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A serious canker disease of *Eucalyptus* in South Africa caused by a new species of *Coniothyrium*

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Abstract

Eucalyptus spp. are being propagated extensively as exotics in plantations in South Africa, and many other parts of the world. In South Africa, a number of diseases result in serious losses to this resource. This paper describes a new and very damaging stem canker disease, which has recently appeared on plantation-grown eucalyptus in South Africa. The disease, first noted in an isolated location in Zululand is now common in other parts of the country, and is typified by discrete necrotic lesions on stems. These lesions coalesce to form large, gum-impregnated cankers and malformed stems. The causal agent of the disease, as inferred from pathogenicity tests, is a new species of *Coniothyrium* described here as *C. zuluense.* This fungus is a serious impediment to eucalypt propagation in South Africa, and is most likely a threat to similar forest industries elsewhere in the world.

Key words: *Eucalyptus* stem canker, *Coniothyrium zuluense*, tree disease, South Africa.

Introduction

The forestry industry of South Africa relies almost exclusively on monocultures of *Pinus* and *Eucalyptus* species. Species of these genera are planted in approximately equal proportions and 1.5 million ha of land are currently afforested. *Eucalyptus* plantations comprise numerous species with *E. grandis* Hill ex Maid. the most common species planted. A contemporary approach is to raise *Eucalyptus* trees vegetatively from cuttings, as opposed to seedling propagation. Clones of *E. grandis* and hybrids of this and numerous other species such as *E. camaldulensis* Dehnh., *E. urophylla* S.T. Blake, *E. tereticornis* Sm. and *E. nitens* (Deane et Maid.) Maid., are thus being propagated on a relatively large scale.

Diseases pose one of the greatest threats to the South African forestry industry [1]. Various diseases have already had a profound effect on the industry and have either made the planting of certain species impossible or have limited planting of desirable species to specific areas. Management practices have also had to be adjusted to accommodate the ravages of certain diseases [2]. Clonal propagation of *Eucalyptus* has raised fears that the impact of diseases could increase due to increased genetic uniformity of plantations. Strategies to ensure that large numbers of clones are planted, and that a high degree of genetic diversity is maintained in clonal plantations, have, therefore, been implemented [3].

A number of diseases have been reported to occur on various species and clones of *Eucalyptus* in South Africa for the first time during the course of the past decade. Amongst the most serious of these are Cryphonectria canker caused by *Cryphonectria cubensis* (Bruner) Hodges [4] and Botryosphaeria canker and die-back caused by *Botryosphaeria dothidea* (Moug.: Fr.) Ces. & De Not [5]. Amongst the new diseases that have appeared on eucalypt trees in recent years is a serious stem canker, apparently unknown elsewhere in the world. The aim of this paper is to describe the disease and the fungus responsible for it.

Materials and methods

Pathogen description

A species of *Coniothyrium* Corda was found to sporulate abundantly on the surface of necrotic lesions on the stems of diseased trees. This is only fungus consistently associated with the disease. Single-celled dematiaceous conidia were collected in sterile distilled water and allowed to germinate on the surface of 1% malt extract agar (MEA) (10 g Merck malt extract, 20 g Merck agar and 1000 ml distilled H_2O). Single germinating conidia were then transferred to MEA plates in order to observe growth characteristics in culture. Growth studies using a single-conidial culture of the *Coniothyrium* sp. were conducted on MEA for 21 days in the dark at temperatures ranging from 5 to 35 °C at 5° intervals, with three plates per temperature. The experiment was repeated once.

In order to clearly determine the mode of conidium development, conidiogenous cells were viewed using scanning electron microscopy (SEM). Pycnidia formed on colonized *E. grandis* leaves on water agar were torn open using a sharp scalpel blade. Small pieces of leaf tissue approximately 5 mm^2 bearing these pycnidia were prepared for SEM. Leaf material was fixed in 3% glutaraldehyde in 0.05 M sodium cacodylate buffer and post-fixed in 2% osmium tetroxide in the same buffer. The tissue was then dehydrated in a graded acetone series, critical point-dried and sputter-coated with gold palladium. The material was viewed using a Joel JSM 6400 scanning electron microscope.

Pathogenicity tests

Pathogenicity tests were conducted on 6-month-old *E. grandis* trees of the clone ZG14 in the Kwambonambi area of Zululand. Fifteen trees were inoculated with MEA plugs derived from a single-conidial isolate of the *Coniothyrium* sp. from infected trees in the area. The same number of trees was also inoculated with sterile MEA discs to serve as controls. Inoculations were done in the field during early summer, by removing a 10 mm diam. disc of bark from the trees at breast height and replacing this with a disc of agar bearing the fungus, or an uninoculated disc in the case of the controls. Inoculation sites were covered with masking tape to prevent desiccation of the inoculum. Trees were inspected for disease development 6 weeks after inoculation.

Results

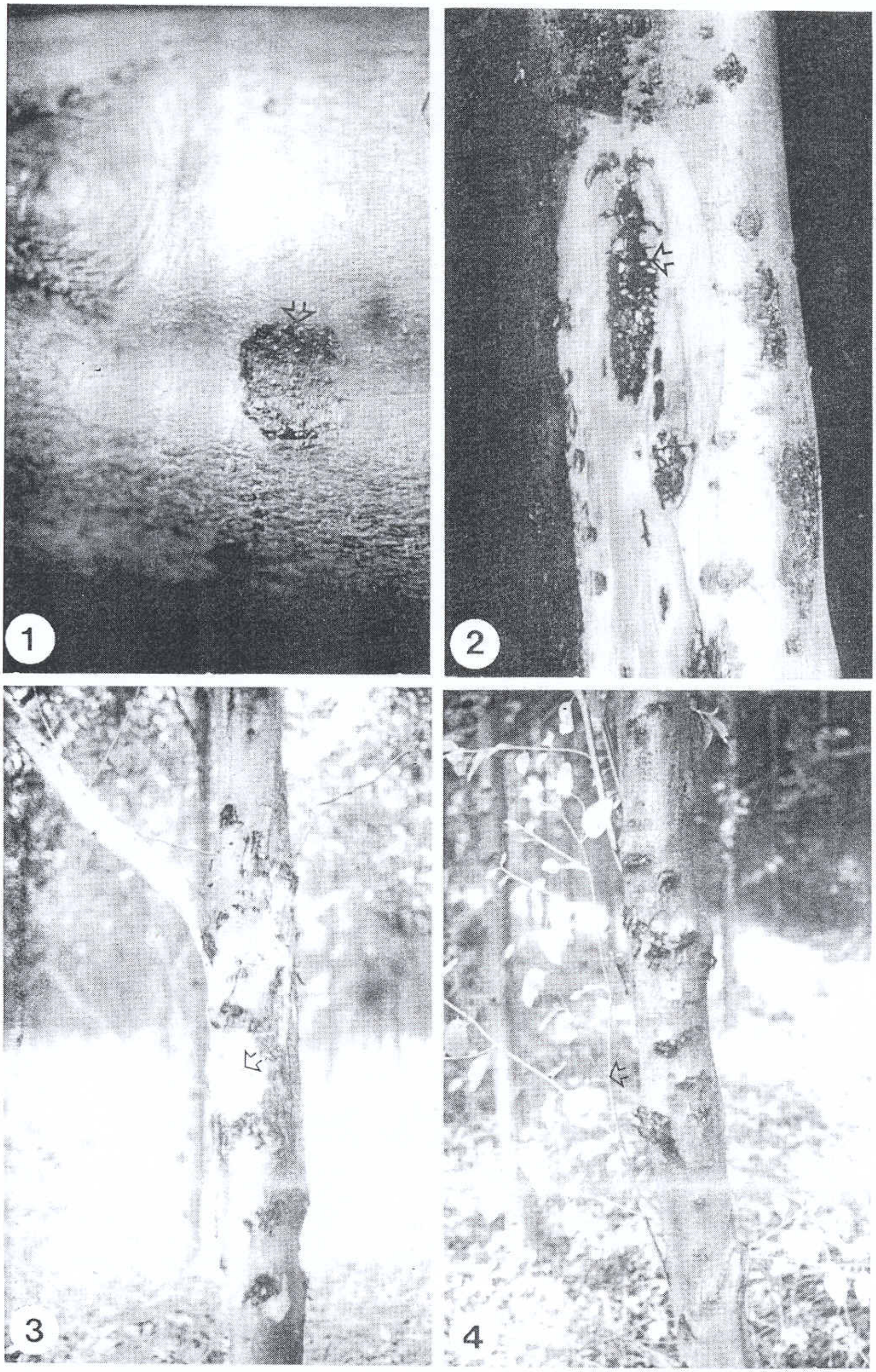
Disease development

The earliest signs of natural infection on *E. grandis* clones are small (2–5 mm diam.), discrete, necrotic lesions on the young green bark (Figure 1). These lesions coalesce to form large necrotic patches on the stems from which copious amounts of red/brown gum exude (Figure 2). Infection sites form in a discrete area of the green stem (Figure 3) suggesting that infections occur in a specific period during the growing season. These infection areas on stems become swollen and spindle-shaped (Figure 3). Epicormic shoots are commonly produced in the areas of the cankers, indicative of a partial girdling of the stems (Figure 4). New infections occur on young green tissue annually which, in severe cases, leads to the development of a series of cankers on stems representing annual infection events. In severely infected clones, the tops of trees die due to the girdling effect of cankers and the production of epicormic shoots or branches, resulting in a resumption of apical dominance. These branches subsequently also become diseased and die at the apices, with the result that height growth virtually ceases.

Pathogen description

The *Coniothyrium* sp. consistently associated with *Eucalyptus* stem cankers is typical of this genus. Pycnidia of the fungus are produced below the epidermis on necrotic tissue and give rise to abundant, single-celled, dark conidia (Figure 5). These conidia are produced percurrently from conidiogenous cells that are distinctly annellated. The fungus is slow growing in culture (Figure 6) reaching only 40.5 mm in 21 days at 30 °C, which is indicative of an apparently biotrophic habit. A comparison of this *Coniothyrium* sp. with other species of the genus from *Eucalyptus*, suggests that the species is new to science.

Several species of *Coniothyrium* are known from *Eucalyptus* leaves and stems [6–8]. Based on conidium size and shape, the South African species can easily be distinguished from species such as *C. eucalypticola* B. Sutton, *C. ahmadii* B. Sutton and *C. kallangurense* B. Sutton & Alcorn. Morphologically, the canker pathogen is similar to two species reported from *Eucalyptus* leaves, namely *C. parvum* Swart and *C. ovatum* Swart. Conidia of the South African strain (4–) 4.5–5(–6) × 2–2.5(–3.5) μm are similar in size to those of *C. parvum* 4.5–6(–7) × 2–3.5 μm, but smaller than



Figures 1–4. Symptoms associated with *Coniothyrium* canker on *Eucalyptus grandis* in South Africa. *Figure 1.* Discrete necrotic lesion on green tissue (arrow), typical of early infections. *Figure 2.* Gum pockets (arrow) found below the bark and in the sapwood of infected trees. *Figure 3.* Spindle-shaped malformation on infected tree, also showing discrete necrotic lesions on infected tissue. *Figure 4.* Epicormic shoots (arrow) produced from cankered stem.