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**CHARACTERIZATION OF BOTRYOSPHERACEAE
AND CRYPHONECTRIACEAE ASSOCIATED WITH
TERMINALIA SPP. IN AFRICA**

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Characterization of Botryosphaeriaceae and Cryphonectriaceae associated with *Terminalia* spp. in Africa

By

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Prof. Michael J. Wingfield



Declaration

I, the undersigned, hereby declare that this thesis, submitted herewith for the degree of Philosophiae Doctor to the University of Pretoria, contains my own independent work and has not been submitted for any degree at any other University.

Aime Didier Begoude Boyogueno

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The work in this thesis is dedicated to the memory of my loving father Boyogueno Thaddeus (06/06/1947-18/02/2000) and to the entire Begoude family. I hope that this work will serve as a small token of appreciation for their belief in me.



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Preface

The pantropical genus *Terminalia* (Combretaceae, Myrtales) accommodates hundreds of species, of which about fifty occur naturally in Africa. These trees are planted throughout the sub-saharan region where they constitute a source of timber and traditional medicine. *Terminalia* trees are also found associated with agricultural crops to establish a “taungya” agri-sylvicultural system where food crops are grown together with tree species. Despite the importance of *Terminalia* spp., very little research has been done regarding the fungal diseases affecting these trees.

The aim of the research presented in this dissertation was to provide a foundation for understanding health issues affecting *Terminalia* spp. in selected regions in Africa. Both native African and an introduced Asian species of *Terminalia* were included in the study, allowing comparison of fungal communities of the same species between different areas. Special emphasis was placed on the identity and diversity of the Botryosphaeriaceae, since these fungi have a wide host and geographic range and represent a fairly well studied group of fungal tree pathogens.

The first chapter of the dissertation is a review of the literature, providing a summary of the knowledge pertaining to *Terminalia* spp. in Africa. A specific focus is given to their origin and distribution, botanic description, ecology, propagation, management, functional uses and international trade. Also, the limited knowledge regarding pests and diseases on these trees is reviewed, providing a background for the contents of the dissertation.

Among all the species of *Terminalia* present on the African continent, *T. catappa* is one of the few species planted widely in West, Central, East and Southern Africa. *T. catappa* has a Meridional Asian origin, but its broad distribution over the continent made it an ideal candidate to characterise endophytic species of the Botryosphaeriaceae under variable geographic and climatic conditions. The results of this study are presented in chapter two.

Evergreen forests dominate the vegetation in West and Central Africa. In this area, *Terminalia* spp. represents some of the most imposing and common tree groups. Native *T. ivorensis* and *T. superba* are of great economic importance as they are among the most important export timbers. However, current management of native *Terminalia* spp. in their natural environment does not take into consideration the impact of diseases, and limited information is available regarding the

fungal pathogens of these trees. Fungal species in the Botryosphaeriaceae are important threats resulting in wood stain, cankers, die-back and death of trees, particularly when trees are under some form of stress. The third chapter of this dissertation presents the results of an investigation aimed to identify and characterize the Botryosphaeriaceae occurring on *Terminalia* spp. in Cameroon.

The flora of Southern Africa is remarkably diverse with over a thousand indigenous tree species including at least 13 species of *Terminalia*. These trees are small shrubs to medium sized trees, found in open woodlands and wooded savannahs where they contribute to biodiversity and provide various benefits to rural populations. In contrast to Western and Central Africa, very few indigenous tree species are suitable for timber and pulp production in Southern Africa. Therefore, the domestic need for wood in this area is resorbed through plantations of non-native tree species such as *Eucalyptus* or *Pinus* spp. Many introduced, commercially propagated trees are related to native woody plants and growing evidence are showing that pathogens are able to move between them. Knowledge of potentially pathogenic fungi on native trees contributes to assessments of the vulnerability of both native forests and plantations of non-native trees. Fungi belonging to the Botryosphaeriaceae represent interesting model organisms to study the movement of fungal pathogens between native and introduced hosts. Therefore, the study presented in chapter four considers the diversity of the Botryosphaeriaceae associated with native *Terminalia* spp. in southern Africa.

A “taungya” agri-sylvicultural system is an agroforestry system where food crops are grown together with tree species. Some trees, such as *T. ivorensis* and *T. superba* are successfully mixed with *T. cacao* to establish such an agroforestry system in Western Africa. Under such associations, fungal species in the Botryosphaeriaceae, that can exploit more than one host species, can readily move between these hosts and infect plants without producing clear symptoms. Both *L. theobromae* and *L. pseudotheobromae* have been reported from native *Terminalia* spp. and introduced *T. cacao* in Cameroon. Therefore, in order to better understand the ecology and the evolution of interacting partners in a taungya system, the genetic structure of these species was studied in chapter five.

The last chapter of this dissertation considers a stem canker disease on *Terminalia* spp. in Cameroon. The aim of the study was to identify the causal agent of the disease. Symptoms were

typical of those of a fungal disease and fruiting structures of the pathogen were abundant on the dying bark. Thus, the fungus was isolated, identified using a suite of techniques including DNA sequence comparisons and pathogenicity tests were conducted to assess its ability to cause disease.

Studies in this dissertation expand our knowledge pertaining to diseases on native and non-native *Terminalia* spp. in Africa. In addition to previous diseases reports, it appears that *Terminalia* spp. are far from immune to fungal diseases. Although few serious diseases were found during the surveys, the risk of disease outbreaks in the natural ecosystems is considerable since these trees accommodate various latent pathogens that can cause disease under stress conditions. Therefore, sustainable production of *Terminalia* spp. in Africa must rely on the implementation of effective monitoring systems, supported by appropriate management structures.