

OPHIOSTOMATOID FUNGI AND THEIR INSECT VECTORS ON EUCALYPT TREES IN AUSTRALIA AND SOUTH AFRICA

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Eucalypt (bluegum) trees are important components of the commercial forestry industries in many countries in the Southern Hemisphere, including South Africa and neighbouring countries. These trees are native to Australia, where more than 700 species in four genera occur. Eucalypt trees are valued for their tolerance of poor soil and different climatic conditions, their vigour and fast growth rate, as well as their wood quality that make them suitable for construction, paper and pulp production. In South Africa, for example, eucalypt trees have been planted for more than 200 years and form the basis of the South African forestry industry, and industry that provides employment to thousands of people. These trees have contributed to the development of many forestry industries and have also reduced the logging of indigenous forests in the country and elsewhere in the world.

Eucalypt plantations are threatened by a number of factors, including fungal pathogens and insects. Over the last two decades species of fungi in the Ophiostomatoid group, particularly species of *Ceratocystis* have grown in their importance as pathogens of these trees. In the late 1990s the first global disease of a eucalypt tree caused by a species of *Ceratocystis*, was reported by scientists at the Forestry and Agricultural Biotechnology Institute (FABI). This report was from the Republic of Congo, but since then, numerous reports of disease and death of eucalypts as a result of infection by *Ceratocystis* species have been made internationally.

The Ophiostomatoid fungi comprise species in at least five genera of the ascomycota. These include *Ceratocystis*, *Ceratocystiopsis*, *Gondwanamyces*, *Grosmannia* and *Ophiostoma*. Although morphologically similar, these fungi reside in different orders that are phylogenetically unrelated. *Ceratocystis* (Fig 1), for example, resides in the Microascales, while *Ophiostoma* (Fig 2) belongs to the Ophiostomatales. Ophiostomatoid fungi require wounds on their host trees for infection. They are typically adapted to insect dispersal (Fig 3) and share similar ecological niches. It also includes species that are of economic importance as they cause diseases on trees and crop plants globally. However, the wide majority of fungi cause sap stain of timber, downgrading its commercial value substantially.

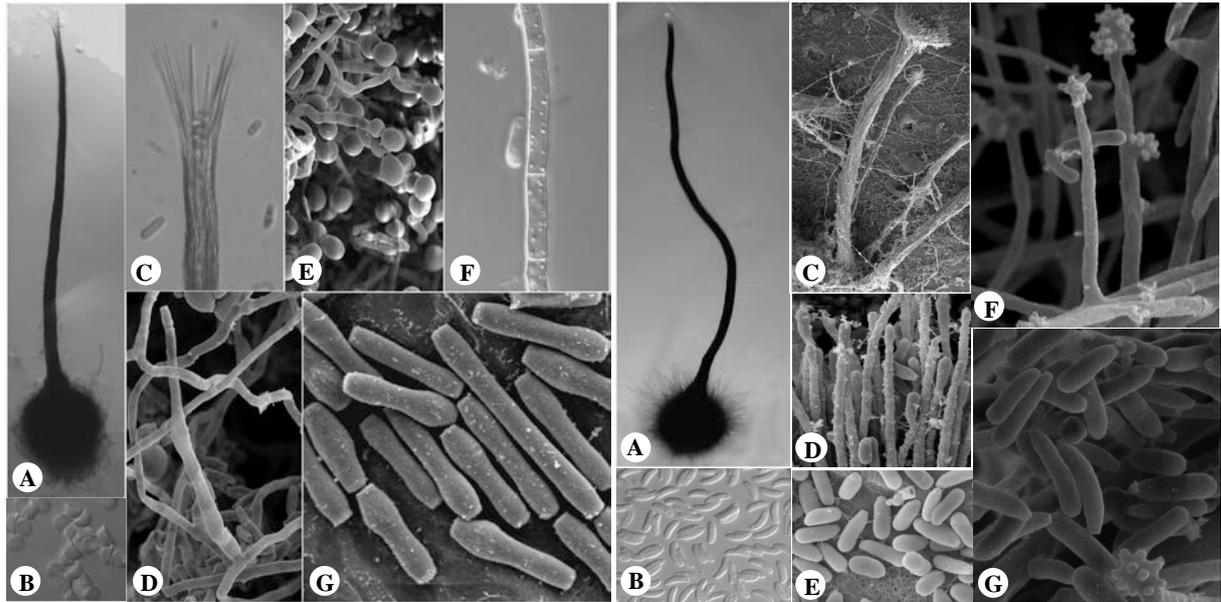


Figure 1. Morphological characteristics of a *Ceratocystis* sp.: (A) Globose ascomatal base, (B) Hat-shaped ascospores in side view, (C) Divergent ostiolar hyphae, (D) Phialidic conidiogenous cell with emerging bacilliform conidia, (E) Ovoid chlamydoconidia, (F) Septate hyphae, (G) Bacilliform shaped conidia with obtuse end and bacilliform shaped conidia with round bases.

Figure 2. Morphological characteristics of an *Ophiostoma* sp.: (A) Globose ascomatal base, (B) allantoid ascospores, (C) synnematal anamorph, (D) conidiogenous cell with annelidic proliferation of conidia, (E) Oblong to cylindrical conidia, (F) Sporothrix conidiogenous cells with denticles visible on tip of conidiogenous cell, (G) Oblong to curved conidia.

To date more than 150 Ophiostomatoid species have been described worldwide. Of these, fifteen species have been reported from eucalypts, but no information was available on their insect vectors. To better understand the diversity of Ophiostomatoid fungi that occur on eucalypt trees, and thus obtain an indication of the future potential threats of these fungi, we studied wounds on eucalypt trees in Australia (the origin of eucalypts) and South Africa. We also aimed to identify insects that spread these fungi on eucalypts in both countries, and thus potentially between different countries globally.

Eighteen Ophiostomatoid species were identified from two eucalypt genera (*Eucalyptus* and *Corymbia*) spanning thirteen different eucalypt species. Eight of these fungi were new taxa. In Australia, four new taxa, *C. tyalla*, *C. corymbiicola*, *O. tasmaniense*, *O. undulatum* as well as four previously known species, *C. pirilliformis*, *Ophiostoma quercus*, *O. tsotsi* and *Pesotum australiae* were identified from eucalypts. In South Africa, nine *Ceratocystis* and five *Ophiostoma* spp. were identified from various *Eucalyptus* spp. and nitidulid beetles. The *Ceratocystis* spp. included two new taxa, *C. salinaria*, *C. decipiens* and seven known species, *C. fimbriata* s.l., *C. pirilliformis*, *C. moniliformis*, *C. oblonga*, *C. savannae*, *Thielaviopsis basicola* and *T. thielavioides*. The *Ophiostoma* spp. included two new taxa of the *Ophiostoma stenoceras*-*Sporothrix schenkii* species complex, *O. candidum*, *O. fumeum*,

and three known species, *O. quercus*, *O. tsotsi*, *O. tasmaniense*. Most of the fungi identified were encountered on nitidulid insects, and four of these fungi were found in both Australia and South Africa. Insect species associated with these fungi included *Brachypeplus depressus*, *B. binotatus*, *B. planus*, *Carpophylus bisignatus*, *Ca. dimidiatus*, *Ca. humeralis*, *Xyleborus affinis* and a Staphilinid species. Our results suggest an intercontinental movement of *Ceratocystis* and *Ophiostoma*, probably mediated by insects, in particular nitidulid beetles.



Figure 3. (A) *Brachypeplus* sp., (B) *Carpophylus* sp., (C) *Xyleborus* sp., (D) *Staphilinid* sp.

Related Publications

Kamgan Nkuekam G, Wilhelm de Beer Z, Wingfield MJ, Roux J, 2011. A diverse assemblage of *Ophiostoma* species, including two new taxa on eucalypt trees in South Africa. *Mycological Progress* (DOI 10.1007/s11557-011-0767-9).

Kamgan Nkuekam G, Wilhelm de Beer Z, Wingfield MJ, Mohammed C, Carnegie AJ, Pegg GS, Roux J, 2011. *Ophiostoma* species (Ophiostomatales, Ascomycota), including two new taxa on eucalypts in Australia. *Australian Journal of Botany* 59, 283-297.

Kamgan Nkuekam G, Mohammed C, Wingfield MJ, Carnegie AJ, Pegg GS, Roux J, 2012. *Ceratocystis* species, including two new species associated with nitidulid beetles, on eucalypts in Australia. *Antonie van Leeuwenhoek* 101, 217-241. (DOI 10.1007/s10482-011-9625-7).

Kamgan Nkuekam G, Wingfield MJ, Roux J, 2013. *Ceratocystis* species, including two new taxa, from *Eucalyptus* trees in South Africa. *Australasian Plant Pathology* 42, 283-311. (DOI 10.1007/s13313-012-0192-9).

Roux J, Wingfield MJ, 2009. *Ceratocystis* species: emerging pathogens of non-native plantation *Eucalyptus* and *Acacia* species. *Southern Forests* 72, 115-120.