

NOTES

FIRST REPORT OF *PHAEOPHLEOSPORA DESTRUCTANS* IN CHINA

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Eucalypts are highly favoured plantation species as they are fast growing and easy to cultivate. The timber is an important source of fibre to the international pulp and paper industry. Plantation forestry in China is rapidly expanding, and now exceeds more than 1.3 million ha, mostly *Eucalyptus urophylla*, *E. grandis* and their hybrids (Minsheng 2003, Qi 2003). A number of foliar plant pathogens have been reported to impact on yields in plantations of eucalypt species in tropical Asia including *Mycosphaerella* spp., *Phaeophleospora* spp., *Cryptosporiopsis* spp. and *Cylindrocladium* spp. (Old *et al.* 2003b, Barber 2004). In this study we report, for the first time, the presence of *Phaeophleospora destructans* in China. Six *Phaeophleospora* species are known to cause disease on eucalypts; *P. delegatensis*, *P. lilianiae*, *P. epicoccoides*, *P. eucalypti* and *P. destructans* and the newly described *P. toledana* (Crous 1998, Crous *et al.* 2004). Of these, *P. delegatensis*, *P. lilianiae* and *P. toledana* are limited in their distribution, while *P. epicoccoides*, *P. eucalypti* and *P. destructans* are considered major eucalypt pathogens (Wingfield *et al.* 1996, Park *et al.* 2000, Hood *et al.* 2002).

Phaeophleospora epicoccoides, *P. eucalypti* and *P. destructans* all cause leaf blights and discoloration of the lower crowns that leads to premature defoliation, reduced growth and vigour, and in some instances, tree death within plantations. *Phaeophleospora epicoccoides* is found wherever eucalypts grow, whilst the distribution of *P. eucalypti* is restricted to Australia and New Zealand (Park *et al.* 2000). *Phaeophleospora destructans*, the most aggressive species, was first described from 1- to 3-year-old *E. grandis* in Sumatra, Indonesia (Wingfield *et al.* 1996). Since then it has been found in Thailand, central and northern Vietnam and East Timor (Old *et al.* 2003a, Old *et al.* 2003b). Besides *E. grandis*, *P. destructans* has been isolated from other eucalypts including clones of *E. camaldulensis* and *E. urophylla* (native in East Timor). *Phaeophleospora destructans* has not been found in

Australia and its potential impact on native eucalypt forests is unknown.

Between November 2003 and July 2004, production nurseries were inspected for the incidence of nursery foliar pathogens in four eucalypt growing regions of China, namely, Longtan, Guang Xi Province; Kaiping and Leizhou Peninsula, Guangdong Province; Simai, Yunnan Province; and Haikou, Hainan Province (one nursery in each province). Leaf blight was observed in all nurseries in all regions. Leaf blight was also observed in young plantations in Guangdong and Guang Xi Provinces. Many leaves had dropped, but early symptoms could be seen (Figures 1A–D). These included large chlorotic lesions not delineated by veins with masses of black fruiting bodies on the undersurface of the leaves. These symptoms are typical of *P. destructans* although microscopic examination of the spores revealed *P. epicoccoides* fruiting in some of these lesions. This was unexpected as *P. epicoccoides* generally infects older leaves. We have since seen these symptoms (caused by *P. epicoccoides*) on seedlings in South Africa and Colombia (unpublished data). In some young plantations on the Leizhou Peninsula, vein-limited purplish lesions were observed on older leaves; these are typical of *P. epicoccoides* (Figure 1). In some cases, symptoms indicative of both pathogens were observed on the same tree.

Phaeophleospora spp. were isolated in the following manner. Under the dissecting microscope, spores oozing from single pycnidia were collected on the tip of a sterile needle. The spores were placed on malt extract (20 g l⁻¹) agar (MEA) in a single spot and allowed to hydrate for 5 min. Under the dissecting microscope, spores were then streaked using a sterile needle and single spores picked off the agar and transferred to new MEA plates. Spores usually germinated within 24 hours. Cultures were maintained at 25 °C.

Cultures of *P. destructans* and *P. epicoccoides* differ

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in colour and texture. Those of *P. epicoccoides* are dense, slow growing and dark while those of *P. destructans* are pinkish, slow growing and slightly fluffy (Figures 1E & F). In comparison with other species, *P. epicoccoides* has short, wide, multiseptate spores, they are olive green in colour whilst spores of *P. destructans* are longer and thinner (Figures 1G & H, Table 1). Spore dimensions of Chinese isolates are within the range of the described species (Walker *et al.* 1992, Wingfield *et al.* 1996).

Symptoms, culture characteristics and spore morphology confirmed the presence of *P. destructans* and *P. epicoccoides* in all regions of China visited. *Phaeophleospora epicoccoides* is found predominantly on ageing leaves and, while it may contribute to early leaf drop, it is generally not considered a major pathogen. *Phaeophleospora destructans* is a major pathogen of juvenile foliage in the nursery, on mother plants and in the field. Infected seedlings, mother plants and cuttings in the nursery can be totally defoliated under humid conditions. If infected material survives to be outplanted, this will result in poor establishment and growth.

Phaeophleospora destructans has only been reported from eucalypts, and as eucalypts are not native to the region (except in East Timor), one possibility is that it is native to Australia and has been introduced elsewhere on germplasm. However, *P. destructans* has not been reported in Australia and currently appears to be restricted to South-East Asia and China. As the symptoms are obvious and the impact so extensive, it can be assumed that it would have been observed earlier than 1996 (Wingfield *et al.* 1996) if its distribution was extensive. Most likely, it emerged as a major disease for the first time in 1996 in the wet tropics in Northern Sumatra and has been distributed throughout Asia on infected germplasm (seed or cuttings). The present distribution in China suggests that the pathogen has been introduced in recent times and has been dispersed with nursery mother stock. East Timor is a potential origin for the pathogen and its occurrence on native *E. urophylla* and other eucalypts in the region needs to be explored and molecular tools used to identify population structures.

Control of *P. destructans* is difficult. Extensive use

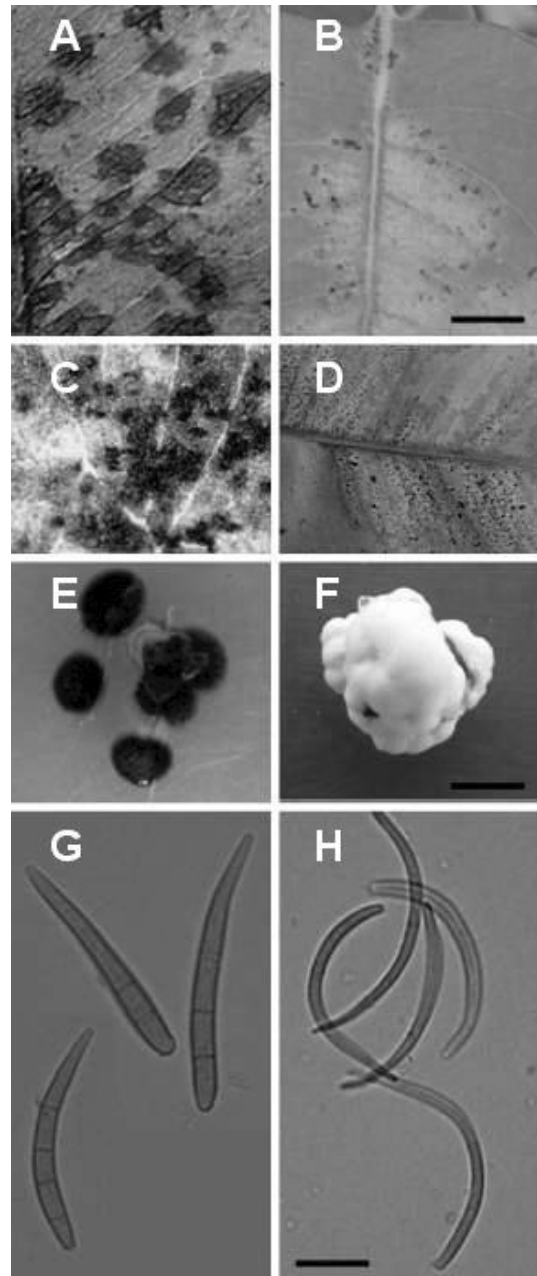


Figure 1 Comparison of the two *Phaeophleospora* spp. found in China. Symptoms of *P. epicoccoides* (A) adaxial, (C) abaxial and *P. destructans* (B) adaxial, (D) abaxial on leaves of *E. urophylla* hybrids from Guangdong Province, China. Sporulation on abaxial surface. Bar = 10 mm. Cultures on MEA of (E) *P. epicoccoides* isolate CMW14696, and (F) *P. destructans* isolate CMW17919. Bar = 5 mm. Spores of (G) *P. epicoccoides* isolate CMW14696, and (H) *P. destructans* isolate CMW17919. Bar = 10 μ m.

Table 1 Comparison of spore dimensions between the *Phaeophleospora* spp. found in China. Representative isolates collected in Kaiping, Guangdong Province.

Isolate*	Species	Conidia (μ m)	Length/Width	Septa
CMW14696	<i>P. epicoccoides</i>	19-(29-35)-43 \times 2.5-4.3 [Ave. 31.9 \times 3.2]	9.9	1-4
CMW17919	<i>P. destructans</i>	34-(36-44)-50 \times 1.4-2.8 [Ave. 40.1 \times 2.4]	17.0	1-2

* CMW = Culture collection of the Forestry and Agriculture Biotechnology Institute, University of Pretoria, South Africa

of fungicides in the nursery can mask symptoms but will not eradicate the pathogen and the disease will express itself in plantations (Brown 2000). Nursery hygiene and the use of elevated benches with good air flow will also reduce impact in the nursery. There are some eucalypt plantations in southern China which are free of the disease, but this is not likely to remain for long, given the movement of planting stock and mother plants over long distances in the region. In the long term, the only practical control is to develop resistance within the eucalypt hosts. *Eucalyptus grandis* is particularly susceptible and we recommend the destruction of susceptible clones in favour of hybrids or clones of *E. grandis* showing some tolerance.

This is the first report of *P. destructans* in China. Its identification in most of the established eucalypt growing regions in south China suggests it has either been present for some time or has been recently distributed around the country on infected germplasm. As new commercial nurseries are being established and mother stock is being sourced from older nurseries, it is very important that hygiene measures are implemented to prevent further contamination of planting stock.

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