flava</i> Bonord.	<i>Ceratostomataceae</i>	E		Poland	Mulenko et al. (2008)
<i>Gonatobotryum</i> sp.	Ascomycota genera <i>incertae sedis</i>	E		Spain	Gonzalez and Tello (2011)
<i>Graphium cinerellum</i> Speg.	<i>Graphiaceae</i>	P	Leaf spot	Italy	Farr (1973)
<i>Greeneria uvicola</i> (Berk. & M.A. Curtis) Punith.*	Diaporthales genera <i>incertae sedis</i>	P	Bitter rot	Australia, Bulgaria, Brazil, Cuba, India, Poland, South Africa, Taiwan, Thailand, Ukraine, Uruguay, USA	Cooke (1878), Simmonds (1966), Gorter (1977), Mathur (1979), Giatgong (1980), Reddy and Reddy (1983), Arnold (1986), Kummuang et al. (1996), Mendes et al. (1998), Castillo-Pando et al. (2001), Farr et al. (2001), Dudka et al. (2004), Longland and Sutton (2008), Mulenko et al. (2008), Bobev (2009), Navarrete et al. (2009), Abreo et al. (2012)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Grovesinia moricola</i> (I. Hino) Redhead	<i>Sclerotiniaceae</i>	P	Bunch rot	USA	Grand (1985)
<i>G. pyramidalis</i> M.N. Cline, J.L. Crane & S.D. Cline	<i>Sclerotiniaceae</i>	P	Bunch rot	Japan	Kobayashi (2007)
<i>Gymnascella</i> sp.*	<i>Gymnoascaceae</i>	S		China	This study
<i>Gyrothrix podosperma</i> (Corda) Rabenh.	Ascomycota genera <i>incertae sedis</i>	S		Pakistan	Ahmad et al. (1997)
<i>Hansfordia pulvinata</i> (Berk. & M.A. Curtis) S. Hughes	Ascomycota genera <i>incertae sedis</i>	S		Pakistan	Ahmad et al. (1997)
<i>H. tonduzii</i> (Speg.) Bat. & A.F. Vital	Ascomycota genera <i>incertae sedis</i>	S		Costa Rica	Batista and Ciferri (1962)
<i>Hansfordia</i> sp.*	Ascomycota genera <i>incertae sedis</i>	S		China	This study
<i>Hapalopilus rutilans</i> (Pers.) Murrill	<i>Polyporaceae</i>	S		USA	Gilbertson et al. (1974)
<i>Helicobasidium mompa</i> Nobuj. Tanaka	<i>Helicobasidiaceae</i>	P	Root rot	Japan	Kobayashi (2007)
<i>Helminthosporium decacuminatum</i> Thüm. & Pass.	Dothideomycetes genera <i>incertae sedis</i>	P	Leaf spot	Greece, Macedonia	Konstantinia-Sulidu (1939), Pantidou (1973)
<i>H. siliquosum</i> Berk. & M.A. Curtis	Dothideomycetes genera <i>incertae sedis</i>	P	Twigs and leaf spot	USA	Anonymous (1960)
<i>H. velutinum</i> (Link) Link	Dothideomycetes genera <i>incertae sedis</i>	S		Japan	Shirouzu and Harada (2004)
<i>Helminthosporium</i> sp.	Dothideomycetes genera <i>incertae sedis</i>	P	Leaf spot	USA	Anonymous (1960), Alfieri Jr. et al. (1984)
<i>Hendersonia cookeana</i> Speg.	Ascomycota genera <i>incertae sedis</i>	S		Italy	Spegazzini (1878), Farr (1973)
<i>H. corticalis</i> Ellis & Everh.	Ascomycota genera <i>incertae sedis</i>	S		USA	Cash (1953)
<i>H. sarmentorum</i> Westend.	Ascomycota genera <i>incertae sedis</i>	P	Twig lesions	Central Asia, Greece, Italy, Pakistan, Spain, USA	Gonzalez Fragoso (1916), Anonymous (1960), Ahmad (1969), Koshkelova and Frolov (1973), Pantidou (1973), Greuter et al. (1991), Ahmad et al. (1997)
<i>H. tenuipes</i> McAlpine	Ascomycota genera <i>incertae sedis</i>	S		Greece	Pantidou (1973)
<i>H. viticola</i> S. Ahmad	Ascomycota genera <i>incertae sedis</i>	S		Greece, Pakistan	Ahmad (1969), Pantidou (1973), Ahmad et al. (1997)
<i>Herpotrichia</i> sp.	<i>Melanommataceae</i>	E		USA	Hanlin (1963)
<i>Hormonema viticola</i> F. Laich & Stchigel*	<i>Dothioraceae</i>	E		Malaysia, Spain	Crous et al. (2015)
<i>Humicola</i> sp.*	<i>Chaetomiaceae</i>	E, S		China, Spain	Gonzalez and Tello (2011), This study
<i>Hydnum viticola</i>	<i>Hydnaceae</i>	S		USA	Saccardo (1878)
<i>Hydnum</i> sp.*	<i>Hydnaceae</i>	S		China	This study
<i>Hyaloceras viticola</i> (Cavara) Died.	<i>Sporocadaceae</i>	P	Fruits	Italy	Saccardo (1878)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Hymenochaetopsis intricata</i> (Lloyd) S.H. He & Jiao Yang	<i>Hymenochaetaceae</i>	S		Japan	Kobayashi (2007)
<i>Hypocrella reineckeana</i> Henn.	<i>Clavicipitaceae</i>	P	Leaf spot	Niue	Dingley et al. (1981)
<i>Hypoderma commune</i> (Fr.) Duby	<i>Rhytismataceae</i>	S		Portugal	Unamuno (1941)
<i>H. rubi</i> (Pers.) DC.	<i>Rhytismataceae</i>	S		China	Ying-Ren (2012)
<i>Hypoxylon hypophlaeum</i> (Berk. & Ravenel) J.H. Mill.	<i>Hypoxylaceae</i>	S		USA	Hanlin (1963)
<i>H. lateripigmentum</i> J. Fourn., Kuhnert & M. Stadler*	<i>Hypoxylaceae</i>	E		China	Dissanayake et al. (2018)
<i>H. rubiginosum</i> (Pers.) Fr.	<i>Hypoxylaceae</i>	S		USA	Hanlin (1963)
<i>Hypoxylon</i> sp.*	<i>Hypoxylaceae</i>	E		China	Dissanayake et al. (2018)
<i>Hysterium pulicare</i> (Lightf.) Pers.	<i>Hysteriaceae</i>	S		Italy	Greuter et al. (1991)
<i>H. viticola</i> Cooke & Peck	<i>Hysteriaceae</i>	S		USA	Saccardo (1878)
<i>Hysterobrevium mori</i> (Schwein.) E. Boehm & C.L. Schoch	<i>Hysteriaceae</i>	S		USA	Anonymous (1960), Barr (1990), Tibpromma et al. (2017)
<i>Hysterographium flexuosum</i> Maire	Pleosporomycetidae genera incertae sedis	P, S	Stem lesions	USA	Hanlin (1963)
<i>H. viticola</i> (Cooke & Peck) Rehm	Pleosporomycetidae genera incertae sedis	P, S	Stem lesions	USA	Wolf et al. (1938), Anonymous (1960)
<i>H. vulvatum</i> (Schwein.) Rehm	Pleosporomycetidae genera incertae sedis	P, S	Stem lesions	USA	Parris (1959), Anonymous (1960)
<i>Ilyonectria crassa</i> (Wollenw.) A. Cabral & Crous*	<i>Nectriaceae</i>	P	Black foot	Uruguay	Abreo et al. (2010)
<i>I. destructans</i> (Zinssmeister) Rossman, L. Lombard & Crous	<i>Nectriaceae</i>	P	Black foot	Argentina, Canada, France, Iran, South Africa, Spain, USA	Gerlach and Ershad (1970), Seifert and Axelrood (1998), Gatica et al. (2001), Petit and Gubler (2005), Gonzalez and Tello (2011), Petit et al. (2011)
<i>I. europaea</i> A. Cabral, Rego & Crous*	<i>Nectriaceae</i>	P	Black foot	Portugal	Úrbez-Torres et al. (2014), Agusti-Brisach et al. (2016), Carlucci et al. (2017)
<i>I. liri dendri</i> (Halleen, Rego & Crous) Chaverri & C. Salgado*	<i>Nectriaceae</i>	P	Black foot	Australia, Canada, France, Portugal, South Africa, Turkey, USA	Halleen et al. (2003), Petit et al. (2011), Whitelaw-Weckert et al. (2013), Úrbez-Torres et al. (2014), Savas et al. (2015), Agusti-Brisach et al. (2016)
<i>I. lusitanica</i> A. Cabral, Rego & Crous*	<i>Nectriaceae</i>	P	Black foot	Portugal	Úrbez-Torres et al. (2014), Agusti-Brisach et al. (2016), Carlucci et al. (2017)
<i>I. pseudodestructans</i> A. Cabral, Rego & Crous*	<i>Nectriaceae</i>	P	Black foot	Portugal	Úrbez-Torres et al. (2014), Agusti-Brisach et al. (2016), Carlucci et al. (2017)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>I. robusta</i> (A.A. Hildebr.) A. Cabral & Crous*	<i>Nectriaceae</i>	P	Black foot	Brazil, Canada, Portugal	Santos et al. (2014), Úrbez-Torres et al. (2014)
<i>Ilyonectria</i> sp.*	<i>Nectriaceae</i>	P, S	Black foot	Australia, China, Portugal	Úrbez-Torres et al. (2014), Parkinson et al. (2017), This study
<i>Inocutis jamaicensis</i> (Murrill) A.M. Gottlieb, J.E. Wright & Moncalvo*	<i>Hymenochaetaceae</i>	P	Hoja de malvón and chlorotic leaf roll	Argentina, Uruguay	Abreo et al. (2012), Rajchenberg and Robledo (2013), Cloete et al. (2015)
<i>Irpex lacteus</i> (Fr.) Fr.	<i>Phanerochaetaceae</i>	E		USA	Brenckle (1918)
<i>I. viticola</i>	<i>Phanerochaetaceae</i>	S		USA	Saccardo (1878)
<i>Kalmusia variispora</i> (Verkley, Göker & Stielow) Ariyawansa & K.D. Hyde	<i>Didymosphaeriaceae</i>	P	Trunk disease	Syria	Verkley et al. (2014)
<i>Karstenula yaline</i> (Ellis & Everh.) M.E. Barr	<i>Didymosphaeriaceae</i>	S		USA	Cash (1954)
<i>Kazachstania viticola</i> Zubcova	<i>Saccharomycetaceae</i>		Fermented juice	Kazakhstan	Zubkova (1971)
<i>Kernia</i> sp.*	<i>Microascaceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>Kluyveromyces marxianus</i> (E.C. Hansen) Van der Walt	<i>Saccharomycetaceae</i>	P	Sour rot	Poland	Mulenko et al. (2008)
<i>Kuehneola vitis</i> (E.J. Butler) Syd. & P. Syd.	<i>Phragmidiaceae</i>	P	Rust	India	Watson (1971), Ragunathan and Ramakrishnan (1973)
<i>Lachnella macrochaeta</i> Speg.	<i>Niaceae</i>	S		Italy	Farr (1973)
<i>L. myceliosa</i> W.B. Cooke	<i>Niaceae</i>	S		France, Germany	Batista and Ciferri (1962)
<i>L. uvicola</i> (Speg.) W.B. Cooke	<i>Niaceae</i>	S		Argentina	Batista and Ciferri (1962)
<i>L. viticola</i> Gonz. Frag.	<i>Niaceae</i>	S		Portugal	Unamuno (1941)
<i>Lachnum virgineum</i> (Batsch) P. Karst.	<i>Lachnaceae</i>	S		Japan	Kobayashi (2007)
<i>Lasiodiplodia brasiliense</i> M.S.B. Netto, M.W. Marques & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2016b)
<i>L. citricola</i> Abdollahzadeh, Javadi & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Italy	Carlucci et al. (2015)
<i>L. crassispora</i> T. Burgess & Barber*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil, South Africa, USA	Úrbez-Torres et al. (2010b), van Niekerk et al. (2010), Correia et al. (2013, 2016b)
<i>L. egyptiaca</i> A.M. Ismail, L. Lombard & Crous*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2016b)
<i>L. euphorbicola</i> A.R. Machado & O.L. Pereira*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2016b)
<i>L. hormozganensis</i> Abdollahzadeh, Zare & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2016b)
<i>L. jatrophicola</i> A.R. Machado & O.L. Pereira*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2016b)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>L. iraniensis</i> Abdollahzadeh, Zare & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Italy	Correia et al. (2016b), Netto et al. (2017)
<i>L. laeliocattleyae</i> (Sibilia) A. Alves*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2016b)
<i>L. margaritacea</i> Pavlic, T.I. Burgess & M.J. Wingf.*	<i>Botryosphaeriaceae</i>	S		China	This study
<i>L. mediterranea</i> Linaldeddu, Deidda & Berraf-Tebbal*	<i>Botryosphaeriaceae</i>	P	Canker and die back	USA	Linaldeddu et al. (2015), Cruywagen et al. (2017), Netto et al. (2017)
<i>L. missouriana</i> Úrbez-Torres, Peduto & Gubler*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil, USA	Úrbez-Torres et al. (2012), Netto et al. (2014, 2017), Linaldeddu et al. (2015), Trakunyingcharoen et al. (2015), Correia et al. (2016b), Cruywagen et al. (2017), Coutinho et al. (2017)
<i>L. parva</i> A.J.L. Phillips, A. Alves & Crous*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil	Correia et al. (2013)
<i>L. plurivora</i> Damm & Crous*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Africa, South Africa	Damm et al. (2007), Begoude et al. (2010), Doilom et al. (2015), Coutinho et al. (2017)
<i>L. pseudotheobromae</i> A.J.L. Phillips, A. Alves & Crous*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Brazil, China	Correia et al. (2013, 2016b), Dissanayake et al. (2015)
<i>L. theobromae</i> (Pat.) Griffon & Maubl.*	<i>Botryosphaeriaceae</i>	P, E	Canker and die back	Argentina, Australia, Bolivia, Brazil, China, Egypt, Florida, Iran, Italy, Iraq, Portugal, South Africa, Spain, Turkey, Uganda, USA	Alfieri Jr. et al. (1984), Úrbez-Torres et al. (2006), van Niekerk et al. (2006), Pitt et al. (2010), Qiu et al. (2011), Yan et al. (2011b), Mondello et al. (2013), Dissanayake et al. (2018)
<i>L. viticola</i> Úrbez-Torres, Peduto & Gubler*	<i>Botryosphaeriaceae</i>	P	Canker and die back	USA	Úrbez-Torres et al. (2012), Linaldeddu et al. (2015), Comont et al. (2016), Coutinho et al. (2017), Netto et al. (2017)
<i>L. vitis</i> Tao Yang & Crous*	<i>Botryosphaeriaceae</i>	P	Canker and die back	Italy	Yang et al. (2017)
<i>Lasiodiplodia</i> sp.*	<i>Botryosphaeriaceae</i>	P, S, E	Canker and die back	China, Italy	Mondello et al. (2013), Dissanayake et al. (2018), This study
<i>Lecanicillium lecanii</i> (Zimm.) Zare & W. Gams	<i>Cordycipitaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Lecanicillium</i> sp.*	<i>Cordycipitaceae</i>	S		China	This study
<i>Lecanidion atratum</i> (Hedw.) Endl.	<i>Patellariaceae</i>	S		Italy	Greuter et al. (1991)
<i>Lecythophora hoffmannii</i> (J.F.H. Beyma) W. Gams & McGinnis*	<i>Coniochaetaceae</i>	E		Switzerland	Casieri et al. (2009)
<i>Leninus</i> sp.*	<i>Polyporaceae</i>	S		China	This study
<i>Lenzites betulina</i> (L.) Fr.	<i>Polyporaceae</i>	S		Pakistan	Ahmad et al. (1997)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Leptodothiorella</i> sp.	<i>Botryosphaeriaceae</i>	P	Black rot	Russia	Melnik and Popushoi (1992)
<i>Leptosphaeria ampelina</i> Curzi & Barbaini	<i>Leptosphaeriaceae</i>	E		Italy	Crane and Shearer (1991)
<i>L. cerlettii</i> Speg.	<i>Leptosphaeriaceae</i>	S		Italy	Farr (1973), Crane and Shearer (1991)
<i>L. chaetostoma</i> Sacc.	<i>Leptosphaeriaceae</i>	S		Italy	Crane and Shearer (1991)
<i>L. cirricola</i> Pass.	<i>Leptosphaeriaceae</i>	S		Italy	Crane and Shearer (1991)
<i>L. gibelliana</i> Pirota	<i>Leptosphaeriaceae</i>	S		Italy	Crane and Shearer (1991)
<i>L. ogilviensis</i> (Berk. & Broome) Ces. & De Not.	<i>Leptosphaeriaceae</i>	S		Pakistan	Ahmad (1978)
<i>L. pampini</i> (Thüm.) Sacc.	<i>Leptosphaeriaceae</i>	S		France, Italy, Portugal	Unamuno (1941), Crane and Shearer (1991)
<i>L. yalin</i> Sacc.	<i>Leptosphaeriaceae</i>	S		Italy, UK	Cannon et al. (1985), Crane and Shearer (1991)
<i>L. vagabunda</i> Sacc.	<i>Leptosphaeriaceae</i>	S		USA	Hanlin (1963)
<i>L. vinealis</i> Pass.	<i>Leptosphaeriaceae</i>	S		Italy	Crane and Shearer (1991)
<i>L. viticola</i> Fautrey & Roum.	<i>Leptosphaeriaceae</i>	S		France	Crane and Shearer (1991)
<i>L. vitigena</i> Sacc.	<i>Leptosphaeriaceae</i>	S		Austria	Crane and Shearer (1991)
<i>L. vitis</i> (Castagne) Pirota	<i>Leptosphaeriaceae</i>	S		Austria, France	Crane and Shearer (1991)
<i>Leptosphaeria</i> sp.*	<i>Leptosphaeriaceae</i>	E, S		China, Spain, Switzerland, Venezuela	Urtiaga (1986), Casieri et al. (2009), Gonzalez and Tello (2011), This study
<i>Leptothyrium passerinii</i> Thüm.	Ascomycota genera incertae sedis	E		China	Tai (1979)
<i>Leucostoma persoonii</i> (Nitschke) Höhn.*	<i>Valsaceae</i>	P	Canker	Germany, Italy, Spain	Greuter et al. (1991), Fischer et al. (2016)
<i>Libertella blepharis</i> A.L. Sm.	<i>Diatrypaceae</i>	P, E	Trunk disease	Bulgaria	Bobev (2009)
<i>L. viticola</i> Fautrey	<i>Diatrypaceae</i>	E		France	Fautrey and Lambotte (1896)
<i>Libertella</i> sp.	<i>Diatrypaceae</i>	P, E	Trunk disease	Australia, Spain	Sosnowski et al. (2007), Gonzalez and Tello (2011)
<i>Lophidium nitidum</i> Ellis & Everh.	<i>Lophiostomataceae</i>	S		USA	Cash (1953)
<i>Lophiostoma caulium</i> (Fr.) Ces. & De Not.	<i>Lophiostomataceae</i>	E		Poland	Mulenko et al. (2008)
<i>L. elegans</i> (Fabre) Sacc.	<i>Lophiostomataceae</i>	E		Pakistan	Ahmad (1969)
<i>L. macrostomum</i> (Tode) Ces. & De Not.*	<i>Lophiostomataceae</i>	E, S		Pakistan, Italy	Ahmad (1978), Ahmad et al. (1997), This study, Jayawardena et al. (2018)
<i>L. pustulatum</i> Ellis & Everh.	<i>Lophiostomataceae</i>	E		USA	Cash (1953)
<i>L. rhopalosporum</i> Ellis & Everh.	<i>Lophiostomataceae</i>	E		USA	Cash (1953)
<i>L. scrophulariae</i> Peck	<i>Lophiostomataceae</i>	E		Canada, USA	Barr (1992)
<i>L. stenostomum</i> Ellis & Everh.	<i>Lophiostomataceae</i>	E		USA	Cash (1953)
<i>L. subcorticale</i> Fuckel	<i>Lophiostomataceae</i>	E		Italy	Saccardo (1878)
<i>L. thuemenianum</i> Speg.	<i>Lophiostomataceae</i>	E		Italy	Farr (1973)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>L. vitigenum</i> (Kaz. Tanaka & Y. Harada) K. Hirayama & Kaz. Tanaka	<i>Lophiostomataceae</i>	E		Japan	Hirayama and Tanaka (2011)
<i>Lophiostoma</i> sp.*	<i>Lophiostomataceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>Lophiotrema eburnoides</i> Kaz. Tanaka, A. Hashim. & K. Hiray.*	<i>Lophiotremataceae</i>	S		Japan	Liu et al. (2015)
<i>L. vitigenum</i> Kaz. Tanaka & Y. Harada	<i>Lophiotremataceae</i>	S		Japan	Tanaka and Harada (2003), Kobayashi (2007)
<i>Loranitschkia viticola</i> Lar.N. Vassiljeva	<i>Nitschkiaceae</i>	S		China, Kunashir Island, Russia	Vasilyeva (1990), Vasilyeva et al. (2009, 2010)
<i>Macrophoma farlowiana</i> (Viala & Sauv.) Tassi	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	USA	Anonymous (1960), Greene (1966)
<i>M. flaccida</i> (Viala & Ravaz) Cavara	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	Bulgaria, France, Greece, India, Italy, Portugal	Mathur (1979), Phillips and Lucas (1997), Phillips (2000), Bobev (2009)
<i>M. longispora</i> (I. Miyake) Hara	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	USA	Anonymous (1960)
<i>M. peckiana</i> Dearn. & House	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	USA	Anonymous (1960)
<i>M. reniformis</i> (Viala & Ravaz) Cavara	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	Italy, USA	Anonymous (1960), Phillips and Lucas (1997)
<i>M. rimiseda</i> (Sacc.) Berl. & Voglino	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	Greece, Morocco, Turkey	Watson (1971), Pantidou (1973)
<i>M. sicula</i> Scalia	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	Central Asia, Italy	Koshkelova and Frolov (1973), Greuter et al. (1991)
<i>Macrophoma</i> sp.	<i>Botryosphaeriaceae</i>	P	Macrophoma rot	India, USA	Mathur (1979), Alfieri Jr. et al. (1984)
<i>Macrophomina phaseolina</i> (Tassi) Goid.	<i>Botryosphaeriaceae</i>	P, E	Charcoal rot	Australia, Hawaii, India, Malawi, South Africa, Spain,	Peregrine and Siddiqi (1972), Marais (1979), Raabe et al. (1981), Gonzalez and Tello (2011)
<i>Macrosporium vitis</i> (Cavara) Cavara	<i>Pleosporaceae</i>	E		Chile	Mujica and Vergara (1945)
<i>Macrosporium</i> sp.	<i>Pleosporaceae</i>	E		Bulgaria, Greece, South Africa	Alexopoulos (1940), Doidge (1950), Bobev (2009)
<i>Marssonina viticola</i> (I. Miyake) F.L. Tai	<i>Drepanopezizaceae</i>	E		China, Japan, Taiwan	Sawada (1959), Watson (1971), Tai (1979), Kobayashi (2007)
<i>Marasmius</i> sp.*	<i>Marasmiaceae</i>	S		China	This study
<i>Massariella viticola</i> Frolov	<i>Amphisphaeriaceae</i>	S		Central Asia	Koshkelova and Frolov (1973)
<i>Massarina corticola</i> (Fuckel) L. Holm*	<i>Massarinaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Merismodes bresadolae</i> (Grélet) Singer	<i>Niaceae</i>	E		Italy	Farr (1973)
<i>Meliola vitis</i> Hansf.	<i>Meliolaceae</i>	E		India, Uganda	Hansford (1947), Patil and Mahamulkar (1999)
<i>Metarhizium</i> sp.*	<i>Clavicipitaceae</i>	S		China	This study
<i>Metasphaeria social</i> (Sacc.) Sacc.	<i>Dothioraceae</i>	S		Italy	Greuter et al. (1991)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Metschnikowia pulcherrima</i> Pitt & M.W. Mill.	<i>Metschnikowiaceae</i>	E		USA	Batra (1973)
<i>M. viticola</i> G. Péter, Tornai-Leh., M. Suzuki & Dlauch*	<i>Metschnikowiaceae</i>	E		Hungary	Peter et al. (2005)
<i>Microascus brevicaulis</i> S.P. Abbott*	Helotiales genera <i>incertae sedis</i>	E		China	Dissanayake et al. (2018)
<i>Microascus</i> sp.	Helotiales genera <i>incertae sedis</i>	S		China	This study
<i>Microdochium bolleyi</i> (R. Sprague) de Hoog & Herm. Nijh.*	<i>Microdochiaceae</i>	E		Switzerland	Casieri et al. (2009)
<i>Microdochium</i> sp.*	<i>Microdochiaceae</i>	S		China	This study
<i>Microdiplodia microsporella</i> (Sacc.) Allesch.	Ascomycota genera <i>incertae sedis</i>	P	Trunk disease	Poland	Mulenko et al. (2008)
<i>M. vineae</i> (Pass. & Beltrani) Tassi	Ascomycota genera <i>incertae sedis</i>	S		Italy	Tassi (1902), Greuter et al. (1991)
<i>Micropora ampelina</i> Sacc. & Fairm.	Ascomycota genera <i>incertae sedis</i>	S		USA	Anonymous (1960)
<i>Microthyrium microscopicum</i> Desm.	<i>Microthyriaceae</i>	S		Portugal	Unamuno (1941)
<i>Minimedusa</i> sp.*	Cantharellales <i>incertae sedis</i>	S		China	This study, Jayawardena et al. (2018)
<i>Moeszia cylindroides</i> Bubák	<i>Nectriaceae</i>	S		Japan	Tubaki (1958)
<i>Mollisia cinerea</i> (Batsch) P. Karst.	<i>Mollisiaceae</i>	S		USA	Hanlin (1963)
<i>M. melaleuca</i> (Fr.) Sacc.	<i>Mollisiaceae</i>	S		USA	Hanlin (1963)
<i>M. pullata</i> (W.R. Gerard) Dennis	<i>Mollisiaceae</i>	S		USA	Dennis (1964)
<i>Monilinia fructicola</i> (G. Winter) Honey*	<i>Sclerotiniaceae</i>	P	Brown rot	Canada, Japan, New Zealand, USA	Preston (1945), Pennycook (1989), Kobayashi (2007), Hrustic et al. (2015)
<i>M. fructigena</i> (Pers.) Pers.	<i>Sclerotiniaceae</i>	S		China	Tai (1979)
<i>M. laxa</i> (Aderh. & Ruhland) Honey	<i>Sclerotiniaceae</i>	S		New Zealand	Pennycook (1989)
<i>Monochaetia ampelophila</i> Speg.	Xylariomycitidae genera <i>insertae sedis</i>	E		Argentina	Guba (1961), Nag Raj (1993)
<i>M. uniseta</i> (Tracy & Earle) Sacc. & D. Sacc.	Xylariomycitidae genera <i>insertae sedis</i>	E		USA	Nag Raj (1993)
<i>Monochaetinula ampelophila</i> (Speg.) Nag Raj	Ascomycota genera <i>incertae sedis</i>	E		Argentina	Nag Raj (1993)
<i>M. terminaliae</i> (Bat. & J.L. Bezerra) Muthumary, Abbas & B. Sutton	Ascomycota genera <i>incertae sedis</i>	E		India	Muthumary et al. (1986)
<i>Monodictys antiqua</i> (Corda) S. Hughes	Dothideomycetes genera <i>incertae sedis</i>	S		Portugal	de Sousa Dias and Lucas (1972)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Mortierella hyalina</i> (Harz) W. Gams*	<i>Mortierellaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Mortierella</i> sp.*	<i>Mortierellaceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>Mucor circinelloides</i> Tiegh.*	<i>Mucoraceae</i>	S		China, Switzerland	Casieri et al. (2009), This study, Jayawardena et al. (2018)
<i>M. hiemalis</i> Wehmer*	<i>Mucoraceae</i>	E, S		Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011)
<i>M. moelleri</i> (Vuill.) Lendn.*	<i>Mucoraceae</i>	S		Switzerland	Casieri et al. (2009)
<i>M. plumbeus</i> Bonord.*	<i>Mucoraceae</i>	S		Switzerland	Casieri et al. (2009)
<i>M. racemosus</i> Fresen.*	<i>Mucoraceae</i>	E, S		China, Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011), This study, Jayawardena et al. (2018)
<i>Mucor</i> sp.	<i>Mucoraceae</i>	E		Greece, Spain, USA	Pantidou (1973), Shaw (1973), Gonzalez and Tello (2011)
<i>Mycosphaerella cuboniana</i> (D. Sacc.) Tomilin	<i>Mycosphaerellaceae</i>	P	Leaf spot	Greece	Pantidou (1973)
<i>M. graminicola</i> (Fuckel) J. Schröt*	<i>Mycosphaerellaceae</i>	E		China	Dissanayake et al. (2018)
<i>M. manganottiana</i> (C. Massal.) Tomilin	<i>Mycosphaerellaceae</i>	P	Leaf spot	Greece	Pantidou (1973)
<i>M. vitis</i> (Fuckel) J. Schröt.	<i>Mycosphaerellaceae</i>	P	Leaf spot	Japan, Poland, Russia	Watson (1971), Kobayashi (2007), Mulencko et al. (2008)
<i>Mycosphaerella</i> sp.*	<i>Mycosphaerellaceae</i>	E		China, USA, Venezuela	Stevenson and Wellman (1944), Dissanayake et al. (2018)
<i>Myrothecium</i> sp.*	<i>Stachybotryaceae</i>	P, S	Leaf spot	China, USA	Alferi Jr. et al. (1984), This study
<i>Myxosporium viticola</i> Dearn. & House	Ascomycota genera <i>incertae sedis</i>	S		USA	Anonymous (1960)
<i>Nectria cinnabarina</i> (Tode) Fr.	<i>Nectriaceae</i>	S		USA	Seifert (1985), Anonymous (1960), Shaw (1973)
<i>N. ramulariae</i> (Wollenw.) E. Müll.*	<i>Nectriaceae</i>	P, E		Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011)
<i>Nectria</i> sp.	<i>Nectriaceae</i>	S		Korea, Mexico	Alvarez (1976), Cho and Shin (2004)
<i>Nemania serpens</i> (Pers.) Gray	<i>Xylariaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Neoanthostomella viticola</i> Daranagama, Camporesi & K. D. Hyde*	<i>Xylariaceae</i>	S		Italy	Daranagama et al. (2016), This study, Jayawardena et al. (2018)
<i>Neofusicoccum algeriense</i> Berraf-Tebbal & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker, die back	Algeria	Berraf-Tebbal et al. (2014), Nogueira et al. (2016)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>N. australe</i> (Slippers, Crous & M.J. Wingf.) Crous, Slippers & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker, die back	Algeria, Australia, Chile, Italy, Mexico, New Zealand, South Africa, Spain, Uruguay, USA	van Niekerk et al. (2004a, b, 2006), Luque et al. (2005), Phillips et al. (2005), Taylor et al. (2005), Úrbez-Torres et al. (2006), Cunnington et al. (2007), Baskarathevan et al. (2008), Úrbez-Torres (2011), Martin et al. (2011b), Sessa et al. (2016)
<i>N. cordaticola</i> Pavlic, Slippers & M.J. Wingf.*	<i>Botryosphaeriaceae</i>	P	Canker, die back	Italy	Sakalidis et al. (2013)
<i>N. italicum</i> Dissan. & K.D. Hyde*	<i>Botryosphaeriaceae</i>	S		Italy	Marin-Felix et al. (2017)
<i>N. kwambonambiense</i> Pavlic, Slippers & M.J. Wingf.*	<i>Botryosphaeriaceae</i>	P	Canker, die back	Uruguay	Sessa et al. (2016)
<i>N. luteum</i> (Pennycook & Samuels) Crous, Slippers & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Botryosphaeria die back	Australia, Germany, Italy, New Zealand, Portugal, South Africa, Spain, Tunisia, Uruguay, USA	Pennycook (1989), van Niekerk et al. (2004a, b), Luque et al. (2005, 2009), Úrbez-Torres et al. (2007), Baskarathevan et al. (2008), Abreo et al. (2012), Fischer et al. (2016)
<i>N. macroclavatum</i> (T.I. Burgess, Barber & G.E. Hardy) T.I. Burgess, Barber & G.E. Hardy	<i>Botryosphaeriaceae</i>	P	Canker, die back	New Zealand	Billones et al. (2010), Úrbez-Torres (2011)
<i>N. mangiferae</i> (Syd. & P. Syd.) Crous, Slippers & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker, die back	China	Dissanayake et al. (2015)
<i>N. mediterraneum</i> Crous, M.J. Wingf. & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker, die back	Algeria, Spain, USA	Úrbez-Torres et al. (2010a, b, c), Berraf-Tebbal et al. (2014)
<i>N. occulatum</i> Sakalidis & T.I. Burgess*	<i>Botryosphaeriaceae</i>	P	Canker, die back	Australia	Sakalidis et al. (2013)
<i>N. parvum</i> (Pennycook & Samuels) Crous, Slippers & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P, E, S	Botryosphaeria die back	Australia, Italy, Brazil, Canada, Chile, China, France, New Zealand, Portugal, South Africa, Spain, Switzerland, Uruguay, USA	Phillips et al. (2002, 2005), van Niekerk et al. (2004a, b, 2006), Luque et al. (2005, 2009), Úrbez-Torres et al. (2006), Cunnington et al. (2007), Baskarathevan et al. (2008), Casieri et al. (2009), Gonzalez and Tello (2011), Abreo et al. (2012), Correia et al. (2013), Mondello et al. (2013), Sakalidis et al. (2013), Wu et al. (2015), This study, Jayawardena et al. (2018)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>N. ribis</i> (Slippers, Crous & M.J. Wingf.) Crous, Slippers & A.J.L. Phillips	<i>Botryosphaeriaceae</i>	P	Botryosphaeria die back, Macrophoma rot	Australia, Italy, South Africa, Tanzania, Pakistan, Portugal, USA	Anonymous (1960), Ebbels and Allen (1979), Milholland (1994), Ahmad et al. (1997), Phillips (2000), Halleen et al. (2003), van Niekerk et al. (2006)
<i>N. stellenboschiana</i> Tao Yang & Crous*	<i>Botryosphaeriaceae</i>	P	Canker, die back	South Africa	Yang et al. (2017)
<i>N. viticlavatum</i> (Van Niekerk & Crous) Crous, Slippers & A.J.L. Phillips	<i>Botryosphaeriaceae</i>	P	Canker, die back	South Africa	Burgess et al. (2005), Farr et al. (2005), Luque et al. (2005), Phillips et al. (2005), van Niekerk et al. (2006)
<i>N. vitifusiforme</i> (Van Niekerk & Crous) Crous, Slippers & A.J.L. Phillips	<i>Botryosphaeriaceae</i>	P	Botryosphaeria die back	Italy, Mexico, South Africa, Spain, USA	van Niekerk et al. (2004a, b), Burgess et al. (2005), Luque et al. (2009), Candolfi-Arballo et al. (2010), Úrbez-Torres (2011), Mondello et al. (2013)
<i>Neomassaria fabacearum</i> Mapook, Camporesi & K.D. Hyde*	<i>Massariaceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>Neonectria candida</i> (Ehrenb.) Rossman, L. Lombard & Crous*	<i>Nectriaceae</i>	S		Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011)
<i>N. coccinea</i> (Pers.) Rossman & Samuels	<i>Nectriaceae</i>	S		USA	Anonymous (1960)
<i>N. fuckeliana</i> (C. Booth) Castl. & Rossman*	<i>Nectriaceae</i>	P, E		Canada, Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011), Petit et al. (2011)
<i>N. macrodidyma</i> Halleen, Schroers & Crous*	<i>Nectriaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>N. microconidia</i> J. Luo, P. Zhao & W.Y. Zhuang*	<i>Nectriaceae</i>	S		Japan	Hirooka et al. (2013)
<i>N. obtusispora</i> (Cooke & Harkn.) Rossman, L. Lombard & Crous	<i>Nectriaceae</i>	P	Black-foot disease	Italy, USA	Scheck et al. (1998a, b), Greuter et al. (1991)
<i>Neopestalotiopsis asiatica</i> (Maharachch. & K.D. Hyde) Maharachch., K.D. Hyde & Crous*	<i>Sporocadaceae</i>	P	Leaf stripe	France	Maharachchikumbura et al. (2016)
<i>N. clavispora</i> (G.F. Atk.) Maharachch., K.D. Hyde & Crous*	<i>Sporocadaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>N. javaensis</i> Maharachch., K.D. Hyde & Crous*	<i>Sporocadaceae</i>	E		France	Maharachchikumbura et al. (2016)
<i>N. vitis</i> Jayawardena, Maharachch., Yan, Li & Hyde*	<i>Sporocadaceae</i>	P, S	Fruit rot, trunk disease, leaf spot	China	Jayawardena et al. (2016a, b)
<i>Neopestalotiopsis</i> sp.*	<i>Sporocadaceae</i>	P	Leaf spot	China, France, India	Jayawardena et al. (2015), Maharachchikumbura et al. (2014, 2016)
<i>Neoplaconema</i> sp.*	Ascomycota genera <i>incertae sedis</i>	P		Switzerland	Casieri et al. (2009)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Neoscytalidium dimidiatum</i> (Penz.) Crous & Slippers*	<i>Botryosphaeriaceae</i>	P	Wood canker, die back	Brazil, India, Iraq, USA,	Wangikar et al. (1969), Sarbhoy et al. (1971), Mathur (1979), Al-Saadoon et al. (2012), Rolshausen et al. (2013), Correia et al. (2016a)
<i>Neurospora</i> sp.*	<i>Sordariaceae</i>	S		China	This study
<i>Nigrospora oryzae</i> (Berk. & Broome) Petch*	Sordariomycetes genera <i>incertae sedis</i>	E		China, Spain	Gonzalez and Tello (2011), Dissanayake et al. (2018)
<i>N. sphaerica</i> (Sacc.) E.W. Mason*	Sordariomycetes genera <i>incertae sedis</i>	E		China	Dissanayake et al. (2018)
<i>Nodulisporium</i> sp.	<i>Xylariaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Odiiodendron</i> sp.*	<i>Myxotrichaceae</i>	E		China	Dissanayake et al. (2018)
<i>Ophiocordyceps</i> sp.*	<i>Ophiocordycipitaceae</i>	S		China	This study
<i>Ophiostoma piceae</i> (Münch) Syd. & P. Syd.*	<i>Ophiostomataceae</i>	E		Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011)
<i>O. quercus</i> (Georgiev.) Nannf.*	<i>Ophiostomataceae</i>	E		Switzerland	Casieri et al. (2009)
<i>O. subalpinum</i> Ohtaka & Masuya*	<i>Ophiostomataceae</i>	E		Switzerland	Casieri et al. (2009)
<i>Ophiostoma</i> sp.*	<i>Ophiostomataceae</i>	E		Switzerland	Casieri et al. (2009)
<i>Ostrechnion curtisii</i> (Duby) M.L. Lohman	<i>Hysteriaceae</i>	S		USA	Hanlin (1963)
<i>Ostreola viticola</i> R. Rao & Modak	<i>Mytiliniaceae</i>	S		India	Pande (2008)
<i>Paecilomyces</i> sp.	<i>Thermoascaceae</i>	P	Root stock	South Africa	Halleen et al. (2003)
<i>Papiliotrema laurentii</i> (Kuff.) X.Z. Liu, F.Y. Bai, M. Groenew. & Boekhout	<i>Tremellaceae</i>	P	Melting decay	USA	Morgan and Michailides (2004)
<i>Papulospora</i> sp.*	Sordariomycetes genera <i>incertae sedis</i>	S		China	This study
<i>Pareutypella sulcata</i> Y.M. Ju & J.D. Rogers	Sordariomycetes genera <i>incertae sedis</i>	S		Taiwan	Ju and Rogers (1995)
<i>Passalora dissiliens</i> (Duby) U. Braun & Crous	<i>Mycosphaerellaceae</i>	P	Leaf spot	Australia, Bulgaria, China, Egypt, France, Iran, India, Israel, Japan, South Africa, Pakistan, Palestine, Poland, Portugal, Yemen	Crous and Braun (2003), Guo and Liu (2003), Zhuang (2005), Kobayashi (2007), Bobev (2009), Mouchacca (2009)
<i>P. fulva</i> (Cooke) U. Braun & Crous*	<i>Mycosphaerellaceae</i>	P	Leaf spot	Switzerland	Casieri et al. (2009)
<i>P. heterosporella</i> U. Braun & Crous	<i>Mycosphaerellaceae</i>	P	Leaf spot	Israel, USA	Crous and Braun (2003)
<i>P. vitis</i> (M.S. Patil & Sawant) Poonam Srivast.	<i>Mycosphaerellaceae</i>	P	Leaf spot	India	Crous and Braun (2003), Kamal (2010)
<i>P. vitis-piadezkii</i> U. Braun & Crous	<i>Mycosphaerellaceae</i>	P	Leaf spot	China	Crous and Braun (2003), Guo and Liu (2003)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>P. vitis-ripariae</i> (U. Braun) U. Braun & Crous	<i>Mycosphaerellaceae</i>	P	Leaf spot	USA	Crous and Braun (2003)
<i>Patellaria atrata</i> (Hedw.) Fr.	<i>Patellariaceae</i>	S		Central Asia	Koshkelova and Frolov (1973)
<i>P. lantanae</i> R. Rao	<i>Patellariaceae</i>	S		India	Pande (2008)
<i>P. viticola</i> Pers.	<i>Patellariaceae</i>	S		Spain	Unamuno (1941)
<i>Paraphoma chrysanthemicola</i> (Hollós) Gruyter, Aveskamp & Verkley*	<i>Phaeosphaeriaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Penicillium adametzioides</i> S. Abe	<i>Aspergillaceae</i>	E, S		Japan	Kobayashi (2007)
<i>P. astrolabium</i> R. Serra & S.W. Peterson*	<i>Aspergillaceae</i>	S		Portugal	Serra and Peterson (2007)
<i>P. aurantiogriseum</i> Dierckx	<i>Aspergillaceae</i>	P	Fruit rot	South Africa	Gorter (1977)
<i>P. brevicompactum</i> Dierckx*	<i>Aspergillaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>P. chrysogenum</i> Thom*	<i>Aspergillaceae</i>	S		China	This study
<i>P. citrinum</i> Thom*	<i>Aspergillaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>P. digitatum</i> (Pers.) Sacc.*	<i>Aspergillaceae</i>	E		China	Dissanayake et al. (2018)
<i>P. elongatum</i> Dierckx	<i>Aspergillaceae</i>	P	Fruit rot	South Africa	Gorter (1977)
<i>P. expansum</i> Link	<i>Aspergillaceae</i>	P	Fruit rot	Bulgaria, South Africa, USA	Gorter (1977), Bobev (2009)
<i>P. funiculosum</i> Thom	<i>Aspergillaceae</i>	S		Cyprus	Georghiou and Papadopoulos (1957)
<i>P. italicum</i> Wehmer	<i>Aspergillaceae</i>	P	Fruit rot	Greece	Pantidou (1973)
<i>P. neocrassum</i> R. Serra & S.W. Peterson*	<i>Aspergillaceae</i>	S		Portugal	Serra and Peterson (2007)
<i>P. olsonii</i> Bainier & Sartory*	<i>Aspergillaceae</i>	E		Portugal	Serra and Peterson (2007)
<i>P. rolfsii</i> Thom	<i>Aspergillaceae</i>	E		USA	Shaw (1973)
<i>P. sclerotigenum</i> W. Yamam.	<i>Aspergillaceae</i>	S		Japan	Kobayashi (2007)
<i>P. sumatraense</i> Svilv.*	<i>Aspergillaceae</i>	P		Iran	Mahdian and Zafari (2017)
<i>P. terrigenum</i> Houbraken, Frisvad & Samson*	<i>Aspergillaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>P. toxicarium</i> I. Miyake*	<i>Aspergillaceae</i>	P, E	Fruit rot	Spain	Garcia-Benavides et al. (2013)
<i>P. variabile</i> Sopp	<i>Aspergillaceae</i>	S		USA	Shaw (1973)
<i>Penicillium</i> sp.*	<i>Aspergillaceae</i>	P, E, S	Fruit rot	Australia, Chile, China, Cuba, France, Italy, Japan, Korea, South Africa, Spain, Switzerland, USA	French (1989), Castillo-Pando et al. (2001), Fourie and Halleen (2002), Casieri et al. (2009), Gonzalez and Tello (2011), Mondello et al. (2013), Oh et al. (2014), Dissanayake et al. (2018), This study

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Peniophora albomarginata</i> (Schwein.) Masee	<i>Peniophoraceae</i>	S		USA	Hanlin (1966)
<i>P. viticola</i> (Schwein.) Höhn. & Litsch.	<i>Peniophoraceae</i>	S		USA	Hanlin (1966)
<i>Peniophora</i> sp.*	<i>Peniophoraceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Penzigomyces dissolvens</i> (Hol.-Jech., Mercado & J. Mena) J. Mena*	Ascomycota genera <i>incertae sedis</i>	S		Cuba	Mena-Portales et al. (2000)
<i>Perenniporia tenuis</i> (Schwein.) Ryvarden	<i>Polyporaceae</i>	S		Greece	Kotlaba (1997), Zervakis et al. (1998)
<i>P. unita</i> (Pers.) Murrill	<i>Polyporaceae</i>	S		USA	Hanlin (1966)
<i>Periconia byssoides</i> Pers.	<i>Periconiaceae</i>	E		Argentina, USA	Grand (1985), Carmaran and Novas (2003)
<i>P. igniaria</i> E.W. Mason & M.B. Ellis	<i>Periconiaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Pestalotiopsis biciliata</i> Maharachch., K.D. Hyde & Crous*	<i>Sporocadaceae</i>	P	Leaf stripe, defoliated shoots	France	Maharachchikumbura et al. (2016)
<i>P. chamaeropsis</i> Maharachch., K.D. Hyde & Crous*	<i>Sporocadaceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>P. funerea</i> (Desm.) Steyaert	<i>Sporocadaceae</i>	P	Leaf spot	Japan	Kobayashi (2007)
<i>P. mangiferae</i> (Henn.) Steyaert	<i>Sporocadaceae</i>	P	Leaf spot	Myanmar	Thaung (2008c)
<i>P. menezesiana</i> (Bres. & Torrend) Bissett*	<i>Sporocadaceae</i>	P	Fruit rot	Australia, China, Greece, India, Japan, Madeira Islands, USA	Mundkur and Thirumalachar (1946), Alfieri Jr. et al. (1984, Nag Raj (1993), Sergeeva et al. (2005)
<i>P. quadriciliata</i> (Bubák & Dearn.) Bissett	<i>Sporocadaceae</i>	P	Leaf spot	Canada	Nag Raj (1993)
<i>P. trachicarpicola</i> Y.M. Zhang & K.D. Hyde*	<i>Sporocadaceae</i>	P	Fruit rot, trunk disease	China	Jayawardena et al. (2015)
<i>P. uvicola</i> (Speg.) Bissett*	<i>Sporocadaceae</i>	P	Fruit rot	Australia, China, India, Italy, Japan, Korea, USA	Simmonds (1966), Tai (1979), Nag Raj (1988, 1993), Cho and Shin (2004), Sergeeva et al. (2005), Kobayashi (2007), Ge et al. (2009), Maharachchikumbura et al. (2011), Úrbez-Torres et al. (2012)
<i>Pestalotiopsis</i> sp.*	<i>Sporocadaceae</i>	P, E, S	Fruit rot	Australia, Cuba, Italy, Japan, Korea, South Africa, USA	Urutiaga (1986), Halleen et al. (2003), Castillo-Pando et al. (2001), Úrbez-Torres et al. (2012), This study

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Phaeoacremonium aleophilum</i> W. Gams, Crous, M.J. Wingf. & Mugnai*	Togniniaceae	P, E	Esca	Algeria, Argentina, Austria, Australia, France, Italy, Iran, Serbia, South Africa, Spain, Turkey, Uruguay, USA, Yugoslavia	Larignon and Dubos (1997), Pascoe and Cottral (2000), Gatica et al. (2001), Lardner et al. (2005), Whiting et al. (2005), Mostert et al. (2006), Sosnowski et al. (2007), Luque et al. (2009), Berraf-Tebbal et al. (2011), Gonzalez and Tello (2011), Abreo et al. (2012), Mohammadi and Banihashemi (2012), Garcia-Benavides et al. (2013), Mohammadi et al. (2013a), Úrbez-Torres et al. (2013a, b)
<i>P. alvesii</i> L. Mostert, Summerb. & Crous*	Togniniaceae	P	Esca	South Africa, Turkey	Essakhi et al. (2008), White et al. (2011)
<i>P. amstelodamense</i> L. Mostert, Summerb. & Crous	Togniniaceae	P	Esca	Netherland	Arzanlou et al. (2014)
<i>P. angustius</i> W. Gams, Crous & M.J. Wingf.	Togniniaceae	P	Esca	France, Portugal, USA	Chicau et al. (2000), Whiting et al. (2005)
<i>P. argentinense</i> L. Mostert, W. Gams & Crous*	Togniniaceae	P	Esca	Argentina	Arzanlou et al. (2014)
<i>P. armeniacum</i> A.B. Graham, P.R. Johnst. & B. Weir*	Togniniaceae	P	Esca	New Zealand	Graham et al. (2009), Arzanlou et al. (2014), Úrbez-Torres et al. (2014)
<i>P. australiense</i> L. Mostert, Summerb. & Crous*	Togniniaceae	P	Esca	Australia, Uruguay	Mostert et al. (2006), Graham et al. (2009), Abreo et al. (2012), Arzanlou et al. (2014), Úrbez-Torres et al. (2014)
<i>P. austroafricanum</i> L. Mostert, W. Gams & Crous*	Togniniaceae	P	Esca	South Africa	Berraf-Tebbal et al. (2011), Úrbez-Torres et al. (2014)
<i>P. canadense</i> J.R. Úrbez-Torres, P. Haag & D.T. O’Gorman*	Togniniaceae	P	Esca	Canada	Úrbez-Torres et al. (2014)
<i>P. chlamydospora</i> (W. Gams, Crous, M.J. Wingf. & Mugnai) Crous & W. Gams*	Togniniaceae	P	Esca	Australia, Chile, France, Italy, Portugal, South Africa, USA	Larignon and Dubos (1997), Dupont et al. (1998b), Scheck et al. (1998b), Chicau et al. (2000), Pascoe and Cottral (2000), Auger et al. (2004b), Lardner et al. (2005), Santos et al. (2006)
<i>P. cinereum</i> Gramaje, Mohammadi, Banihashemi, Armengol & L. Mostert*	Togniniaceae	P	Esca	Iran	Gramaje et al. (2009), Mohammadi and Banihashemi (2012), Mohammadi et al. (2013a), Úrbez-Torres et al. (2014), Sami et al. (2014)
<i>P. fraxinopennsylvanicum</i> (T.E. Hinds) D. Gramaje, L. Mostert & Crous*	Togniniaceae	P	Esca	Canada, Croatia, Germany, Hungary, Iran, South Africa, Spain, USA	Eskalen et al. (2005), Fischer et al. (2016)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>P. globosum</i> A.B. Graham, P.R. Johnst. & B. Weir*	<i>Togniniaceae</i>	P	Esca	New Zealand	Graham et al. (2009), Arzanlou et al. (2014), Úrbez-Torres et al. (2014)
<i>P. griseorubrum</i> L. Mostert, Summerb. & Crous*	<i>Togniniaceae</i>	P	Esca	Italy	Essakhi et al. (2008), Gramaje et al. (2009), Berraf-Tebbal et al. (2011)
<i>P. hispanicum</i> Gramaje, Armengol & L. Mostert*	<i>Togniniaceae</i>	P	Esca	Algeria, Iran, Spain	Martin et al. (2011a), Úrbez-Torres et al. (2014)
<i>P. hungaricum</i> Essakhi, Mugnai, Surico & Crous*	<i>Togniniaceae</i>	P	Esca	Hungary	Essakhi et al. (2008), Berraf-Tebbal et al. (2011), Arzanlou et al. (2014), Úrbez-Torres et al. (2014),
<i>P. inflatipes</i> W. Gams, Crous & M.J. Wingf.*	<i>Togniniaceae</i>	P, E	Esca	Chile, Iran, Italy, Spain, USA,	Scheck et al. (1998a, b), Mugnai et al. (1999), Whiting et al. (2005), Mostert et al. (2006), Gonzalez and Tello (2011), Mohammadi and Banihashemi (2012)
<i>P. iranianum</i> L. Mostert, Gräfenhan, W. Gams & Crous*	<i>Togniniaceae</i>	P	Esca	Canada, Iran, Italy, South Africa, Spain	Mostert et al. (2006), Essakhi et al. (2008), Gramaje et al. (2009), White et al. (2011), Mohammadi et al. (2013a), Sami et al. (2014), Úrbez-Torres et al. (2014)
<i>P. italicum</i> A. Carlucci & M.L. Raimondo*	<i>Togniniaceae</i>	P	Esca	Italy	Raimondo et al. (2014)
<i>P. krajdenii</i> L. Mostert, Summerb. & Crous*	<i>Togniniaceae</i>	P	Esca	Canada, Europe, South Africa, Spain	Mostert et al. (2006), Gramaje et al. (2011), Úrbez-Torres et al. (2014)
<i>P. minimum</i> (Tul. & C. Tul.) D. Gramaje, L. Mostert & Crous*	<i>Togniniaceae</i>	P	Esca	Argentina, Austria, Australia, Brazil, Canada, Chile, France, Germany, Greece, Hungary, Iran, Israel, Italy, Mexico, South Africa, Uruguay, USA, Yugoslavia	Mostert et al. (2006), Úrbez-Torres et al. (2012, 2014), Baloyi et al. (2013), Whitelaw-Weckert et al. (2013)
<i>P. mortoniae</i> Crous & W. Gams*	<i>Togniniaceae</i>	P	Esca	Iran, New Zealand	Whiting et al. (2005), Mohammadi and Banihashemi (2012)
<i>P. occidentale</i> A.B. Graham, P.R. Johnst. & B. Weir*	<i>Togniniaceae</i>	P	Esca	New Zealand	Graham et al. (2009), Arzanlou et al. (2014), Úrbez-Torres et al. (2014)
<i>P. parasiticum</i> (Ajello, Georg & C.J.K. Wang) W. Gams, Crous & M.J. Wingf.*	<i>Togniniaceae</i>	P	Esca	Algeria, Argentina, Australia, Brazil, Chile, Iran, Peru, South Africa	Gatica et al. (2001), Dupont et al. (2002), Berraf-Tebbal et al. (2011)
<i>P. roseum</i> (J.R.) Urb.-Torr., P. Haag & O’Gorman*	<i>Togniniaceae</i>	P	Esca	Canada	da Silva et al. (2017)
<i>P. rubrigenum</i> W. Gams, Crous & M.J. Wingf.*	<i>Togniniaceae</i>	P	Esca	Argentina, Chile, Croatia, France, Iran, New Zealand, South Africa, USA	Dupont et al. (2000), Kubatova et al. (2004), Essakhi et al. (2008), Sami et al. (2014)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>P. scolyti</i> L. Mostert, Summerb. & Crous*	<i>Togniniaceae</i>	P	Esca	France, Italy, South Africa, Spain, Turkey	Essakhi et al. (2008), Gramaje et al. (2008), Ozben et al. (2012), Úrbez-Torres et al. (2014)
<i>P. sicilianum</i> Essakhi, Mugnai, Surico & Crous*	<i>Togniniaceae</i>	P	Esca	Italy, South Africa, Spain	Essakhi et al. (2008), White et al. (2011), Arzanlou et al. (2014), Úrbez-Torres et al. (2014), Gramaje et al. (2009)
<i>P. subulatum</i> L. Mostert, Summerb. & Crous*	<i>Togniniaceae</i>	P	Esca	South Africa	Mostert et al. (2006), Berraf-Tebbal et al. (2011)
<i>P. tuscanicum</i> Essakhi, Mugnai, Surico & Crous*	<i>Togniniaceae</i>	P	Esca	Spain	Garcia-Benavides et al. (2013)
<i>P. venezuelense</i> L. Mostert, Summerb. & Crous*	<i>Togniniaceae</i>	P	Esca	Algeria, South Africa	Mostert et al. (2006), Berraf-Tebbal et al. (2011)
<i>P. viticola</i> J. Dupont*	<i>Togniniaceae</i>	P	Esca	France, Germany, Spain	Luque et al. (2009), Úrbez-Torres et al. (2014), Fischer et al. (2016)
<i>Phaeoacremonium</i> sp.*	<i>Togniniaceae</i>	P, S	Esca	Argentina, China, Iran, South Africa, Spain	Gatica et al. (2001), Fourie and Halleen (2002), Halleen et al. (2003), Gramaje et al. (2009), White et al. (2011), Mohammadi and Banihashemi (2012), This study
<i>Phaeomoniella chlamydospora</i> (W. Gams, Crous, M.J. Wingf. & Mugnai) Crous & W. Gams*	<i>Phaeomoniellaceae</i>	P, E	Esca	Argentina, Australia, Brazil, Bulgaria, Chile, Europe, France, Iran, Italy, New Zealand, Slovakia, South Africa, Spain, Switzerland, Turkey, Uruguay, USA	Larignon and Dubos (1997), Crous and Gams (2000), Karimi et al. (2001), Cunningham (2003), Halleen et al. (2003), Whiting et al. (2005), Kakalikova et al. (2009), Bobev (2009), Casieri et al. (2009), Luque et al. (2009), Smetham et al. (2010), Gonzalez and Tello (2011), Correia et al. (2013), Garcia-Benavides et al. (2013), Mohammadi et al. (2013a), Diaz and Latorre (2014), Akgul et al. (2015)
<i>Phaeotrichoconis crotalariae</i> (M.A. Salam & P.N. Rao) Subram.*	Ascomycota genera <i>incertae sedis</i>	E		Brazil	Bezerra and De Lima (2012)
<i>Phakopsora ampelopsidis</i> Dietel & P. Syd.	<i>Phakopsoraceae</i>	P	Rust	Hong Kong, Korea, India, Taiwan, Thailand	Mundkur (1943), Sawada (1943), Lu et al. (2000), Cho and Shin (2004), Lorsuwan et al. (1984)
<i>P. cronartiiformis</i> Dietel	<i>Phakopsoraceae</i>	P	Rust	India	Mundkur (1943), Padwick (1946), Watson (1971), Sarbhoy and Agarwal (1990)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>P. euvitis</i> Y. Ono	<i>Phakopsoraceae</i>	P	Rust	Bangladesh, Brazil, China, Indonesia, Jamaica, Japan, Malaysia, North Korea, Philippines, Thailand, Taiwan, USA	Teodoro (1937), Giatgong (1980), Ono (2000), Chatasiri and Ono (2008)
<i>P. meliosmae-myrianthae</i> (Henn. & Shirai) Y. Ono*	<i>Phakopsoraceae</i>	P	Rust	Japan, Taiwan	Pota et al. (2015), Ono (2016)
<i>P. montana</i> Y. Ono & Chatasiri*	<i>Phakopsoraceae</i>	P	Rust	Japan	Pota et al. (2015), Ono (2016)
<i>P. uva</i> Buriticá & J.F. Hennen*	<i>Phakopsoraceae</i>	P	Rust	Colombia, Costa Rica, Cuba, Guatemala, Mexico, USA, Venezuela	Buriticá and Pardo Cardona (1996), Pardo Cardona (1998), Buriticá (1999), Salazar-Yepes et al. (2002)
<i>P. vitis</i> P. Syd.	<i>Phakopsoraceae</i>	P	Rust	Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Indonesia, Japan, Russia, Taiwan, Trinidad and Tobago, USA, Venezuela	Arthur (1918), Chardon and toro (1930), Jackson (1931), Kern et al. (1934), Baker and Dale (1951), Berndt (2004)
<i>Phakopsora</i> sp.	<i>Phakopsoraceae</i>	P	Rust	Costa Rica	Berndt (2004)
<i>Phanerochaete viticola</i> (Schwein.) Parmasto	<i>Phanerochaetaceae</i>	E	Rust	USA	Burdall (1985)
<i>Phellinidium noxium</i> (Corner) Bondartseva & S. Herrera	<i>Hymenochaetaceae</i>	P	Esca	Taiwan	Ann et al. (2002)
<i>Phellinus igniarius</i> (L.) Quél.	<i>Hymenochaetaceae</i>	P	Esca	Bulgaria	Bobev (2009)
<i>P. resupinatus</i> M. Fisch., M. Cloete, L. Mostert & F. Halleen*	<i>Hymenochaetaceae</i>	P	Esca	Nambia, South Africa	Cloete et al. (2016)
<i>Phellinus</i> sp.*	<i>Hymenochaetaceae</i>	P	Esca	Argentina, Australia, South Africa, USA	Gatica et al. (2001), Lardner et al. (2005), Sosnowski et al. (2007), White et al. (2011)
<i>Phialophora</i> sp.	<i>Herpotrichiellaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Phialosimplex</i> sp.*	<i>Trichocomaceae</i>	E, S		China	Dissanayake et al. (2018), This study
<i>Phoma confluens</i> Welw. & Curr.	<i>Didymellaceae</i>	OP	Leaves and stem lesions	Central Asia	Koshkelova and Frolov (1973)
<i>P. herbarum</i> Westend.*	<i>Didymellaceae</i>	OP	Leaves and stem lesions	China	Dissanayake et al. (2018)
<i>P. lenticularia</i> Cavara	<i>Didymellaceae</i>	S		Italy	Cavara (1888)
<i>P. medicaginis</i> Malbr. & Roum.*	<i>Didymellaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>P. reniformis</i> Viala & Ravaz	<i>Didymellaceae</i>	OP	Leaves and stem lesions	China, Portugal	Phillips and Lucas (1997), Zhuang (2005)
<i>P. vitis</i> Bonord.	<i>Didymellaceae</i>	OP	Leaves and stem lesions	Australia, Greece, India, Italy, USA,	Pantidou (1973), Mathur (1979), French (1989), Shivas (1989), Greuter et al. (1991)
<i>Phoma</i> sp.*	<i>Didymellaceae</i>	P, E, S	Leaves and stem lesions	China, Italy, Spain, Switzerland	Casieri et al. (2009), Gonzalez and Tello (2011), Mondello et al. (2013), Dissanayake et al. (2018), This study

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Phyllosticta ampelicida</i> (Engelm.) Aa*	<i>Phyllostictaceae</i>	P, S	Black rot	All over the world	Larter and Martyn (1943), Mujica and Oehrens (1967), Alvarez (1976), Mendes et al. (1998), Dudka et al. (2004), Kobayashi (2007), Slippers et al. (2007a, b), Goos (2010), Wicht et al. (2012)
<i>P. ampelophila</i> Politis	<i>Phyllostictaceae</i>	P	Black rot	Greece	Pantidou (1973)
<i>P. badamii</i> (Cooke)	<i>Phyllostictaceae</i>	P	Black rot	UK, Ukraine	Watson (1971), Dudka et al. (2004)
<i>P. microspila</i> Pass.	<i>Phyllostictaceae</i>	P	Black rot	Italy	Watson (1971)
<i>P. muscadinii</i> (Luttr.) Wulandari	<i>Phyllostictaceae</i>	P	Black rot	USA	Hanlin (1963), Alfieri Jr. et al. (1984, Kummung et al. (1996)
<i>P. pilispora</i> Speschnew	<i>Phyllostictaceae</i>	P	Black rot	China, Japan, Ukraine, Uzbekistan	Gaponenko (1965), Tai (1979), Kobayashi (2007), Dudka et al. (2004)
<i>P. spermoides</i> Peck	<i>Phyllostictaceae</i>	P	Black rot	China, USA	Anonymous (1960), French (1987, 1989), Bai (2000)
<i>P. turmalis</i> Ellis & Everh.	<i>Phyllostictaceae</i>	P	Black rot	USA	Cash (1953)
<i>P. vitis-rotundifoliae</i> N. Zhou & L. Cai*	<i>Phyllostictaceae</i>	P	Black rot	USA	Zhou et al. (2015)
<i>Phytophthora cactorum</i> (Lebert & Cohn) J. Schröt.	<i>Peronosporaceae</i>	P	Root rot	South Africaa	Oudemans and Coffey (1991), Erwin and Ribeiro (1996)
<i>P. cambivora</i> (Petri) Buisman	<i>Peronosporaceae</i>	P	Root rot	South Africa	Oudemans and Coffey (1991)
<i>P. cinnamomi</i> Rands*	<i>Peronosporaceae</i>	P	Root rot	Australia, New Zealand, South Africa	Gorter (1977), Marais (1980), Pennycook (1989), Shivas (1989), Oudemans and Coffey (1991), Erwin and Ribeiro (1996), Gadgil (2005), Blair et al. (2008), Langrell et al. (2011)
<i>P. citricola</i> Sawada	<i>Peronosporaceae</i>	P	Root rot	New Zealand	Pennycook (1989), Erwin and Ribeiro (1996), Gadgil (2005)
<i>P. cryptogea</i> Pethybr. & Laff.*	<i>Peronosporaceae</i>	P	Root rot	South Africa	Mills et al. (1991), Erwin and Ribeiro (1996), Martin et al. (2014)
<i>P. drechsleri</i> Tucker	<i>Peronosporaceae</i>	P	Root rot	Korea	Cho and Shin (2004)
<i>P. megasperma</i> Drechsler	<i>Peronosporaceae</i>	P	Root rot	Australia, USA	Shivas (1989), Forster and Coffey (1993)
<i>P. nicotianae</i> Breda de Haan	<i>Peronosporaceae</i>	P	Root rot	India, South Africa	Erwin and Ribeiro (1996)
<i>P. niederhauseri</i> Z.G. Abad & J.A. Abad*	<i>Peronosporaceae</i>	P	Root rot	South Africa	Abad et al. (2014)
<i>Phytophthora</i> sp.*	<i>Peronosporaceae</i>	P	Root rot	Australia, Chili, Mexico, USA	Mujica and Oehrens (1967), Alvarez (1976), French (1989), Castillo-Pando et al. (2001), Brasier et al. (2003)
<i>Pilidium concavum</i> (Desm.) Höhn.	<i>Chaetomellaceae</i>	P	Excoriose and cane blight	Portugal	Phillips (2000)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>P. lythri</i> (Desm.) Rossman	<i>Chaetomellaceae</i>	P	Excoriose and cane blight	USA	Greene (1963)
<i>Pionnotes biasoletiana</i> (Corda) Sacc.	<i>Nectriaceae</i>	E		Japan	Kobayashi (2007)
<i>Plagiostoma devexum</i> (Desm.) Fuckel*	<i>Gnomoniaceae</i>	E		Europe, USA	Sogonov et al. (2008)
<i>Plasmopara viticola</i> (Berk. & M.A. Curtis) Berl. & De Toni	<i>Peronosporaceae</i>	P	Downey mildew	All over the world	Doidge (1950), Riley (1960), Whiteside (1966), Dennis (1970), Stevenson (1975), Gorter (1977), Giatgong (1980), Simonyan (1981), Mendes et al. (1998), McKirdy et al. (1999), Dudka et al. (2004), Voglmayr et al. (2004), Gadgil (2005), Garcia- Blazquez et al. (2006), Mulenko et al. (2008), Thaung (2008b), Bobev (2009)
<i>Pleospora herbarum</i> (Pers.) Rabenh.	<i>Pleosporaceae</i>	E		Chile, Libya, Pakistan	Mujica and Oehrens (1967), El-Buni and Rattan (1981), Ahmad et al. (1997)
<i>P. penicillus</i> Fuckel	<i>Pleosporaceae</i>	S		Portugal, Spain	Checa (2004)
<i>P. phaecomoides</i> (Sacc.) G. Winter	<i>Pleosporaceae</i>	S		USA	Hanlin (1963)
<i>P. vitis</i> Catt.	<i>Pleosporaceae</i>	E		Central Asia, Greece, Italy, Spain	Unamuno (1941), Koshkelova and Frolov (1973), Pantidou (1973), Shoemaker (1992)
<i>P. vitis-viniferae</i> Frolov	<i>Pleosporaceae</i>	E		Central Asia, Russia	Koshkelova and Frolov (1973), Shoemaker (1992)
<i>P. vulgaris</i> Niessl	<i>Pleosporaceae</i>	E		Central Asia	Koshkelova and Frolov (1973)
<i>Pleospora</i> sp.	<i>Pleosporaceae</i>	E		Portugal	Phillips (2000)
<i>Pleurophoma</i> sp.	<i>Lentitheciaceae</i>	P	Excoriose and cane blight	Portugal	Phillips (2000)
<i>Pleurostoma richardsiae</i> (Nannfeldt) Réblová & Jaklitsch*	<i>Pleurostomataceae</i>	P	Trunk disease	Italy, South Africa, Spain	White et al. (2011), Carlucci et al. (2015), Pintos Varela et al. (2016)
<i>Pleurotus ostreatus</i> (Jacq.) P. Kumm.	<i>Pleurotaceae</i>	P	Wood rot	USA	Vail et al. (1995)
<i>Preussia africana</i> Arenal, Platas & Peláez*	<i>Sporormiaceae</i>	S		Spain	Garcia-Benavides et al. (2013)
<i>P. intermedia</i> (Auersw.) S. Ahmad	<i>Sporormiaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Pseudallescheria</i> sp.*	<i>Microascaceae</i>	S		China	This study
<i>Pseudocamarosporium</i> <i>propinquum</i> (Sacc.) Wijayaw., Camporesi & K.D. Hyde*	<i>Didymosphaeraceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>P. brachypus</i> (Ellis & Everh.) X.J. Liu & Y.L. Guo	<i>Mycosphaerellaceae</i>	P	Leaf spot	USA	Alfieri Jr. et al. (1984)
<i>P. daspurensis</i> (A.K. Kar & M. Manda)	<i>Mycosphaerellaceae</i>	P	Leaf spot	India	Sarbhoj et al. (1971)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Pseudocercospora riachueli</i> (Speg.) Deighton	<i>Mycosphaerellaceae</i>	P	Leaf spot	India, Thailand	Kamal (2010), Phengsintham et al. (2013)
<i>P. vitis</i> (Lév.) Speg.*	<i>Mycosphaerellaceae</i>	P	Leaf spot	Australia, Barbados, Brazil, Bulgaria, China, France, Hungary, India, Iowa, Iran, Italy, Japan, Korea, Mauritius, Myanmar, Pakistan, Poland, South Africa, South Korea, Taiwan, Tanzania, Thailand, USA, Zimbabwe	Gilman and Archer (1929), Wiehe (1948), Riley (1960), Vasudeva (1963), Whiteside (1966), Norse (1974), Deighton (1976), Gorter (1977), Giatgong (1980), Thaung (1984), Pons and Sutton (1988), Cook and Dubé (1989), Hsieh and Goh (1990), Ahmad et al. (1997), Roux et al. (1997), Kim and Shin (1998), Liu and Guo (1998), Mendes et al. (1998), Zhuang (2001), Dugan et al. (2004), Kobayashi (2007), Mulenko et al. (2008), Bobev (2009), Kamal (2010), Sultan et al. (2011), Pirnia et al. (2012), Liang et al. (2016), This study, Jayawardena et al. (2018)
<i>Pseudogymnoascus pannorum</i> (Link) Minnis & D.L. Lindner*	<i>Myxotrichaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Pseudolachnea hispidula</i> (Schr.) B. Sutton*	<i>Chaetosphaeriaceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>Pseudopestalotiopsis camelliae-sinensis</i> F. Liu & L. Cai*	<i>Sporocadaceae</i>	S		Italy	This study, Jayawardena et al. (2018)
<i>Pseudopezicula tetraspora</i> Korf, R.C. Pearson & W.Y. Zhuang	<i>Drepanopezizaceae</i>	P	Angular leaf scorch	USA	Pearson et al. (1988)
<i>P. tracheiphila</i> (Müll.-Thurg.) Korf & W.Y. Zhuang)	<i>Drepanopezizaceae</i>	P	Angular leaf scorch	Australia, France, Germany, Hungary, Jordan, Moldova, Romania, Switzerland, Tunisia, Turkey, Ukraine, Yugoslavia	Korf et al. (1986)
<i>Psilogonium clavispurum</i> (Seaver) E. Boehm, C.L. Schoch & Spatafora	<i>Hysteriaceae</i>	S		USA	Hanlin (1963)
<i>Punctulariopsis cremeoalbida</i> (M.J. Larsen & Nakasone) Ghobad-Nejhad	<i>Punctulariaceae</i>	S		USA	Larsen and Nakasone (1984)
<i>Pyrenochaeta</i> sp.*	<i>Cucurbitariaceae</i>	E		China	Dissanayake et al. (2018)
<i>Pyrenophora phaeocomes</i> (Rebent.) Fr.	<i>Pleosporaceae</i>	E		Portugal	Unamuno (1941)
<i>P. phaeocomoides</i> (Berk. & Broome) Sacc.	<i>Pleosporaceae</i>	E		France, Portugal	Unamuno (1941), Shoemaker (1992)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Pyrigemmula aurantiaca</i> D. Magyar & R. Shoemaker*	<i>Chaetosphaeriaceae</i>	E, S		Hungary	Magyar et al. (2011)
<i>Pythium acanthicum</i> Drechsler*	<i>Pythiaceae</i>	P	Root rot	Australia, South Africa	Shivas (1989), McLeod et al. (2009)
<i>P. anasculinum</i> Y.N. Yu*	<i>Pythiaceae</i>	S		China	This study
<i>P. aphanidermatum</i> (Edson) Fitzp.	<i>Pythiaceae</i>	P	Root rot	Australia, South Africa	Cook and Dubé (1989)
<i>P. coloratum</i> Vaartaja*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. cryptoirregulare</i> Garzón, Yáñez & G.W. Moorman*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. debaryanum</i> R. Hesse	<i>Pythiaceae</i>	P	Root rot	Chile, India	Mujica and Vergara (1945)
<i>P. echinulatum</i> V.D. Matthews*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. helicoides</i> Drechsler*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. heterothallicum</i> W.A. Campb. & F.F. Hendrix*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. irregulare</i> Buisman*	<i>Pythiaceae</i>	P	Root rot	Asutralia, South Africa	Cook and Dubé (1989), Shivas (1989), McLeod et al. (2009)
<i>P. kunmingense</i> Y.N. Yu*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. mamillatum</i> Meurs*	<i>Pythiaceae</i>	P	Root rot	Australia, South Africa	Shivas (1989), McLeod et al. (2009)
<i>P. parasiticum</i> S. Rajagop. & K. Ramakr.	<i>Pythiaceae</i>	P	Root rot	South Africa	Gorter (1977)
<i>P. paroecandrum</i> Drechsler*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. periilum</i> Drechsler*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. perplexum</i> H. Kouyeas & Theoh*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. pyrilobum</i> Vaartaja*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. recalcitrans</i> Belbahri & E. Moralejo*	<i>Pythiaceae</i>	P	Root rot	South Africa	Moralejo et al. (2008)
<i>P. rostratifingens</i> De Cock & Lévesque*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. rostratum</i> E.J. Butler	<i>Pythiaceae</i>	P	Root rot	Australia	Cook and Dubé (1989)
<i>P. spinosum</i> Sawada*	<i>Pythiaceae</i>	P	Root rot	Australia, South Africa	Shivas (1989), McLeod et al. (2009)
<i>P. splendens</i> Hans Braun	<i>Pythiaceae</i>	P	Root rot	Malaysia	Liu (1977)
<i>P. sylvaticum</i> W.A. Campb. & F.F. Hendrix	<i>Pythiaceae</i>	P	Root rot	South Africa	Gorter (1977)
<i>P. torulosum</i> Coker & P. Patt.*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>P. ultimum</i> Trow	<i>Pythiaceae</i>	P	Root rot	Australia, New Zealand, South Africa	Cook and Dubé (1989), Shivas (1989), Gadgil (2005)
<i>P. vanterpoolii</i> V. Kouyeas & H. Kouyeas*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>P. vexans</i> de Bary	<i>Pythiaceae</i>	P	Root rot	Malaysia	Liu (1977)
<i>P. viola</i> Chesters & Hickman*	<i>Pythiaceae</i>	P	Root rot	South Africa	McLeod et al. (2009)
<i>Pythium</i> sp.*	<i>Pythiaceae</i>	P, S	Root rot	Australia, China, USA	Alfieri Jr. et al. (1984, French (1989), Castillo-Pando et al. (2001), This study
<i>Ramularia khandalensis</i> Patw. & A.K. Pande	<i>Mycosphaerellaceae</i>	P, E	Leaf spot	India	Sarbhoy et al. (1971)
<i>R. mali</i> Videira & Crous*	<i>Mycosphaerellaceae</i>	P, E	Leaf spot	Iran	Bakhshii and Arzanlou (2017)
<i>R. vitis</i> (Richon) U. Braun	<i>Mycosphaerellaceae</i>	P, E	Leaf spot	Armenia, Australia, Caucasus, Europe, France	Braun (1998)
<i>Rhabdospora ampelina</i> (Thüm.) Sacc.	Dothideomycetes genera <i>incertae sedis</i>	P	Stem, leaf spot	Japan	Kobayashi (2007)
<i>R. labruscae</i> Gonz. Frag.	Dothideomycetes genera <i>incertae sedis</i>	P	Stem, leaf spot	Spain	Gonzalez Fragoso (1917)
<i>R. mueggenburgii</i> (Pirota) Sacc.	Dothideomycetes genera <i>incertae sedis</i>	P	Stem, leaf spot	Poland	Mulenko et al. (2008)
<i>R. vitis</i> Koshk. & Frolov	Dothideomycetes genera <i>incertae sedis</i>	P	Stem, leaf spot	Central Asia	Koshkelova and Frolov (1973)
<i>Rhinocladiella atrovirens</i> Nannf.	<i>Herpotrichiellaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Rhizoctonia solani</i> J.G. Kühn	<i>Ceratobasidiaceae</i>	P, E	Root rot	South Africa, Spain, USA	Marais (1979), Alfieri Jr. et al. (1984, Halleen et al. (2003), Gonzalez and Tello (2011)
<i>Rhizoctonia</i> sp.*	<i>Ceratobasidiaceae</i>	P, E	Root rot	Australia, Chili, Mexico, Switzerland	Mujica and Vergara (1945), Alvarez (1976), Castillo-Pando et al. (2001), Casieri et al. (2009)
<i>Rhizopus arrhizus</i> A. Fisch.	<i>Rhizopodaceae</i>	P, E	Bunch rot	USA	French (1987, 1989)
<i>R. oryzae</i> Went & Prins. Geerl.*	<i>Rhizopodaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>R. stolonifer</i> (Ehrenb.) Vuill.*	<i>Rhizopodaceae</i>	P, E	Bunch rot	Australia, Cuba, Japan, SouthAfrica, Spain, Switzerland	Gorter (1977), Urtiaga (1986), Cook and Dubé (1989), Witbooi et al. (2000), Kobayashi (2007), Casieri et al. (2009), Gonzalez and Tello (2011)
<i>Rhizopus</i> sp.*	<i>Rhizopodaceae</i>	P, E	Bunch rot	France, Italy, Switzerland	Castillo-Pando et al. (2001), Casieri et al. (2009), Mondello et al. (2013)
<i>Rhodosporidium</i> sp.*	Sporidiobolales genera <i>incertae sedis</i>	S		China	This study
<i>Rhodotorula</i> sp.*	Sporidiobolales genera <i>incertae sedis</i>	S		China	This study
<i>Robillarda vitis</i> Prill. & Delacr.	<i>Sporocadaceae</i>	E		France	Nag Raj (1993)
<i>Roesleria pallida</i> (Pers.) Sacc.	<i>Roesleriaceae</i>	P	Root rot	Japan	Kobayashi (2007)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>R. subterranea</i> (Weinm.) Redhead*	Roesleriaceae	P	Root rot	Italy, USA	Kepley et al. (2015)
<i>Rosellinia akulovii</i> L.E. Petrini	Xylariaceae	S		France	Petrini (2013)
<i>R. amblystoma</i> Berl. & F. Sacc.	Xylariaceae	S		Portugal	Unamuno (1941)
<i>R. aquila</i> (Fr.) De Not.	Xylariaceae	S		France	Petrini (1992)
<i>R. necatrix</i> Berl. ex Prill.	Xylariaceae	P	White root rot	Bulgaria, France, Greece, Italy, Japan, Mexico, Ukraine	Alvarez (1976), Greuter et al. (1991), Holevas et al. (2000), Dudka et al. (2004), Kobayashi (2007), Bobev (2009), Petrini (2013)
<i>R. rosarum</i> Niessl	Xylariaceae	S		Poland	Mulenko et al. (2008)
<i>Sarocladium strictum</i> (W. Gams) Summerb.	Hypocreales genera <i>incertae sedis</i>	E		Spain	Gonzalez and Tello (2011)
<i>Schizophyllum commune</i> Fr.	Schizothyriaceae	P	White rot on already dead parts of grapevine trunks	Greece	Zervakis et al. (1998)
<i>Schizothyrium pomi</i> (Mont.) Arx,	Schizothyriaceae	P	White rot on already dead parts of grapevine trunks	Japan, USA	Anonymous (1960), Kobayashi (2007)
<i>Sclerostagonospora</i> sp.	Phaeosphaeriaceae	P	Excortiose and cane blight	Portugal	Phillips (2000)
<i>Sclerotinia sclerotiorum</i> (Lib.) de Bary*	Sclerotiniaceae	P, E	Shoot blight	Australia, Chile, Greece, Japan, Mexico, New Zealand, Spain, Switzerland, USA	French (1989), Shivas (1989), Latorre and Guerrero (2001), Casieri et al. (2009), Gonzalez and Tello (2011), Ferrada et al. (2014)
<i>Sclerotium echinatum</i> Fuckel	Sclerotiniaceae	P	Shoot blight	Poland	Mulenko et al. (2008)
<i>S. rolfsii</i> Sacc.	Sclerotiniaceae	P	Shoot blight	Japan, USA	French (1987, 1989), Kobayashi (2007)
<i>Sclerotium</i> sp.	Sclerotiniaceae	P	Shoot blight	Thailand	Giatgong (1980)
<i>Scolicotrachium vitiphyllum</i> (Speschnew) Karak. & Vassiljevsky	Ascomycota genera <i>incertae sedis</i>	P	Shoot blight	Central Asia	Koshkelova and Frolov (1973)
<i>Scopulariopsis</i> sp.*	Microascaceae	S		China	This study
<i>Scytinostroma alutum</i> Lanq.	Lachnocladiaceae	P, S	Root rot	France	Boidin and Lanquetin (1987)
<i>Seimatosporium botan</i> Sat. Hatak. & Y. Harada*	Sporocadaceae	P	Trunk disease	Chile	Diaz et al. (2012)
<i>S. hysterooides</i> (Fuckel) Brockmann*	Sporocadaceae	P	Trunk disease	Australia, England, France, Greece, Germany, Italy	Nag Raj (1993), Sergeeva et al. (2005)
<i>S. lichenicola</i> (Corda) Shoemaker & E. Müll.	Sporocadaceae	P	Trunk disease	Australia	Cook and Dubé (1989), Shivas (1989)
<i>S. loniceriae</i> (Cooke) Shoemaker	Sporocadaceae	P	Trunk disease	Australia	Shivas (1989)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>S. parasiticum</i> (Dearn. & House) Shoemaker	<i>Sporocadaceae</i>	P	Trunk disease	Germany, Pakistan	Sutton (1980), Ahmad et al. (1997)
<i>S. vitis</i> P. Xiao, Camporesi & K.D. Hyde*	<i>Sporocadaceae</i>	P, S	Trunk disease	Hungary, Italy	Senanayake et al. (2015), Váczy (2017), This study, Jayawardena et al. (2018)
<i>Seiridium cupressi</i> (Guba) Boesew.	<i>Sporocadaceae</i>	P	Trunk disease	China	Teng (1996)
<i>Selenophoma</i> sp.	<i>Sacchettoeciaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Septobasidium tanakae</i> (Miyabe) Boedijn & B.A. Steinm.	<i>Septobasidiaceae</i>	P		Japan	Kobayashi (2007)
<i>Septoria ampelina</i> Berk. & M.A. Curtis	<i>Mycosphaerellaceae</i>	P	Leaf spot	Bulgaria, Italy, Mexico, Romania, Ukraine	Radulescu et al. (1973), Alvarez (1976), Greuter et al. (1991), Vanev et al. (1997), Dudka et al. (2004), Bobev (2009)
<i>S. badhamii</i> Berk. & Broome	<i>Mycosphaerellaceae</i>	P	Leaf spot	Japan, Romania, UK	Watson (1971), Radulescu et al. (1973), Kobayashi (2007)
<i>S. melanopsis</i> Pat.	<i>Mycosphaerellaceae</i>	P	Leaf spot	Brazil, Italy, Kenya, Tunisia, UK	Natrass (1961), Watson (1971)
<i>S. vitis</i> Schulzer	<i>Mycosphaerellaceae</i>	P	Leaf spot	Australia	Priest (2006)
<i>S. vineae</i> Pass.	<i>Mycosphaerellaceae</i>	S		Romania	Watson (1971), Radulescu et al. (1973)
<i>Septoriella allojunci</i> W.J. Li, Camporesi, D.J. Bhat & K.D. Hyde*	<i>Phaeosphaeriaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Simplicillium</i> sp.*	<i>Cordycipitaceae</i>	S		China	This study
<i>Sordaria fimicola</i> (Roberge ex Desm.) Ces. & De Not.*	<i>Sordariaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Sordaria</i> sp.	<i>Sordariaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Spencermartinsia plurivora</i> Abdollahz., Javadi & A.J.L. Phillips*	<i>Botryosphaeriaceae</i>	P	Canker/die back	Australia, Spain	Pitt et al. (2015)
<i>S. viticola</i> (A.J.L. Phillips & J. Luque) A.J.L. Phillips, A. Alves & Crous*	<i>Botryosphaeriaceae</i>	P	Canker/die back	Australia, France, South Africa, Spain, USA	Luque et al. (2005), Úrbez-Torres et al. (2007), de Wet et al. (2009), Qiu et al. (2011), Úrbez-Torres (2011), Diaz et al. (2013), Pitt et al. (2013, 2015), Li et al. (2014), Carlucci et al. (2015), Pavlic-Zupanc et al. (2015), Valencia et al. (2015), Comont et al. (2016), Coutinho et al. (2017), Lawrence et al. (2017b)
<i>S. westrale</i> W.M. Pitt, J.R. Úrbez-Torres & Trouillas*	<i>Botryosphaeriaceae</i>	P	Canker/die back	Australia	Pitt et al. (2015)
<i>Spencermartinsia</i> sp.	<i>Botryosphaeriaceae</i>	P	Canker/die back	Spain	Gonzalez and Tello (2011)
<i>Sphaeropsis ampelos</i> (Schwein.) Cooke	<i>Botryosphaeriaceae</i>	P	Canker/die back	China	Teng (1996)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>S. peckiana</i> Thüm.	<i>Botryosphaeriaceae</i>	P	Canker/die back	Italy	Greuter et al. (1991)
<i>S. porosa</i> (Van Niekerk & Crous) A.J.L. Phillips & A. Alves	<i>Botryosphaeriaceae</i>	P	Canker/die back	South Africa	van Niekerk et al. (2004a, b, 2006), Phillips et al. (2005), Luque et al. (2005), de Wet et al. (2009), Urbez-Torres (2011)
<i>Sphaeropsis</i> sp.	<i>Botryosphaeriaceae</i>	P	Canker/die back	Greece	Holevas et al. (2000)
<i>Spiromastix</i> sp.*	<i>Spiromastigaceae</i>	S		China	This study
<i>Spiromyces</i> sp.*	<i>Kickxellaceae</i>	S		China	This study
<i>Sporoschisma ampullula</i> Sacc.	<i>Chaetosphaeriaceae</i>	S		Yugoslavia	Nag Raj and Kendrick (1975)
<i>Sporocadus rhododendri</i> (Schwein.) M. Morelet*	<i>Amphisphaeriaceae</i>	P	Cane lesions	Australia	Sergeeva et al. (2005)
<i>Stagonospora bulgarica</i> Vanev	<i>Phaeosphaeriaceae</i>	P	Leaf spot	Bulgaria	Vanev et al. (1997)
<i>Stachybotrys</i> sp.*	<i>Stachybotryaceae</i>	S		China	This study
<i>Stemphylium viticola</i> Pass.	<i>Pleosporaceae</i>	E		Poland	Mulenko et al. (2008)
<i>Stemphylium</i> sp.	<i>Pleosporaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Stereum hirsutum</i> (Willd.) Pers.*	<i>Stereaceae</i>	P	Esca	Bulgaria, France, Greece, Spain	Larignon and Dubos (1997), Zervakis et al. (1998), Bobev (2009), Luque et al. (2009), Cloete et al. (2015)
<i>Stereum</i> sp.	<i>Stereaceae</i>	P	Esca	USA	French (1989)
<i>Stigmina esfandiarii</i> Petr.	<i>Mycosphaerellaceae</i>	P	Leaf spot	Iran, Pakistan	Esfandiari and Petrak (1950), Khan and Kamal (1974)
<i>Strickeria sylvana</i> (Sacc. & Speg.) Cooke	<i>Sporocadaceae</i>	S		Poland	Mulenko et al. (2008)
<i>S. trubicola</i> (Fuckel) G. Winter	<i>Sporocadaceae</i>	S		Central Asia	Koshkelova and Frolov (1973)
<i>Stromatoneurospora</i> sp.*	Xylariales genera <i>incertae sedis</i>	S		China	This study
<i>Talaromyces amestolkiae</i> N. Yilmaz, Houbraken, Frisvad & Samson*	<i>Trichocomaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>T. pinophilus</i> (Hedgc.) Samson, N. Yilmaz, Frisvad & Seifert*	<i>Trichocomaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>T. purpureogenum</i> Stoll*	<i>Trichocomaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Talaromyces</i> sp.*	<i>Trichocomaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>Terana coerulea</i> (Lam.) Kuntze	<i>Phanerochaetaceae</i>	P	Wood decay	USA	Campbell et al. (1950), Hanlin (1966)
<i>Tetracoccusporium</i> sp.	Ascomycota genera <i>incertae sedis</i>	P	Root stock disease	South Africa	Halleen et al. (2003)
<i>Thanatephorus cucumeris</i> (A.B. Frank) Donk	<i>Ceratobasidiaceae</i>	S		China	Tai (1979)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>Thaxteriella pezizula</i> (Berk. & M.A. Curtis) Petr.	<i>Tubeufiaceae</i>	S		USA	Hanlin (1963)
<i>Thelonectria olida</i> (Wollenw.) P. Chaverri & Salgado	<i>Nectriaceae</i>	P	Black foot disease	Uruguay	Abreo et al. (2012)
<i>Thielavia</i> sp.	<i>Chaetomiaceae</i>	S		China	This study
<i>Tilletiopsis minor</i> Nyland*	<i>Exobasidiomycetidae incertae sedis</i>	S		British Colombia, Canada	Urquhart et al. (1997)
<i>T. washingtonensis</i> Nyland	<i>Exobasidiomycetidae incertae sedis</i>	S		Japan	Urquhart et al. (1997)
<i>Tomentella atramentaria</i> Rostr.	<i>Thelephoraceae</i>	S		Spain	Hernandez (2004)
<i>T. bryophila</i> (Pers.) M.J. Larsen	<i>Thelephoraceae</i>	S		Spain	Hernandez (2004)
<i>Tomentella</i> sp.*	<i>Thelephoraceae</i>	E		China	Dissanayake et al. (2018)
<i>Torula viticola</i> Allesch.	<i>Torulaceae</i>	E		USA	Saccardo (1878)
<i>Torula</i> sp.	<i>Torulaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Toxicocladosporium</i> sp.*	<i>Cladosporiaceae</i>	E		China	Dissanayake et al. (2018)
<i>Trametes zonata</i> (Nees) Pilát	<i>Polyporaceae</i>	S		New Zealand	Cunningham (1965)
<i>Trichocladium asperum</i> Harz*	<i>Chaetomiaceae</i>	E, S		Russia, Switzerland	Melnik and Popushoi (1992), Casieri et al. (2009)
<i>Trichoderma atroviride</i> P. Karst.*	<i>Hypocreaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>T. aureoviride</i> Rifai	<i>Hypocreaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>T. koningii</i> Oudem.	<i>Hypocreaceae</i>	S		Russia	Melnik and Popushoi (1992)
<i>T. harzianum</i> Rifai*	<i>Hypocreaceae</i>	E, S		China, Spain	Gonzalez and Tello (2011), This study, Jayawardena et al. (2018)
<i>T. lixii</i> (Pat.) P. Chaverri*	<i>Hypocreaceae</i>	S		China	This study, Jayawardena et al. (2018)
<i>T. parapiluliferum</i> (B.S. Lu, Druzhin. & Samuels) Jaklitsch & Voglmayr*	<i>Hypocreaceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Trichoderma</i> sp.*	<i>Hypocreaceae</i>	E		South Africa, Spain, Switzerland	Fourie and Halleen (2002), Casieri et al. (2009), Gonzalez and Tello (2011)
<i>Trichothecium roseum</i> (Pers.) Link*	<i>Hypocreales genera incertae sedis</i>	P	Berry rot	Australia, China, Greece, India, Japan, Korea	Alexopoulos (1940), Tai (1979), Shivas (1989), Sharma and Agarwal (1997), Kobayashi (2007), Oh et al. (2014), This study
<i>Trullula melanochlora</i> (Desm.) Höhn.	<i>Leotiomycetes genera incertae sedis</i>	P		France, Portugal	Phillips (2000)
<i>Truncatella angustata</i> (Pers.) S. Hughes*	<i>Sporocadaceae</i>	P, E		France, Iran, Portugal, Spain, Switzerland	Nag Raj (1993), Casieri et al. (2009), Gonzalez and Tello (2011), Arzanlou et al. (2013), Maharachchikumbura et al. (2016)

Table 6 (continued)

Species	Family	Life mode	Disease caused	Locality	References
<i>T. pitospora</i> (M.E.A. Costa & Sousa da Câmara) Bissett	<i>Sporocadaceae</i>	P		Portugal	Nag Raj (1993)
<i>Typhula viticola</i> (Peck) Berthier	<i>Typhulaceae</i>	S		USA	Berthier (1976)
<i>Ulocladium</i> sp.	<i>Pleosporaceae</i>	E		South Africa, Spain	Halleen et al. (2003), Gonzalez and Tello (2011)
<i>Umbelopsis isabellina</i> (Oudem.) W. Gams*	<i>Mucoraceae</i>	S		Switzerland	Casieri et al. (2009)
<i>Valsaria insitiva</i> (Tode) Ces. & De Not.	<i>Valsariaceae</i>	P		Portugal, Spain	Phillips (2000), Unamuno (1941)
<i>Verticillium ahlia</i> Kleb.*	<i>Plectosphaerellaceae</i>	P		China, Japan, USA	French (1989), Kobayashi (2007), Zhang et al. (2009)
<i>Verticillium</i> sp.	<i>Plectosphaerellaceae</i>	P		Mexico	Alvarez (1976)
<i>Verpa bohemica</i> (Krombh.) J. Schröt*	<i>Morchellaceae</i>	E		Switzerland	Casieri et al. (2009)
<i>Volutella</i> sp.*	<i>Nectriaceae</i>	S		China	This study
<i>Xeromyces bisporus</i> L.R. Fraser*	<i>Aspergillaceae</i>	S		Australia	Pettersson et al. (2011)
<i>Xerotus viticola</i> Berk. & M.A. Curtis	<i>Polyporaceae</i>	S		USA	Berkeley (1872)
<i>Xylaria arbuscula</i> Sacc.	<i>Xylariaceae</i>	S		Taiwan	Ju and Rogers (1999)
<i>Xylaria hypoxylon</i> (L.) Grev.	<i>Xylariaceae</i>	E		Spain	Gonzalez and Tello (2011)
<i>Xylaria</i> sp.*	<i>Xylariaceae</i>	S		China	This study
<i>Zetiaspizna thuemenii</i> (Speg.) Nag Raj	<i>Sporocadaceae</i>	S		Italy	Nag Raj (1993)

Life mode—*P* pathogen, *E* endophyte, *S* saprotroph, *M* mycoparasitic on powdery mildew fungi, *OP* opportunistic pathogen and *U* unknown

*Identification is confirmed by molecular data in the studies. The records are taken from the literatures and thus may not be correct and the same taxon could be listed more than once. It would be necessary to re-examine all collections if available to confirm their identities. Even the molecular data may be needed to establish their correct names

but this was shown not to be accurate (Ko et al. 2011). The most recent studies on fungal pathogens of grapevine have incorporated multigene analysis to accurately resolve taxa (Dissanayake et al. 2015; Jayawardena et al. 2015; Yan et al. 2015; Chethana et al. 2017).

Most previous studies did not address the total community of fungi on *Vitis vinifera*. Pancher et al. (2012) carried out an extensive study on endophytes on this host, showing that how various anthropic and nonanthropic factors shape microbial communities. There have been extensive studies on the disease causing agents with more than 150 taxa known to cause various diseases of grapevine. For example, *Colletotrichum* species cause grape ripe rot of *Vitis vinifera* worldwide (Jayawardena et al. 2016b). There have however, been no investigation on the saprobes of grapevines using molecular identification and there has been no study using mycobiome analysis to reveal saprotrophic communities. The study of saprotrophs is

important, as they not only decay dead leaves and branches, thus beneficial recyclers, but they may also become pathogens when conditions are suitable.

This study therefore fills this void by establishing the saprotrophic fungi on *Vitis vinifera* using both traditional and culture-independent approaches. In this study we did not obtain similar results from the two methods. In the traditional method, 45 species belonging to 30 genera were identified (Table 2), while in culture-independent method 226 OTUs' and 72 genera were identified. Even though we isolated directly from the fruiting bodies, some fungi were not able to grow on media. Several single spore isolations were unsuccessful. This may be due to the availability of nutrient content, pH, temperature, and presence of inhibitors and the time of incubation. The number of isolates obtained was less than the actual fungal community and can be misinterpreted (Hugenholtz et al. 1998). These conditions make it difficult to accurately identify and

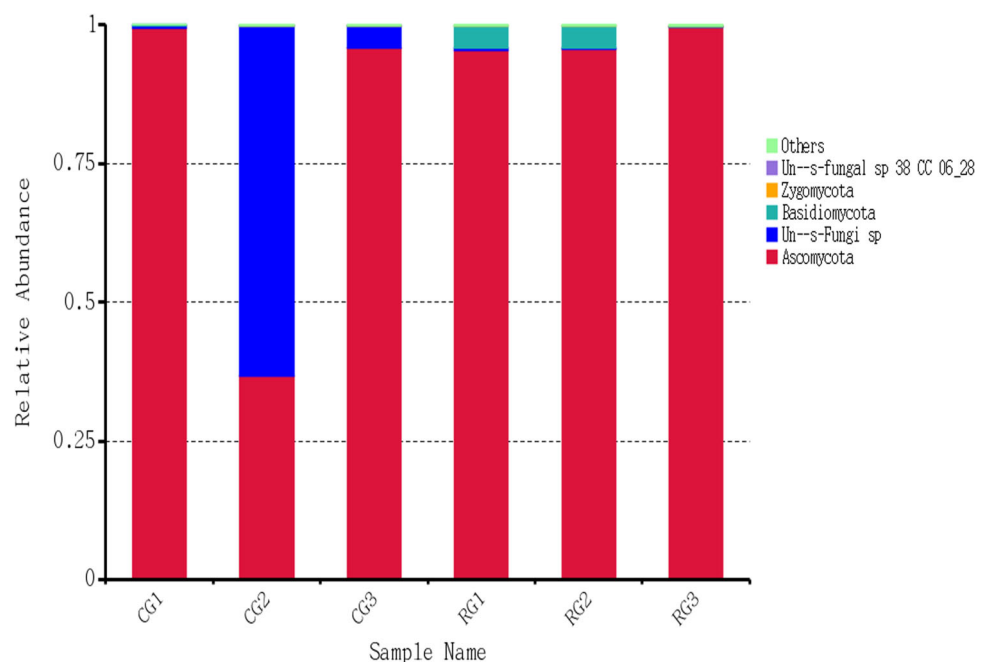
document the vast number of unrecognized taxa (Lücking and Moncada 2017). For example, in this study the total identified taxa from the traditional method were 45. Therefore, to overcome the constraints of traditional methods, culture-independent techniques are proposed as an alternative technique (Hoppe et al. 2016).

The aim of environmental sequence nomenclature is to place names of species of fungi that would otherwise be left undescribed (Lücking and Moncada 2017). These techniques can provide sequence reads almost 1000 times more than the traditional DNA sequencing methods (Lücking and Moncada 2017). Lücking and Moncada (2017) showed that a formally recognized unnamed lichenicolous basidiomycete can be considered as a new genus, with seven new species, although there is no physical type specimens are available. These authors also suggested that this would allow the recognition of thousands of species of voucher less taxa detected through environmental sequencing techniques. However, there are several constrains to NGS methods. DNA may not be recovered from all genotypes and the results of NGS can be biased towards the most abundant organisms at the time of sampling (Ward et al. 1990). The reason for this is that the relative abundance (Fig. 5) of microbial species in a natural habitat is rarely equal. Usually, with a few species being predominant among a larger group of common species makes it difficult to identify the species that are actually present. NGS are mainly based on analysis of ITS regions (Schoch et al. 2012). However, due to the high variability of ITS regions (ITS1 and ITS2), reliable sequence alignments are difficult to obtain for some fungal taxa. Therefore, this method is not reliable for species level identification. The identification levels are usually reported at the genus level or

even higher taxonomic levels, such as family or order (Purahong et al. 2018). Another constraint of NGS is that the correspondence of OTU with species can be unreliable. OTUs are defined based on the similarity threshold, usually with a 97% (Sneath and Sokal 1973). However, some species have genes that are 97% similar, which will result in merged OTUs containing multiple species. In the same way, a single species may have paralogs that are < 97% similar, causing the species to be split across two or more species. Some identified clusters, even when a majority, may be false, due to the artifacts including reading errors and chimeras (Sneath and Sokal 1973). Assessing species richness and diversity of a microbial community using culture-independent method (rarefaction curves), suggests that OTUs are observations of organisms with ‘negligible error’. Also, it suggests that the number of reads correlates well with the total number of individuals present in the community. However, if the majority of OTUs are experimental artifacts, the traditional species richness estimations cannot be applied. The measures between sample variations will tend to reflect differences in artifact frequencies rather than biological differences (Sokal and Sneath 1963).

Artifacts can be occurred due to several reasons. PCR amplification steps can be affected by preferentially/differentially that can hinder the detection of some genotypes when analysing bulk DNA extracts from a substrate (Kanagawa 2003). Primer mismatches, a lower rate of primer hybridization, occurrence of heteroduplexes and chimeric amplicons can generate additional signals that do not correspond to the genotypes in the same samples (Suzuki and Giovannoni 1996; Kanagawa 2003). Also, the

Fig. 5 Relative abundance of the top 10% phylum from different samples of the cultivars Carbanate Gernischet and Red Globe of *Vitis vinifera*



analysis of fungal rRNA genes limits identification to the genus or family level (Anderson and Cairney 2004).

Dissanayake et al. (2018) in her study using paired-end Illumina sequencing with 55, 822 high quality sequences per endophyte sample (saturated rarefaction curves for all samples) revealed 59 OTUs (the majority containing genera level identification) that were similar to genera revealed by the traditional method (28 species).

Traditional versus culture-independent methods: can matching of these two approaches enable us to identify correct fungal taxonomic information at genus and species levels?

In this study, taxa (OTUs) of *Aspergillus*, *Botrytis*, *Cladosporium*, *Clonostachys*, *Fusarium*, *Penicillium*, *Phoma* and *Talaromyces* were identified using both traditional and culture-independent approaches. Some fast growing fungi may be dominant in the culture plates, even though in the natural habitat they may be minorities. Many hyphomycetes tend to grow faster than the other groups of fungi. So, they may suppress the growth of other important, dominant fungi. The fast growing fungi (hyphomycetes) identified in the traditional method such as *Mucor* and *Rhizopus* were not recognized in the culture-independent method. The majority of the genera identified in the traditional method are phytopathogens, while in the culture-independent method the majority are saprotrophs. In the traditional method using both morphological and molecular approaches, we were able to identify many taxa to species level, although in six cases the identification is only up to the genus level due to lack of data. We have generated a phylogenetic tree for the genus *Colletotrichum* using the strains identified in the traditional approach as well as the OTU identified in the culture-independent method. OTU-234, was identified as *Glomerellaceae* sp. in the culture-independent approach. The blastn result of OTU-234 in NCBI shows 100% similarity to many strains of *C. gloeosporioides*. Two-hundred and fifteen basepairs of OTU-234 were used in the alignment (Supplementary Fig. S6). In the phylogenetic tree constructed using the ex-type strains of gloeosporioides complex and the truncatum complex, OTU-234 cluster within the truncatum complex, closely to *C. curcuma* (Supplementary Fig. S7). This example also provides evidence that the NGS sequences is not reliable to identify an organism to the species level. However, in the culture-independent technique we were able to identify 90 out of 226 OTUs to species level, and the rest were identified to genera or family level. These may not be correctly identified as in general NGS fungal taxa identification may be only accurate to the genus level (Purahong et al. 2018), which suggests that the sequence data from the culture-independent approach is inadequate to accurately identify species. The overlap between the two methods in identifying the taxa to the species level is negligible.

Matching between the traditional and culture-independent data allows us to have a better understanding concerning the functional information of the fungal OTUs resulting from culture-independent methods. Next generation sequencing often results in sequences that are associated with taxa, which have not been reported in previous studies (Tejesvi et al. 2010; Ko et al. 2011; Taylor et al. 2016). However, as most of these OTUs are identified to genus or family level, it makes it difficult to relate whether these are actually correctly identified and whether the use of this method is important. In the preparation of the checklist of fungi on *Vitis* species, the authors had to eliminate most of the taxa that were identified using NGS, as those data can be unreliable. In our study, we compared the sequence similarity between the two cultivars using a 90% similarity of ITS1 sequence data, followed by a manual BLAST based identification of the respective OTUs. We considered the ITS similarity at 98–99% as the same species (Garnica et al. 2016; Jeewon and Hyde 2016). In this criterion, identification of genera can be bias/difficult as some of the data in databases have mistakes or they may be inaccurate. The increase of the ITS similarity to 99–100% can give us better and reliable identification of the species. However, ITS sequence data alone will not be able to identify the complexes genera such as *Colletotrichum* and *Diaporthe* to their species level. For a better resolution of these genera protein coding gene regions are required.

Can direct matching between traditional and culture-independent methods help to identify the rare taxa?

Our results show that some singletons, which were usually removed as artifacts or errors of the NGS may actually be real OTUs. In this study, we found two OTUs (*Botryosphaeria* OTU-178 and Ascomycota OTU-213) as singletons and removed them from the analysis. However, with direct matching, we found that these OTUs are *Botryosphaeria dothidea* and *Coniella vitis*. Therefore, we can assume that not all the singletons are artifacts and matching between traditional and culture-independent methods can help to identify the real rare taxa in the fungal community.

Potential effect of grape cultivars (table grape (Red Globe) and wine grape (Carbanate Gernischet) on fungal saprotrophic community composition and richness

Another aspect of this study was to study whether there is any difference in the fungal communities based on cultivars. In the present study, traditional and culture-independent approaches allows the identification of potential roles of the saprotrophs in the two grapevine cultivars. In this study we identified more than 10 main and important

fungal pathogens of grapevine using both methods. With the evaluation of both community composition and community diversity we were able to identify that the fungal communities of the two grape cultivars appear to be different. *Alternaria vitis*, *Albifimbria viridis*, *Bipolaris maydis*, *Botryosphaeria dothidea*, *Botrytis cinerea*, *Colletotrichum hebeinse*, *C. truncatum*, *C. viniferum*, *Didymella pomorum*, *Dothiorella sarmentorum*, *Epicoccum nigrum*, *Fusarium* sp., *Mucor circinelloides*, *Paraphoma chrysanthemicola*, *Neopestalotiopsis clavisporea*, *Stagonosporopsis* sp.1, *Minimedusa* sp., *Peniophora* sp., *Penicillium brevicompactum* and *P. citrinum* were recorded only from Red Globe cultivar while *Albifimbria verucaria*, *Neopestalotiopsis vitis*, *Pythium amasculinum*, *Stagonosporopsis* sp.2, *Trichoderma lixii* and *Septoriella aliojunci* were recorded from Carbanate Gernischet cultivar in the traditional method. In the culture-independent approach, *Acremonium chrysogenum* (OTU-195), *Apodus* sp. (OTU-235), Ascomycota (OTU-80, 99, 182, 222, 253), *Aspergillus* sp. (OTU-116, 199), *Candida mucifera* (OTU-227), *Cylindrocarpon* sp. (OTU-171), *Dactylellina phymatopaga* (OTU-58), *Davidiella tassiana* (OTU-86), *Deroxomyces* sp. (OTU-225), Fungal (OTU-245, 254), *Fusarium* cf. *dimerum* (OTU-162), Helotiales (OTU-91), Hypocreales (OTU-65), *Kernia nitida* (OTU-184), *Kernia pachypleura* (OTU-211), *Lecanicilium dimorphum* (OTU-101), *Lentinus squarrosulus* (OTU-249), *Lophiostoma* sp. (OTU-142), Microascales (OTU-138), *Metarhizium pinghaense* (OTU-210), *Myceliophthora fergusii* (OTU-198), *Myrothecium* sp. (OTU-238), *Nectriaceae* (OTU-97, 194), *Papulospora equi* (OTU-148), *Phialosimplex caninus* (OTU-187), *Psathyrellaceae* (OTU-145), *Pseudallescheria angusta* (OTU-183), *Pyronemataceae* (OTU-237), *Remersonia* sp. (OTU 108), Sordariomycetes (OTU-128), Sordariales (OTU-196, 200, 214), *Xylaria* sp. (OTU-159) were found only in association with the Red Globe cultivar while *Acremonium* sp. (OTU-188), *Apllosporella yalgorensis* (OTU-85), *Arachnomyces kanei* (OTU-170), *Aspergillus melleus* (OTU-143), *Aspergillus wentii* (OTU-175), *Cado-phora luteo-olivaceae* (OTU-146), *Ceratobasidiaceae* (OTU-219), *Chaetomium carinthiacum* (OTU-177), *Chyso sporium lobatum* (OTU-150), *Cladosporium grevilleae* (OTU-121), Dothideomycetes (OTU-140), Eurotiales (OTU-76), Fungal (OTU-82, 104, 165), *Gymnascella aurantiaca* (OTU-151), *Hansfodia* sp. (OTU-232), Hypocreales (OTU-49, 92, 202), *Lasiophaeriaceae* (OTU-189), *Leptosphaeria* sp. (OTU-205), *Magnoporthaceae* (OTU-141, 149), Microascales (OTU-114), *Microascus* sp. (OTU-185), *Microdochium* sp. (OTU-225), *Nectriaceae* (OTU-218), *Penicillium ilderdanum* (OTU-163), *Penicillium neocrassum* (OTU-168), *Podospora communis* (OTU-190), *Scopulariopsis* sp. (OTU-164), Sordariales (OTU-133), *Spiromastix princeps* (OTU-139), *Thielavia basicola*

(OTU-155), *Trichomaceae* (OTU-156, 166) were recorded on from Carbanate Gernischet cultivar.

The difference of the two fungal communities can be due to the geographic variation of the cultivars. This can be a result from the interactions with specific *V. vinifera* varieties and its soil and climatic conditions (Bokulich et al. 2014). Red Globe cultivar was collected in Beijing, which is a region in North of China and Carbanate Gernischet cultivar was collected from Yunnan which is in the southern part of the country. The difference between the fungal communities in regions may be a function of a neutral process, where these different communities established by chance and lack of species dispersal allows these communities to persist (Martiny et al. 2006). This difference can also be due to the Baas Becking hypothesis, which states that there is no limit to the range of species but that selection sorts these species and defines community composition and diversity in any one area (Hanson et al. 2012). Climate can also co-relates with differences in fungal communities in China, as one moves North up in China, the climate becomes increasingly cold and dry so the pattern of lower fungal species richness in the northern most regions hints that selection might have a role in determining these patterns.

Plant pathogens and endophytes in the saprotrophic fungal community

Species richness and distribution patterns of saprotrophic fungi in a vineyard can provide important insights into the roles of each fungal group for the stability and functioning of its respective ecosystem (Kubartova et al. 2012). However, knowledge of saprotrophic fungi associated with grapevine is very much limited. In this study, we identified 17 primary and six species of secondary pathogens of grapevine as saprobes using the traditional method, while 27 OTUs were identified as both primary and secondary pathogens from dead material of *Vitis vinifera* in the culture-independent method.

Species of *Alternaria* are responsible in causing berry rots, raisin molds and rots as well as pedicel and rachis diseases (Barbe and Hewitt 1965; Gonzalez and Tello 2011; Tao et al. 2014, Ariyawansa et al. 2015) and also considered as wound and secondary invaders. *Alternaria alternata* and *A. vitis* were isolated in this study. *Aspergillus* is a causal agent of berry rots as well as a wound and secondary invader (Hewitt 2015). In our study *A. aculeatus* and *A. niger* were recorded using the traditional method, while *A. aculeatus* was also recorded from culture-independent method. Botryosphaerious taxa are well-known to be associated with grapevine canker and die back (Úrbez-Torres et al. 2012, 2013a, b). In our study we identified *Botryosphaeria dothidea* and *Dothiorella sarmentorum* as

saprotrophs using traditional methodology. *Lasiodiplodia* was recorded in the culture-independent method.

Botrytis is another genus that we obtained in both traditional and independent approaches. *Botrytis cinerea* is a pathogen of grapevine causing Botrytis bunch rot and blight all over the world (Fournier et al. 2013; Hyde et al. 2014; Javed et al. 2017). *Cladosporium* was also recorded in both approaches. Species of this genus cause minor foliage diseases of grapevine, as well as bunch rots (Bensch et al. 2015). *Clonostachys* is another genus recorded in both approaches. *Clonostachys rosea* is known to cause root rot of grapevine in Switzerland (Casieri et al. 2009). *Colletotrichum hebeiense*, *C. truncatum* and *C. viniferum* were recorded in the traditional method. Species of this genus cause grape ripe rot affecting the quality and production of grapevine (Yan et al. 2015). *Diaporthe eres* is another pathogen of grapevine causing die back (Lawrence et al. 2015; Baumgartner et al. 2013; Cinelli et al. 2016; Fischer et al. 2016; Bastide et al. 2017), which was recorded via the traditional methodology as well as via the culture-independent approach.

Species of *Fusarium* cause wilt disease of grapevine (Castillo-Pando et al. 2001; Gonzalez and Tello 2011). This genus was recorded in both approaches. *Neopestalotiopsis vitis* recorded from traditional method is a pathogen causing fruit rot, die back and leaf spots of grapevine (Jayawardena et al. 2015, 2016a). *Coniella vitis* is a pathogen causing white rot of grapes, identified using traditional methods (Chethana et al. 2017). Species of *Penicillium* are wound and secondary pathogens of grapevines causing bunch rot (Kim et al. 2007). *Rhizopus oryzae* is another wound and secondary pathogen causing bunch rots of grapevines (Hewitt 2015).

Several genera were identified only in the culture-independent method. *Aplosporella* is known to cause lesions on grapevine stems in China (Tai 1979). *Claviceps* is known to be a pathogen on grasses and cereals, but has not been recorded as a pathogen of grapevine (Mey et al. 2002). Therefore, this study provides the first record of this genus on *V. vinifera*. *Cylindrocarpon* species are known to cause the black foot disease of grapevine (Abreo et al. 2010, 2012; Mohammadi et al. 2013a, b). *Devriesia* is a facultative pathogen, but there are no records of this species on *V. vinifera* (Seifert et al. 2004). Therefore, this study provides the first record of this genus on *V. vinifera*. Species of *Leptosphaeria* has been reported as endophytes and saprotrophs of grapevine (Crane and Shearer 1991). However, some species of this genus can be pathogenic to some economically important crops (Fitt et al. 2006). *Monographella* is a known leaf pathogen on rice, barley, maize and wheat (Daamen et al. 1991; Hock et al. 1992; Tatagiba et al. 2015). However, there are no records of species of this genus associated with grapevine. Therefore, this study provides the first record of *Monographella*

associated with grapevine. Species of *Phaeoacremonium* are causal agents of Esca disease around the world (Garcia-Benavides et al. 2013). Species of *Trichothecium* are known to cause berry rot of grapevine, but this is not considered as a major pathogen on grapevine (Oh et al. 2014).

Even though genus *Volutella* is a facultative pathogen causing leaf spot and cankers (Henricot et al. 2000; Shi and Hsiang 2014), there is no record of this genus occurring on grapevine. Therefore, this study provides the first record of *Volutella* associated with *V. vinifera* as a saprotroph.

Among the 45 identified saprotrophic taxa, 17 are well known pathogens of *Vitis vinifera* causing severe yield as well as economic losses to viticulture worldwide (Table 2). Six secondary pathogens were also identified in this study. Most of the pathogens tend to survive or overwinter on dead plant material as saprotrophs and act as the primary inoculum once the conditions are favourable (Armijo et al. 2016).

Many studies have shown that most pathogenic fungi can survive unsuitable conditions, such as cold during the winter, by changing their life mode to saprotrophs, and become active pathogens again once the conditions are suitable. Therefore, dead plant materials are the potential primary inocula for plant pathogens in vineyards. In order to avoid this problem, vineyards must be kept clean. If there are any dead grapevines they must be removed and if possible should be burned. This will reduce the pathogenic fungi from year to year.

Checklist of fungi on *Vitis*

Nine-hundred and five micro- and macro- fungal taxa reported on *Vitis* species are listed in this study. This is an updated worldwide checklist of fungi on *Vitis*. These taxa are distributed in 156 families and 343 genera. For each species, family, life mode, diseases caused and the known locality as well as references are provided.

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