

***Ceratocystis* species in southern and eastern Africa
with particular reference to *Ceratocystis albifundus***

by

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DECLARATION

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

A handwritten signature in black ink, appearing to read 'R. Heath', written over a horizontal line.

Ronald Natale Heath

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PREFACE

The genus *Ceratocystis* includes numerous plant pathogens, including devastating pathogens of hardwood tree species and wood staining agents. The pathogenic species are known to cause cankers, wilting and mortality of their hosts. The species causing vascular staining do not affect the host or wood structure, but reduces the value of the products produced. It is well documented that fungi in this genus require wounds for infection and are disseminated to these wounds by insects. Both the role that wounds as well as insects play in the biology and ecology of these fungi have been studied to some extent, however, no studies of this nature have been performed on these fungi in Africa.

Understanding the difficulties and short-comings in the taxonomy of the genus *Ceratocystis* is important for the accurate identification of previously undescribed species. Chapter one of this dissertation reviews the past problems experienced with the taxonomy of the genus *Ceratocystis*. This chapter further reviews the biology and ecology of the genus in general and focuses on the impact specific species within the genus has on the hosts they infect. An emphasis of this chapter is the association of species within the genus with insects. This section of the chapter reviews various groups of insects associated with *Ceratocystis* spp., adaptations of the fungi for the purpose of dispersal and the levels of dependence between the fungi and their insect associates.

Research relating to fungal pathogens of forestry crops in Africa has been neglected in the past. Chapter two of this thesis investigates the diversity of *Ceratocystis* spp. infecting wounds of hardwood species used in commercial forestry in Southern and Eastern African countries including South Africa, Tanzania, Kenya and Malawi. This chapter reports two known *Ceratocystis* spp., five previously undescribed *Ceratocystis* spp. and one undescribed *Thielaviopsis* sp. and investigates the pathogenicity of these fungi on their respective hosts.

Ceratocystis albifundus, the causal agent of wilt and canker of non-native *Acacia mearnsii*, has been reported to be one of the most serious pathogens of this tree in Africa. It has been hypothesised to be native to the African continent. This is based on the high genetic diversity of this fungus on non-native *A. mearnsii* in South Africa and Uganda and the fact that *C. albifundus* has only been reported from the African continent. This fungus also occurs on a number of native African tree species and does not seem to lead to disease on these hosts. Chapter three of this thesis investigates the population structure of this fungus from native as well as non-native hosts using microsatellite markers. It is the most extensive population study of this pathogen to date and provides interesting information on the possible origin of the fungus in Africa.

It has been well documented that *Ceratocystis* spp. are associated with insects such as nitidulid beetles and flies. However, no studies have been performed on the possible insects associated with *Ceratocystis* spp. in Africa. Knowledge of the insects and their biology could contribute to the formulation of management strategies to reduce the impact of disease in plantations. Chapter four of this dissertation reports on the identity of nitidulid beetles associated with *C. albifundus* in both a native ecosystem and non-native *A. mearnsii* plantation. This study also provides information regarding the effect climate has on the number of insects as well as the fluctuation of the number of fungal isolates obtained.

As *Ceratocystis* spp. require wounds for infection, numerous studies have been performed on factors relating to wounds that affect the infection success of *Ceratocystis* spp. However, most of these studies have been performed in the Northern Hemisphere. To date, no information is available regarding the influence of wound age and size on the infection success of *C. albifundus*. Chapter five investigates these factors on the infection success of *C. albifundus* on *A. mearnsii* in the Gauteng Province of South Africa. We also investigated the possible decrease of infection success of *C. albifundus* due to pre-inoculation of the wounds by the saprophytic fungus *Ophiostoma quercus* under field conditions.

Studies in this dissertation show the need to increase our knowledge pertaining to the fungal biodiversity within non-native forestry plantations as well as the native flora of



Africa. It indicates the importance of understanding the biology and ecology of these fungi and the need for research in this respect. It finally highlights the importance of understanding the interaction of native fungi on non-native flora and *visa versa*.