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A Comprehensive Global Checklist of *Diplocarpon* species causing Plant diseases around the World

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Abstract

Fungi account for more than half of the plant diseases worldwide. The fungal genus *Diplocarpon* causes plant diseases that lead to significant economic losses across a wide range of hosts, especially the members of *Rosaceae,* which includes ornamentals like Rose, and plantation crops like apple, and pear. Successful management of these diseases starts with correct identification and prior knowledge of the fungus reported in the region. This paper was compiled by collecting and compositing data from various databases to provide a country-wise checklist of all the species of *Diplocarpon,* and their hosts. Eleven species of *Diplocarpon* have been reported since the discovery of the fungus. This checklist aims to provide a clear understanding of the worldwide diversity, ecology and frequency of the fungal genus and to form a robust foundation for further taxonomic studies.

Keywords – Anamorphic fungi – Checklist – Leaf spot – Plant pathogen – *Rosaceae* – Taxonomy

Introduction

The world's major crops suffer losses of 10-15% every year due to plant diseases. Among which, plant pathogenic fungi accounts for about 70-80% of the diseases (Mahadevakumar & Sridhar 2021). Although most fungi are saprobic and draw their nutrition from dead and decaying organic matter, many are pathogenic and necrotrophic causing diseases in plants (Mekapogu et al. 2021). For example, Wheat rust fungus, *Puccinia graminis tritici* causes about 10-70% of harvest losses every year in Wheat production (Fisher et al. 2012). The spores of this fungus can travel in the air between continents (Brown & Hovmoller 2002). Similarly, rice production faces losses of anywhere between 10-100% due to *Pyricularia oryzae,* causing Rice blast (Vanaraj et al. 2013, Coelho et al. 2016, Savary et al. 2019, Onaga et al. 2025). More recently, a new fungal species, *Paecilomyces formosus,* was reported to cause canker disease on apple cultivars in India (Azizi et al. 2025). The fungi belonging *Sordariomycetes*, *Dothideomycetes*, *Leotiomycetes*, and

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Pucciniomycetes, *Ustilaginomycetes* belonging to phylum Ascomycota and Basidiomycota respectively, are the most economically damaging fungal pathogens (Mekapogu et al. 2021). In ornamental plants, these diseases cause even worse damage due to the loss of marketability of the produce. This is due to the visual symptoms caused by these fungal pathogens. About 70% of the diseases in ornamental plants are caused by fungi (Punja 2006). One such genus of fungi, that is responsible for causing diseases in many plants is *Diplocarpon.*

The global average of fungi-to-plant species ratio is estimated to be 9.8:1 (Hawksworth & Lücking 2017, Gafforov et al. 2025). It is vital to make a unified database or a checklist of reported fungal species as it reveals the present state of mycology in an area and provides older or forgotten names of fungi that have been replaced with new names. These checklists, keep a well-defined record for all the reported fungi of a particular region, provides the ability to compare fungi from different geographical regions which will help in identifying fungi from under-sampled or less explored geographical areas (Piepenbring et al. 2020). The importance of species checklists is recognized under the 1992 Rio Convention on Biological Diversity, emphasizing their role in characterization of their biodiversity and management.

However, when searching the internet for a comprehensive checklist of the reported species of *Diplocarpon*, there were no results. Hence, it was decided to collect and compile all the reported species of *Diplocarpon* to make a unified checklist of the species reported from the genus known to cause diseases across a wide range of hosts throughout the world. This compilation of different species of *Diplocarpon* will serve as a checklist for identification and reference to aid research and taxonomic studies related to this genus. This comprehensive checklist reflects the ecology, host range, diseases caused and the frequency of each species of this genus present all across the globe in all reported countries.

Material & Methods

The checklist in this paper was compiled and analyzed based on reports from various scientific journals and technical bulletins, which were listed in the US National Fungus Collections, Fungus-Host Database of the US Department of Agriculture, Agriculture Research Service (https://fungi.ars.usda.gov) (Farr & Rossman 2024). The legitimacy of the species was confirmed by cross-checking with MycoBank and Index Fungorum (accessed on 6-May-2026). Slides were prepared using sterile distilled water. Microscopic morphological characteristics were examined and recorded with an Olympus BX53 DIC (Differential Interference Contrast) microscope equipped with a DP-75 camera and measurements were conducted using Olympus cellSens Entry 4.2.1 software. A multi-layered hierarchical Krona plot was constructed using Krona XML tools (Ondov et al. 2011). The data from the checklist was converted into a standardized Krona-compatible text file and processed within the KronaTools package. An interactive, multi-layered Krona chart was generated as an independent HTML file for each continent, depicting the frequency of reports of each species from every country along with their host diversity.

Taxonomy

Diplocarpon F.A. Wolf, *Bot. Gaz.* 54: 231 (1912) Fig. 1

IndexFungorum number: IF1601; MycoBank MB#1601

Parasitic on plants (Persoon 1822, Trail 1889, Wolf 1912, Chen 2022) worldwide. **Sexual morph:** Dark brown fruiting bodies are formed in connection with an extensive subcuticular mycelium, consisting of a sub-cuticular shield with more or less radiate elements, especially at the margin, and an innate apothecium. Apothecium is joined with the margin of the shield at maturity. Hymenium ruptures at maturity in an irregularly stellate manner. Asci are oblong to subclavate, 8-spored; paraphyses are unbranched; Ascospores elongated, 2-celled, hyaline at maturity. **Asexual morph:** Hyphae hyaline, septate and narrow. *Acervuli* are formed that are subcutaneous, covered by the cuticle, which ruptures irregularly at maturity. Conidia 2-celled, hyaline and guttulate, often deeply constricted, straight or subfalcate.

Fig. 1 – *Diplocarpon rosae* A Symptoms on Leaves. B Acervuli on leaves. C-D Conidia. Scale Bar C-D= 10µm.

Type species – *Diplocarpon rosae* (Lib.) F.A. Wolf, *Bot. Gaz.* 54: 231 (1912)

The genus *Diplocarpon* was introduced by Frederick A. Wolf in 1912 for *Actinonema* with *Diplocarpon rosae* (Wolf) as a type species. Presently 11 species accepted in the genus (*Index fungorum*; Hyde et al. 2024). *Diplocarpon* exhibits a hemi-biotrophic nature and have both teleomorph and anamorph stages. The genus had undergone several revisions. The type species, *D. rosae*, has been linked to an anamorph in *Marssonina, i.e. M. rosae*, the causal agent of black spot of roses (Sivanesan & Gibson 1976a). The type species of *Entomosporium*, i.e *E. mespili*, is the anamorph of *Diplocarpon mespili* (syn. *Diplocarpon maculatum*), which causes the leaf and fruit spot disease of rose and other rosaceous plants (Sivanesan & Gibson 1976b). Another genus *Bostrichonema*, based on *B. alpestre*, and now regarded as *B. polygoni*, includes seven names.

Bostrichonema polygoni is considered an anamorph of *Diplocarpon polygoni* (Müller 1977*). Diplocarpon rosae* is congeneric with *D. mespili* and *D. polygoni*, then *Entomosporium* and *Bostrichonema* are taxonomically congruent with *Diplocarpon*. *Diplocarpon earlianum* (now a synonym of *D. fragariae* Johnston et al. 2014) is considered to be a teleomorph of species of yet another genus *Marssonina* that is *M. potentillae* as *M. fragariae* (Sivanesan & Gibson 1976c). In addition, the phylogenetic analysis based on ITS sequences indicates that the type species of *Diplocarpon*, *Entomosporium*, and *Marssonina* may be congeneric. An obscure fifth genus, *Entomopeziza*, based on *E. soraueri* (syn. *Entomosporium mespili*), is considered a synonym of *Diplocarpon*. Thus, *Bostrichonema, Diplocarpon, Entomosporium, Marssonina and Entomopeziza* are treated as taxonomically congruent. Since the name *Diplocarpon* is more frequently used and known to cause serious, widespread diseases of rosaceous plants and is widely known in plant pathology literature, Johnston et al. (2014) protected the name of genus *Diplocarpon* over other names. The genus is placed in family *Drepanopezizaceae* (Johnston et al. 2014) and the same was accepted by Hyde et al. (2024).

Diplocarpon species thrive in temperate to sub-tropical regions of the world; for example, the species *D. rosae* has optimal spore germination at 18°C, and most vigorous hyphal growth at 21°C (Liang et al. 2025). The black spot is the most severe disease occurring on roses around the globe (Gachomo & Kotchomi 2007). Another species, *D. coronariae* causes apple blotch, resulting in severe defoliation that reduces yield, affects fruit quality and reduces overall tree vigor (Crous et al. 2020). *Diplocarpon fragariae* causes leaf scorch disease in multiple plant species with symptoms resembling scorching or burning (Bolton 1963). This species can infect leaves, petioles, fruits and stems, representing another economically important member of the genus in horticultural systems.

Results

Checklist of Diplocarpon species

Eleven species of *Diplocarpon* have been recorded and identified from different countries around the world. These species cause various diseases (black spot of rose, leaf blotch of apple, scorching in strawberry, *etc*.) on different plants around the globe. The most frequently reported species of *Diplocarpon* are *Diplocarpon rosae* (67) and *D. mespili* (47), followed by *D. fragariae* (30), *D. alpestre* (6), *D. saponariae* (5), *D. mali* (4), *D. impressum* (3), *D. corornariae* (1), *D. hymenaeae* (1), *D. mespilicola* (1) and *D. polygoni* (1). Fig. 2 represents the overall species diversity of the genus. Predictably, most reports belong to *Diplocarpon rosae*, being the most commonly occurring and widely studied species of the genus.

Host range

Most of the species belonging to *Diplocarpon* are causing diseases in the members of family *Rosaceae* including Roses, Pome fruit trees and other tree crops. Seven out of the eleven *Diplocarpon* species cause diseases in members of family *Rosaceae*. However, the pathogenicity of *Diplocarpon* species is not limited to *Rosaceae* as a few species have also been reported to cause diseases in other host families as well which include *Caryophyllaceae, Fabaceae,* and *Poaceae*. One species, *Diplocarpon saponariae* specifically causes disease in the plants of family *Caryophyllaceae*. Another species, *D. hymenaeae* was reported to cause disease in the family *Fabaceae* specifically on *Hymenaea martiana,* commonly known as the Jatoba tree in Brazil. A single report by Mendes et al. (1998), also showed that the fungus *Diplocarpon rosae* causes disease in Custard apple (*Annona squamosa*) as well. The fungus *Diplocarpon fragariae,* although commonly causes diseases of rosaceous plants, has also been reported to cause disease in *Pennisetum* sp. of *Poaceae* from Hong Kong. (Zhuang 2001). Within the *Rosaceae* family the hosts ranged from flowering ornamentals like common Roses (*Rosa* spp.), shrubs like Strawberries (*Fragaria* spp.) to trees like Apple (*Malus* spp.), Pear (*Pyrus* spp.), Loquat (*Eriobotrya* spp.), Quince (*Cydonia* spp.) *etc*., which reflects that the fungi of the genus *Diplocarpon* most commonly infect Rosaceous plants but their pathogenicity is not limited to these hosts. A pie-chart

representing the percentage of reports across different host families was constructed as shown in Figure 3, clearly depicting the dominance of infection in the family *Rosaceae*, a whopping 90.96% of reports of the fungus compared to other host families which are far less. Since most reports of species belonging to this genus are from the family *Rosaceae*, we can conclude that it is the most preferred host family. However, it is important to note that reports, although comparatively far less, have been observed from other host families as well. Species like *D. polygoni* and *D. alpestre*, which were recently moved into the genus *Diplocarpon* due to their phylogenetic similarity, were only reported to cause diseases in the host family *Polygonaceae*. The different species of *Diplocarpon* are restricted to cause diseases in a single host family with the exception of *D. rosae* and *D. fragariae* which were both reported from at least two host families although the majority of their reports lie within the *Rosaceae* family.

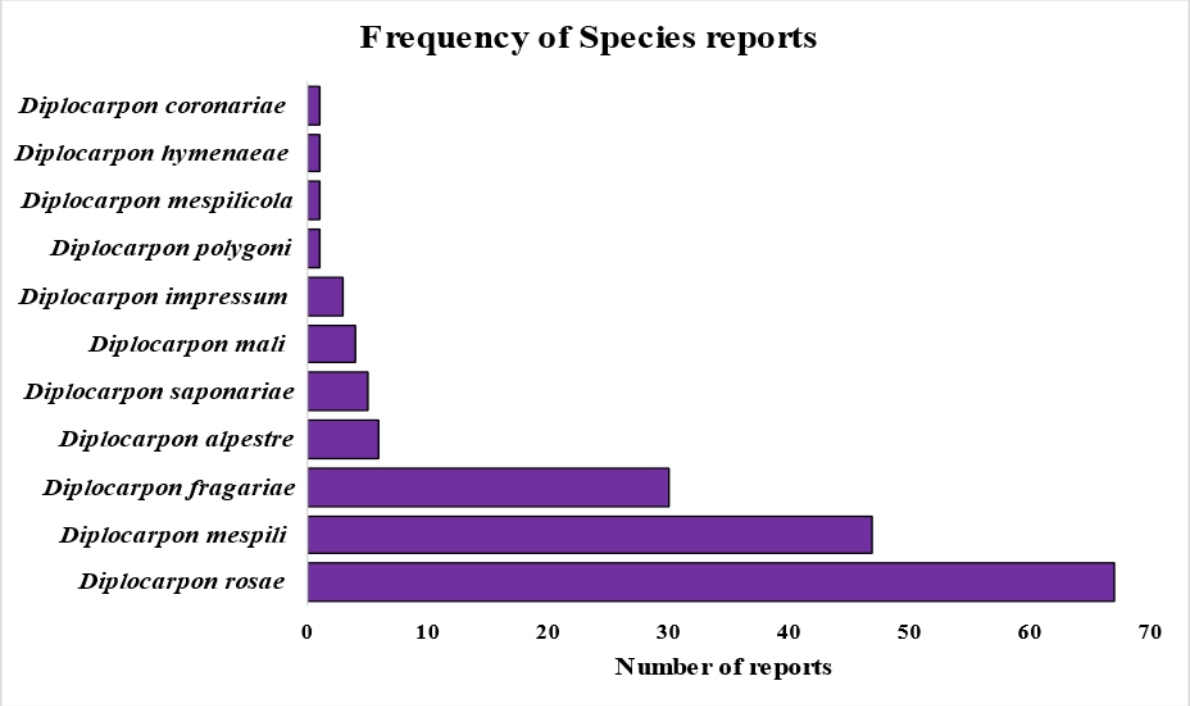

Fig. 2 – Species diversity of the genus *Diplocarpon* based on global reports.

Ecology

The species of genus *Diplocarpon* have been reported from all the continents, including North America (64), Asia (31), Europe (29), Oceania (17), Africa (16) and South America (10) except Antarctica. This shows the cosmopolitan range and spread of the fungal genus throughout the planet on its hosts. Looking at the species distribution, the species *Diplocarpon rosae* along with *D. fragariae* and *D. mespili* can be designated as cosmopolitan species owing to their existence in the six continents except Antarctica. However, *D. mali* and *D. mespilicola* are found to be endemic to Asia while *D. coronariae, D. impressum, D. polygoni* are endemic to Europe and *D. hymeneae* is endemic to South America. Whereas, *D. alpestre* and *D. saponariae* are reported from Europe as well as North America.

Out of the 195 countries in the world, the species of *Diplocarpon* have been reported only from 46 countries. Most of the reports are from the United States of America (40) followed by Canada (15), New Zealand (12) and China (11) as shown in a global heat map (Fig. 4) and graphically represented in Figure 5. The species of *Diplocarpon* causes diseases mostly in the countries with temperate and sub-tropical regions. It falls in line with already known information that *Diplocarpon* fungi thrive in milder temperatures compared to tropical temperatures. Thus, most reports have appeared from the temperate regions of the northern hemisphere.

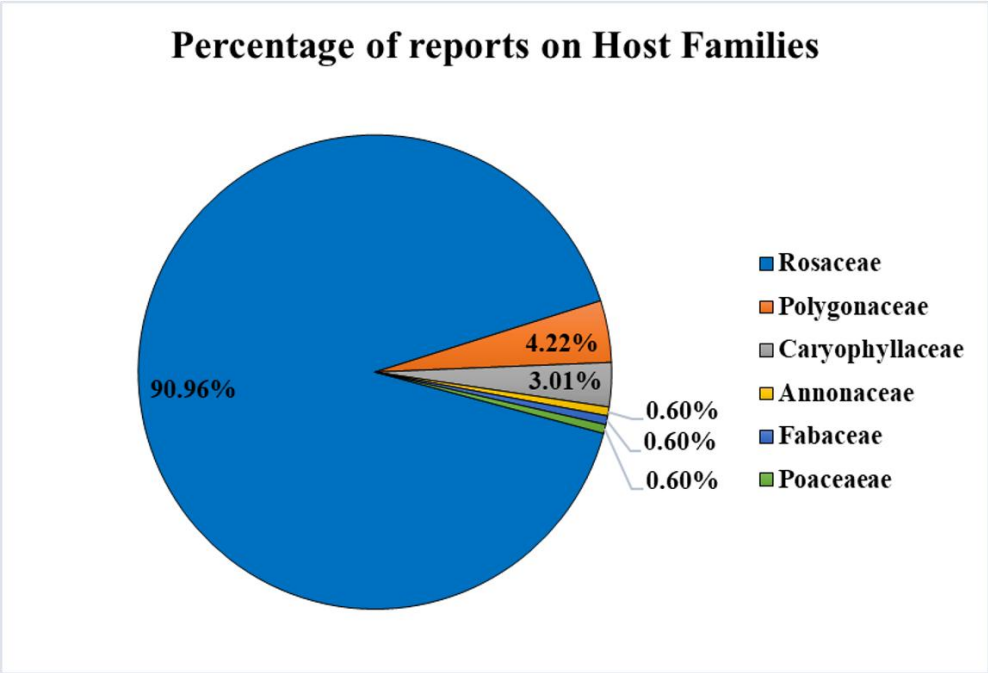

Fig. 3 – The percentages of Host families reported to harbor different species of *Diplocarpon*.

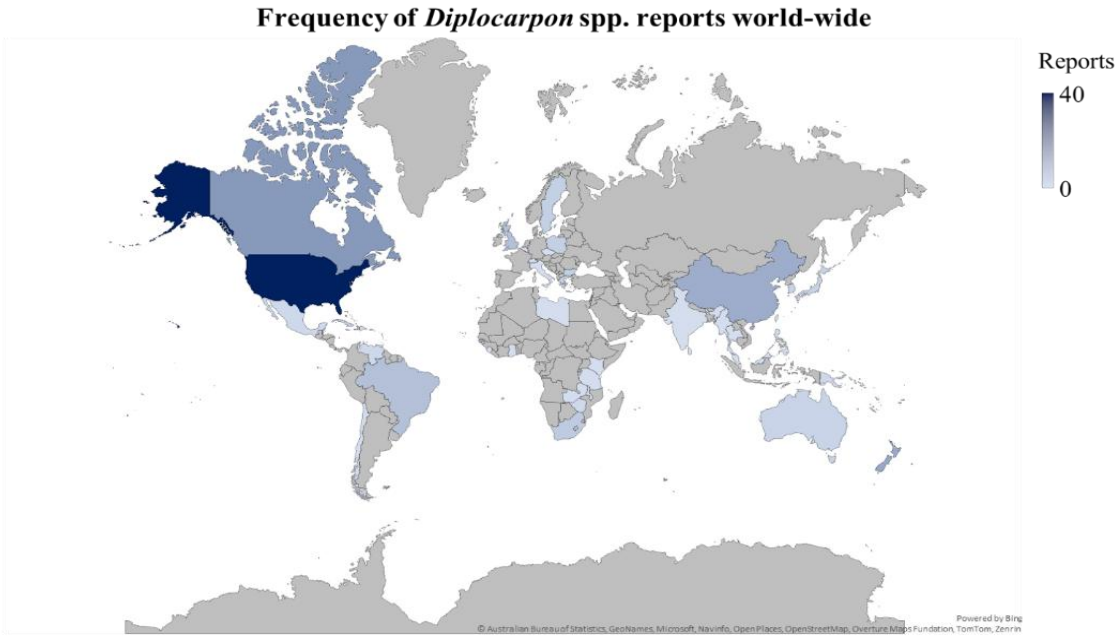

Fig. 4 – World heat-map depiction of different countries based on the number of reports of different *Diplocarpon* spp.

Diplocarpon rosae was reported from 42 of the 46 countries where this genus has been reported, indicating that it is the most prevalent and widely documented species globally, reflecting its cosmopolitan nature. This record is only followed by *D. fragariae*, reported from 17 (about 37%) different countries across the world, which shows a wide margin of reports between the most reported and the second most reported species of the genus. A few species like *D. impressum*, *D. mali*, *D. mespili*, and *D. coronariae*, *etc.*, have only been reported in a few instances. Although this could also mean that the fungal species, previously named as such, might have had their nomenclature altered through the discovery and development of modern phylogenetic and

molecular basis of classifications. The most recently discovered species, *D. mespilicola*, was only reported from China in 2022 as a pathogen causing leaf spots on Rosaceous plants.

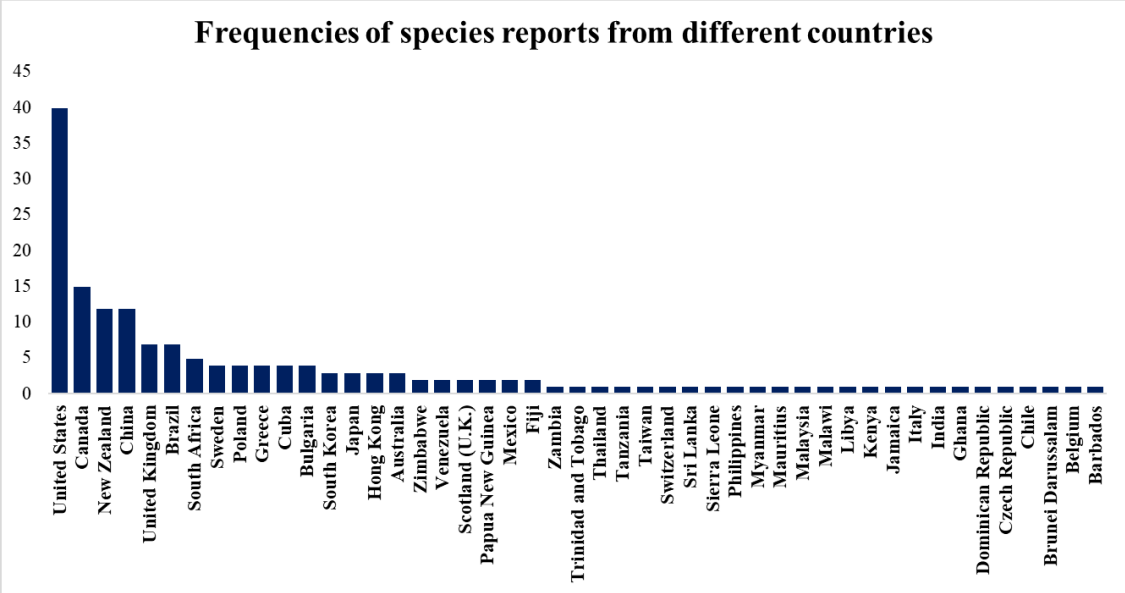

Fig. 5 – Bar chart depicting the reports of *Diplocarpon* species from various countries of the world.

Global Fungal Checklist

All the reported and verified species of *Diplocarpon* from around the world were compiled and made into a table, along with the hosts they were reported to cause disease in, the host family and country of report in Table 1.

Table 1 Country-wise checklist of all reported *Diplocarpon* species in the world.

Species	Host	Host family	Country	Reference
*Diplocarpon fragariae***	*Fragaria ×ananassa*	*Rosaceae*	Australia	Simmonds 1966
*Diplocarpon fragariae***	*Fragaria* sp.	*Rosaceae*	Australia	Cunnington 2003
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Australia	Simmonds 1966
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Barbados	Norse 1974
Diplocarpon coronariae	*Malus domestica*	*Rosaceae*	Belgium	Dumont et al. 2024
*Diplocarpon fragariae***	*Fragaria* sp.	*Rosaceae*	Brazil	Mendes et al. 1998
*Diplocarpon fragariae***	*Fragaria vesca*	*Rosaceae*	Brazil	Mendes et al. 1998
Diplocarpon hymenaea	*Hymenaea martiana*	*Fabaceae*	Brazil	Mendes et al. 1998
Diplocarpon mespili	*Malus domestica*	*Rosaceae*	Brazil	Mendes et al. 1998
Diplocarpon rosae	*Annona squamosa*	Annonaceae	Brazil	Mendes et al. 1998
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Brazil	Mendes et al. 1998
*Diplocarpon mespili****	*Cydonia vulgaris*	*Rosaceae*	Brazil	Mendes et al. 1998
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Brunei	Peregrine & Ahmad 1982
*Diplocarpon fragariae***	*Fragaria ananassa*	*Rosaceae*	Bulgaria	*fide* Bobev 2009
*Diplocarpon mespili****	*Mespilus germanica*	*Rosaceae*	Bulgaria	*fide* Bobev 2009
*Diplocarpon mespili****	*Pyrus* sp.	*Rosaceae*	Bulgaria	*fide* Bobev 2009
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Bulgaria	*fide* Bobev 2009

Table 1 Continued

Species	Host	Host family	Country	Reference
*Diplocarpon saponariae**	*Silene acaulis* var. *exscapa*	*Caryophyllaceae*	Canada	*fide* Ginns 1986
*Diplocarpon fragariae***	*Fragaria virginiana*	*Rosaceae*	Canada	*fide* Parmelee 1988
*Diplocarpon fragariae***	*Fragaria ×ananassa*	*Rosaceae*	Canada	*fide* Ginns 1986
*Diplocarpon mespili****	*Sorbus americana*	*Rosaceae*	Canada	*fide* Parmelee 1988
Diplocarpon mespili	*Amelanchier alnifolia* var. *semiintegrifolia*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Amelanchier canadensis*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Crataegus curvisepala*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Cydonia oblonga*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Rhaphiolepis indica*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Sorbus americana*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Sorbus occidentalis*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon mespili	*Sorbus* sp.	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon rosae	*Rosa rugosa*	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Canada	*fide* Ginns 1986
Diplocarpon alpestre	*Polygonum viviparum*	*Polygonaceae*	Canada	*fide* Ginns 1986
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Chile	Mujica & Oehrens 1967
Diplocarpon rosae	*Rosa banksiae*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Rosa chinensis*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Rosa dahurica*	*Rosaceae*	China	*fide* Chen 2002
Diplocarpon rosae	*Rosa davurica*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Rosa laevigata*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Rosa microcarpa*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Rosa multiflora*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	China	*fide* Chen 2002
Diplocarpon rosae	*Rosa xanthina*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon rosae	*Sanguisorba officinalis*	*Rosaceae*	China	*fide* Tai 1979
Diplocarpon mespilicola	*Crataegus pinnatifida*	*Rosaceae*	China	Chen et al. 2022
*Diplocarpon fragariae***	*Fragaria vesca* var. *americana*	*Rosaceae*	Cuba	Arnold 1986
Diplocarpon rosae	*Rosa canina*	*Rosaceae*	Cuba	Urtiaga 1986
Diplocarpon rosae	*Rosa indica*	*Rosaceae*	Cuba	Urtiaga 1986
Diplocarpon rosae	*Rosa laevigata*	*Rosaceae*	Cuba	Urtiaga 1986
Diplocarpon impressum	*Rubus chamaemorus*	*Rosaceae*	Czech Republic	Chlebicki 2002
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Dominican Republic	Ciferri 1961
*Diplocarpon fragariae***	*Fragaria ananassa*	*Rosaceae*	Fiji	Dingley et al. 1981
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Fiji	Firman 1972
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Ghana	Hughes 1952
*Diplocarpon saponariae**	*Silene fabarioides*	*Caryophyllaceae*	Greece	*fide* Pantidou 1973
*Diplocarpon saponariae**	*Silene vulgaris*	*Caryophyllaceae*	Greece	*fide* Pantidou 1973

Table 1 Continued

Species	Host	Host family	Country	Reference
*Diplocarpon fragariae***	*Fragaria vesca*	*Rosaceae*	Greece	*fide* Pantidou 1973
Diplocarpon rosae	*Rosa* sp	*Rosaceae*	Greece	Pantidou 1973
*Diplocarpon fragariae***	*Fragaria hybrid*	*Rosaceae*	Hong Kong	*fide* Lu et al. 2000
*Diplocarpon fragariae***	*Pennisetum* sp.	Poaceae	Hong Kong	Zhuang 2001
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Hong Kong	*fide* Lu et al. 2000
Diplocarpon rosae	*Rosa multiflora*	*Rosaceae*	India	*fide* Pande 2008
*Diplocarpon saponariae*****	*Saponaria officinalis*	*Caryophyllaceae*	Italy	*fide* Cesati V 1853
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Jamaica	Larter & Martyn 1943
Diplocarpon mali	*Chaenomeles lagenaria*	*Rosaceae*	Japan	*fide* Kobayashi 2007
Diplocarpon mali	*Malus pumila* var. *domestica*	*Rosaceae*	Japan	*fide* Kobayashi 2007
Diplocarpon mali	*Malus sieboldii* var. *zumi*	*Rosaceae*	Japan	*fide* Kobayashi 2007
Diplocarpon rosae	*Rosa damascena*	*Rosaceae*	Kenya	Nattrass 1961
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Libya	El-Buni & Rattan 1981
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Malawi	Wiehe 1953
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Malaysia	Liu 1977
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Mauritius	Orieux & Felix 1968
*Diplocarpon fragariae***	*Fragaria mexicana*	*Rosaceae*	Mexico	Alvarez 1976
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Mexico	Alvarez 1976
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Myanmar	Thaung 2008
*Diplocarpon fragariae***	*Fragaria ×ananassa*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Crataegus monogyna*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Cydonia oblonga*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Eriobotrya japonica*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Mespilus germanica*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Photinia glabra*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Pyrus communis*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Pyrus pyrifolia*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Rhaphiolepis delacourii*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon mespili	*Rhaphiolepis indica*	*Rosaceae*	New Zealand	*fide* Pennycook 1989
Diplocarpon rosae	*Rosa rubiginosa*	*Rosaceae*	New Zealand	*fide* McKenzie 1990

Table 1 Continued

Species	Host	Host family	Country	Reference
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	New Zealand	*fide* Pennycook 1989
*Diplocarpon fragariae***	*Fragaria* ×*ananassa*	*Rosaceae*	Papua New Guinea	Shaw 1984
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Papua New Guinea	Shaw 1984
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Philippines	Teodoro 1937
Diplocarpon impressum	*Rubus chamaemorus*	*Rosaceae*	Poland	Chlebicki 2002
Diplocarpon rosae	*Rosa canina*	*Rosaceae*	Poland	Adamska 2001
Diplocarpon alpestre	*Polygonum bistorta*	*Polygonaceae*	Poland	*fide* Mulenko et al. 2008
Diplocarpon alpestre	*Polygonum viviparum*	*Polygonaceae*	Poland	*fide* Mulenko et al. 2008
*Diplocarpon fragariae***	*Fragaria* sp.	*Rosaceae*	Scotland	Foister 1961
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Scotland	Foister 1961
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Sierra Leone	Deighton 1936
*Diplocarpon fragariae***	*Fragaria* sp.	*Rosaceae*	South Africa	*fide* Crous et al. 2000
Diplocarpon mespili	*Cydonia oblonga*	*Rosaceae*	South Africa	*fide* Crous et al. 2000
Diplocarpon mespili	*Eriobotrya japonica*	*Rosaceae*	South Africa	*fide* Crous et al. 2000
Diplocarpon mespili	*Pyrus communis*	*Rosaceae*	South Africa	Crous et al. 2001
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	South Africa	Crous et al. 2001
*Diplocarpon fragariae***	*Fragaria* ×*ananassa*	*Rosaceae*	South Korea	*fide* Cho & Shin 2004
Diplocarpon mali	*Malus pumila* var. *dulcissima*	*Rosaceae*	South Korea	*fide* Cho & Shin 2004
Diplocarpon rosae	*Rosa hybrida*	*Rosaceae*	South Korea	*fide* Cho & Shin 2004
Diplocarpon rosae	*Rosa indica*	*Rosaceae*	Sri Lanka	Adikaram & Yakandawala 2020
Diplocarpon impressum	*Rubus chamaemorus*	*Rosaceae*	Sweden	Chlebicki 2002
Diplocarpon mespili	*Cydonia vulgaris*	*Rosaceae*	Sweden	Eriksson 2014
Diplocarpon mespili	*Pyrus communis*	*Rosaceae*	Sweden	Eriksson 2014
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Sweden	Eriksson 2014
Diplocarpon polygoni	*Polygonum viviparum*	*Polygonaceae*	Switzerland	Muller 1977
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Taiwan	Anonymous 1979
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Tanzania	Riley 1960
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Thailand	*fide* Giatgong 1980
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Trinidad and Tobago	Baker & Dale 1951
*Diplocarpon saponariae**	*Silene dioica*	*Caryophyllaceae*	United Kingdom	*fide* Dennis 1986
*Diplocarpon fragariae***	*Fragaria* sp.	*Rosaceae*	United Kingdom	Cannon et al. 1985
*Diplocarpon fragariae***	*Potentilla anserina*	*Rosaceae*	United Kingdom	*fide* Dennis 1986
*Diplocarpon fragariae***	*Potentilla erecta*	*Rosaceae*	United Kingdom	*fide* Dennis 1986
Diplocarpon mespili	*Cydonia* sp.	*Rosaceae*	United Kingdom	Cannon et al. 1985
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	United Kingdom	Cannon et al. 1985

Table 1 Continued

Species	Host	Host family	Country	Reference
Diplocarpon alpestre	*Polygonum viviparum*	*Polygonaceae*	United Kingdom	*fide* Dennis 1986
*Diplocarpon fragariae***	*Fragaria ×ananassa*	*Rosaceae*	United States	Alfieri et al. 1984
*Diplocarpon fragariae***	*Fragaria bracteata*	*Rosaceae*	United States	Anonymous 1960
*Diplocarpon fragariae***	*Fragaria chiloensis*	*Rosaceae*	United States	Sprague 1955
*Diplocarpon fragariae***	*Fragaria chiloensis* var. *ananassa*	*Rosaceae*	United States	Mankin 1969
*Diplocarpon fragariae***	*Fragaria* sp.	*Rosaceae*	United States	Maneval 1937
*Diplocarpon fragariae***	*Fragaria vesca*	*Rosaceae*	United States	Shaw 1973
*Diplocarpon fragariae***	*Fragaria vesca* var. *americana*	*Rosaceae*	United States	Anonymous 1960
*Diplocarpon fragariae***	*Fragaria virginiana*	*Rosaceae*	United States	*fide* Parris 1959
*Diplocarpon mespili****	*Cydonia oblonga*	*Rosaceae*	United States	Grand 1985
*Diplocarpon mespili****	*Photinia* sp.	*Rosaceae*	United States	Grand 1985
*Diplocarpon mespili****	*Pyrus communis*	*Rosaceae*	United States	Grand 1985
Diplocarpon mespili	*Cotoneaster* sp.	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Crataegus laevigata*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Crataegus* sp.	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Cydonia oblonga*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Eriobotrya deflexa*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Eriobotrya japonica*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Heteromeles arbutifolia*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Heteromeles* sp.	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Mespilus germanica*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Photinia* sp.	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Prunus persica*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Pyrus betulifolia*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Pyrus communis*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Pyrus kawakamii*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Pyrus pyrifolia*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon mespili	*Rhaphiolepis indica*	*Rosaceae*	United States	*fide* French 1989
Diplocarpon rosae	*Rosa bracteata*	*Rosaceae*	United States	Anonymous 1960
Diplocarpon rosae	*Rosa carolina*	*Rosaceae*	United States	Preston 1947
Diplocarpon rosae	*Rosa chinensis*	*Rosaceae*	United States	Preston 1947
Diplocarpon rosae	*Rosa gallica*	*Rosaceae*	United States	Preston 1947
Diplocarpon rosae	*Rosa nutkana*	*Rosaceae*	United States	Shaw 1973
Diplocarpon rosae	*Rosa odorata*	*Rosaceae*	United States	Raabe et al. 1981
Diplocarpon rosae	*Rosa pisocarpa*	*Rosaceae*	United States	Shaw 1973
Diplocarpon rosae	*Rosa rugosa*	*Rosaceae*	United States	Cash 1953
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	United States	*fide* Parris 1959
Diplocarpon rosae	*Rosa virginiana*	*Rosaceae*	United States	*fide* Guba 1937
Diplocarpon rosae	*Rosa woodsii*	*Rosaceae*	United States	Preston 1947
Diplocarpon alpestre	*Polygonum bistortoides*	*Polygonaceae*	United States	Anonymous 1960
Diplocarpon alpestre	*Polygonum viviparum*	*Polygonaceae*	United States	Cash 1953

Table 1 Continued

Species	Host	Host family	Country	Reference
Diplocarpon rosae	*Rosa canina*	*Rosaceae*	Venezuela	Urtiaga 1986
Diplocarpon rosae	*Rosa indica*	*Rosaceae*	Venezuela	Urtiaga 1986
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Zambia	Riley 1956
*Diplocarpon fragariae***	*Fragaria vesca*	*Rosaceae*	Zimbabwe	*fide* Whiteside 1966
Diplocarpon rosae	*Rosa* sp.	*Rosaceae*	Zimbabwe	*fide* Whiteside 1966

*Previously *Diplocarpon agrostemmatis* **Previously *Diplocarpon earlianum* ***Previously *Diplocarpon maculatum* ****Previously *Diplocarpon soraueri* *****Previously *Phacidium saponariae*

Fig. 6 – Krona chart indicating overall host diversity of different *Diplocarpon* species reported from the continent of Africa.

Discussion

This comprehensive checklist represents the first unified compilation of *Diplocarpon* species documented globally, furthering mycological taxonomy and disease studies. This study reveals that even though eleven *Diplocarpon* species have been identified and recorded across different

countries, the genus remains understudied relative to its significance in fields. Looking at the broader picture, the genus is cosmopolitan in nature due to its existence in all continents of the world except Antarctica, of which North America (64) accounted for most reports, followed by Asia (31). From this perspective, the species *D. mali, D. mespilicola*, *D. coronariae, D. impressum*, *D. polygoni, D. hymeneae* were found to be endemic in the continents they were reported from whereas the species *D. rosae*, *D. fragariae* and *D. mespili* share the cosmopolitan nature with *D. rosae* as they appear to be present in all the continents except Antarctica. However, the distribution of the fungus *Diplocarpon* across the world is not uniform; instead, it is concentrated in regions with temperate and subtropicalclimates, as evident from the reports. This pattern aligns with established knowledge that *Diplocarpon* fungi thrive in cooler climates, with optimal conditions for species like *Diplocarpon rosae* occurring at temperatures between 18°C and 21°C (Liang et al. 2005). Although the fungus has been reported in all continents except Antarctica, it has been documented in only 46 countries, representing 23% of the world's nations. The United States (40) leads other countries in reporting frequency, followed by Canada (15), New Zealand (12) and China (11).

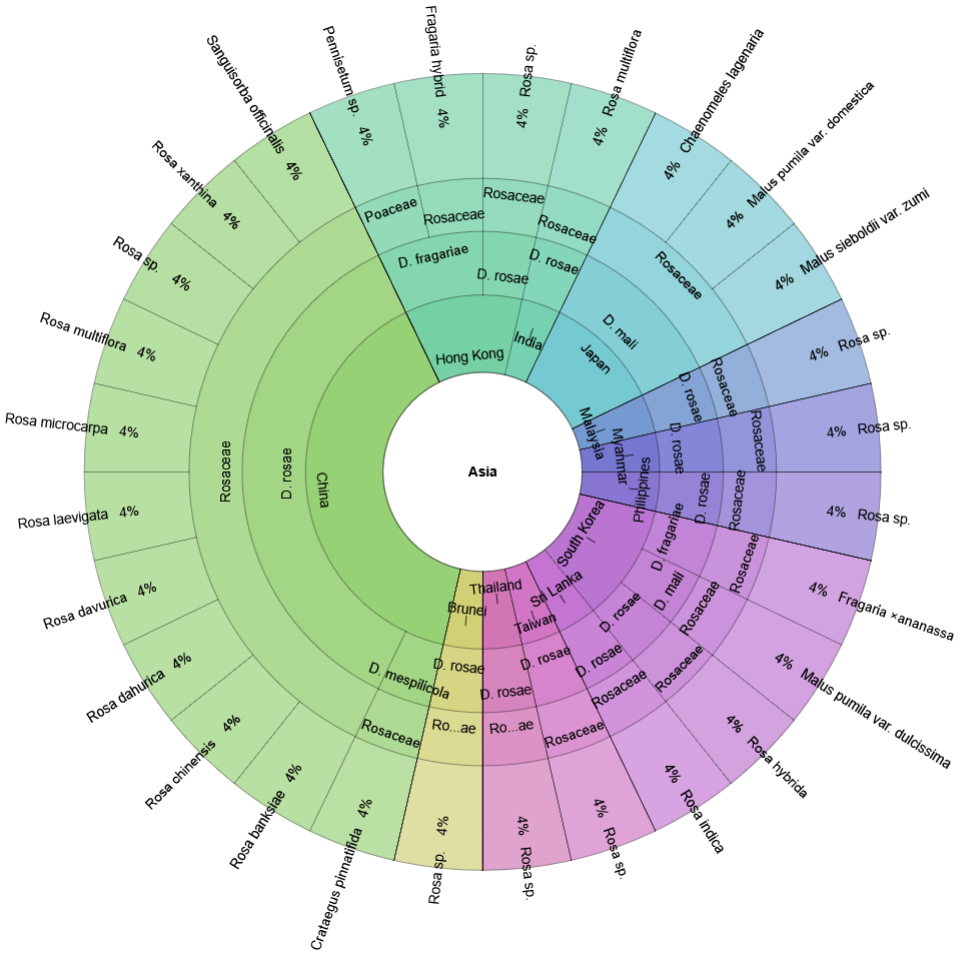

Fig. 7 – Krona chart indicating overall host diversity of different *Diplocarpon* species reported from the continent of Asia.

This suggests that the documentation of the fungal genus in underdeveloped or developing countries is far lesser compared to the countries leading research. The true global distribution pattern of *Diplocarpon* species is underestimated for this same reason. On the other side of the coin, it also represents the research potential in nations with similar climate and ecology.

There also exists a striking host range pattern in the infections caused by *Diplocarpon* species. Most of the hosts affected by this fungal genus belong to the family *Rosaceae.* However,

new and emerging reports of the fungus in other families of plants reflect the evolution of the fungus into a more flexible infection pattern. The host preference includes a wide range of Rosaceous plants, from ornamental roses (Rosa spp.) to commercial tree crops such as apples (*Malus* spp.), pears (*Pyrus* spp.), quinces (*Cydonia* spp.), and loquats (*Eriobotrya* spp.). The species *Diplocarpon rosae* also demonstrates the potential of the fungus to breach host barriers by infecting custard apple (*Annona squamosa*) from family *Annonaceae* as reported from Brazil (Mendes et al. 1998). The species *Diplocarpon polygoni* and *Diplocarpon alpestre* specifically cause diseases in plants belonging to the family *Polygonaceae.* These species, although initially classified into other genera, were moved to *Diplocarpon* owing to their closer phylogenetic relationships with the genus. This varied host pattern suggests further research potential to identify the existence of physiological races of the pathogen that infect different hosts across families. Krona charts depicting the relationships and reports of the genus were created to make an interactive map linking the reports of species from each country with their host families and specific hosts for each continent of Africa (Fig. 6), Asia (Fig. 7), Europe (Fig. 8), North America (Fig. 9), Oceania (Fig. 10) and South America (Fig. 11). A clear dominance of reports from the host family *Rosaceae* can be observed, along with the most frequently reported species, *Diplocarpon rosae.* These findings underscore the need to molecularly characterise additional fungal isolates to further clarify host-pathogen relationships

From a disease management perspective, the systematic checklist of *Diplocarpon* species distributions and their associated hosts enables researchers and agricultural practitioners to forecast and prevent disease outbreaks in their regions and to prioritise crop varieties based on susceptibility

Fig. 8 – Krona chart indicating overall host diversity of different *Diplocarpon* species reported from the continent of Europe.

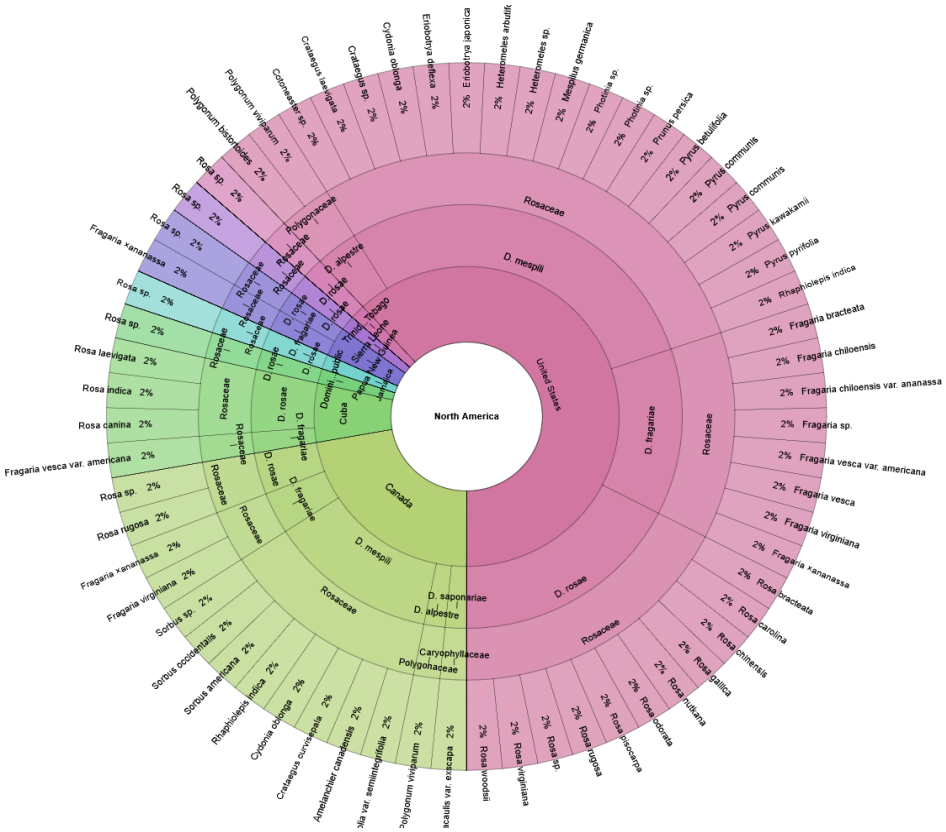

Fig. 9 – Krona chart indicating overall host diversity of different *Diplocarpon* species reported from the continent of North America.

Fig. 10 – Krona chart indicating overall host diversity of different *Diplocarpon* species reported from the continent of Oceania.

Fig. 11 – Krona chart indicating overall host diversity of different *Diplocarpon* species reported from the continent of South America.

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