Phaeoseptoria Leaf Spot of *Eucalyptus* in South Africa

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SYNOPSIS

Phaeoseptoria eucalypti is one of the more important leaf pathogens of *Eucalyptus* spp. in South Africa. It is capable of causing complete defoliation of an entire plantation and the death of seedlings. This paper reviews the available literature on the pathogen with a view to establishing a base for future research in South Africa.

INTRODUCTION

Phaeoseptoria eucalypti Hans. is a leaf pathogen of *Eucalyptus* spp. capable of causing severe defoliation of the lower branches of trees (Chipompha, 1987; Crous *et al.*, 1989a). The fungus was first reported in South Africa by Wingfield (1987) and is regarded as one of the more important leaf pathogens of eucalypts in South Africa.

From preliminary observations it appears that *E. grandis* is one of the most susceptible species to *P. eucalypti*. *E. grandis* comprises 80 % of *Eucalyptus* spp. plantings in South Africa. For this reason it is important to study this disease with a view to finding a possible means of control as well as identifying those eucalypt species resistant to the disease.

TAXONOMY

Phaeoseptoria eucalypti was first described by Hansford in 1957. Walker (1962) amended this description after finding differences between the type material and the published description of *Phaeoseptoria eucalypti*. Walker (1962) highlighted the differences that occur in disease symptoms due to host differences and also provided a broader range of measurements for the conidia than did Hansford (1957). The most important of these differences is the number of transverse septa that occur per conidium. Hansford (1957) reported a narrow range of 1–3 septa whereas Walker (1962) suggested that 3–5 are normal but as many as 7 and as few as 1 can occur (*Figure 1*). According to Chipompha (1987) and Crous *et al.* (1989a and b) conidia are predominantly 5-celled.

P. eucalypti is an obligate, stomatal penetrant (Heather, 1967b) which forms substomatal pycnidia predominantly on the lower leaf lamina. Conidial development is annellidic and the walls of the conidia are slightly roughened owing to small protrusions which cover the whole of the conidium except for the smooth base (Walker, 1962).

The taxonomy of the genus *Phaeoseptoria* is currently under review (Crous *et al*, 1989). Members of the genus *Phaeoseptoria* are predominantly found on grasses (Barnett and Hunter, 1972). Conidia of *Phaeoseptoria xanthorrhoeae* occurring on the *Xanthorrhoea* spp. grass are smooth walled (Sivanesan and Sutton, 1985), as opposed to the brown rough-walled conidia found in *P. eucalypti* (Sutton, pers. comm.).

DISTRIBUTION AND HOST RANGE

P. eucalypti has been reported to occur in Australia (Heather, 1967a and b; Hansford, 1957; Walker, 1962), Brazil (Ferreira, 1989), Hawaii (Gardner and Hodges, 1988), India (Padaganur and Hiremath, 1973; Sharma, Mohanan and Maria Florence, 1985), Malawi (Chipompha, 1987) and South Africa (Crous *et al.*, 1988 and 1989a,b,c; Wingfield 1987). The fungus is known to infect a wide variety of *Eucalyptus* spp. occurring primarily in the subgenus *Symphyomyrtus* (Crous *et al.*, 1989b). These include *E. camaldulensis*, *E. pellita*, *E. punctata* and *E. tereticornis* (Chipompha, 1987), *E. bicostata* (Heather, 1967a and b), *E. grandis*, *E. cladocalyx*, *E. urophylla*, *E. globulus*, *E. maidenii*, *E. nitens*, *E. saligna*, *E. macarthurii* and *E. grandis* crosses (Crous *et al.*, 1988). In South Africa it appears to occur predominantly on *E. grandis*, the most widely planted species.

P. eucalypti occurs on mature trees, seedlings and clonal hedges (Crous *et al.*, 1988). The occurrence of the pathogen appears to be important on seedlings and clonal hedges as infection can lead to death of the plant. Infection of mature trees is more likely to retard growth than kill the tree.

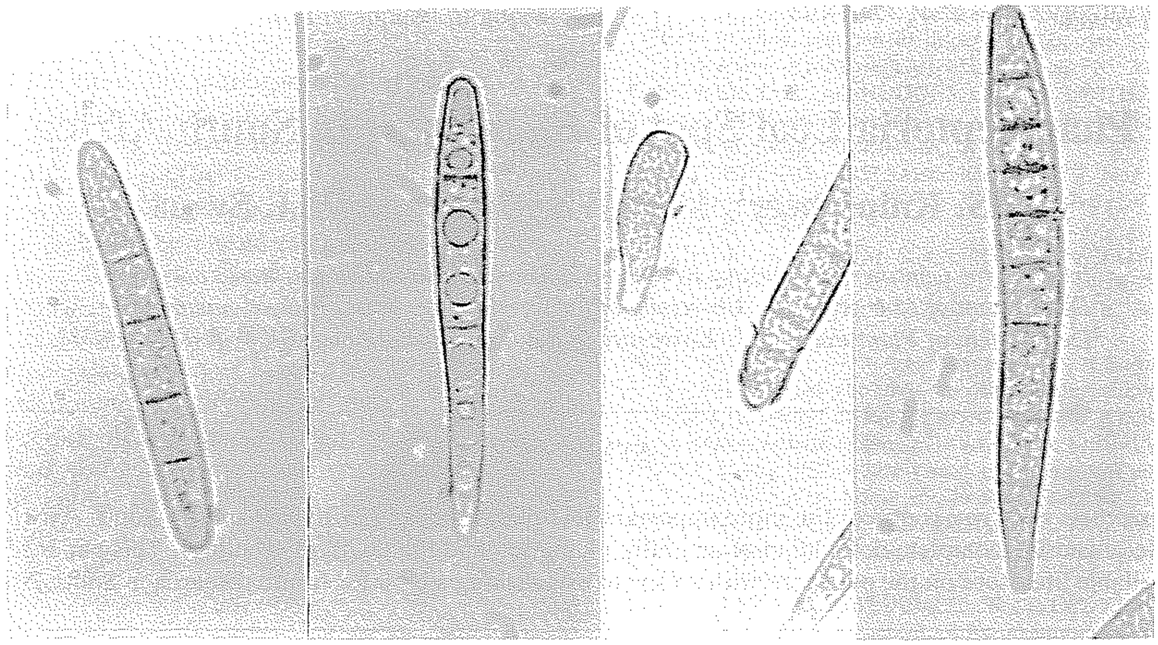

Figure 1. Conidia of P. eucalypti *demonstrating variation in morphology.*

INFECTION

Conidia emerge from pycnidia in long black cirri and are then dispersed either by rain (Heather, 1967a) or by wind and rain (Chipompha, 1987). Successful infection is dependent on whether climatic conditions allow the fungus to produce spores which can germinate and penetrate leaves. Chipompha (1987) reported that *P. eucalypti* favours warm misty weather, but Sharma *et al.* (1985) found that in dry weather the leaf spots became necrotic and produced pycnidia.

The surface of eucalypt leaves has been found to play an important role in infection. Certain water soluble materials and a wax layer on the leaf surface play a role in inhibiting the germination of *P. eucalypti* conidia (Heather, 1967a). Both the juvenile leaves and the leaves on the upper portion of the tree have been found to have a more substantial wax layer than older leaves lower down on the tree. This apparently forms an effective barrier to penetration. Removal of the waxy coating of juvenile *E. bicosta* leaves rendered them more susceptible to infection by *P. eucalypti* (Heather, 1967a).

The amount of wax present varies according to the host species and the physiological age of the leaves (Heather, 1967a). Crous *et al.* (1989b) found that the wax layer of a non-host such as *E. cladocalyx* was thicker and more granular than that of a host such as *E. grandis*. Weathering of the wax layer and an increased angle at which the leaf is held can increase the susceptibility of the leaves. Spores will be deposited more efficiently on leaves at an angle of 90 °. In contrast spores tended to bounce from the surface of leaves held at angles other than 90 ° (Heather, 1967b).

According to Heather (1967a) the reduced intensity of *P. eucalypti* infection on upper leaves may only partly be explained by the increased glaucousness of the leaf surface of *E. bicosta*. *E. grandis* is a non-glaucous species but the lower leaves were still found to be 200 % more susceptible than the upper leaves.

Crous *et al.*, (1989b) reported that six months after inoculation with *P. eucalypti* conidia, *E. camaldulensis*, *E. cladocalyx* and *E. grandis* had shed infected leaves whereas *E. nitens* merely showed a retardation of growth.

POTENTIAL IMPORTANCE IN SOUTH AFRICA

Leaf diseases of trees can result in considerable losses in growth and even in tree death. For example, *Dothistroma pini* Hulbary, which causes red-band disease of pines, has resulted in severe defoliation and mortality in *Pinus radiata* stands in Kenya (Ivory, 1967). *Melampsora medusae* Thum. weakened younger trees of *Populus deltoides* Marsh. owing to continual leaf drop, eventually causing die-back and even death of some nursery trees (Walker, Hartigan and Bertus, 1974). The susceptibility of *E. globulus* to the leaf spot pathogen *Mycosphaerella nubilosa* has resulted in the planting of *E. globulus* being abandoned in many areas in South Africa since the 1930s (Lundquist and Purnell, 1987). The infection of the juvenile leaves is so severe as to lead to this species being considered unsuitable for afforestation. In the case of *E. nitens*, only the New South Wales provenances should be planted in *M. nubilosa* prone areas. These are more resistant than the Victoria provenances (Lundquist and Purnell, 1987). As yet the exact effect of *P. eucalypti* on the yield and growth of the tree, along with the differences in susceptibility of the different species and provenances, is unknown (*Figure 2*).

In South Africa, the threat of leaf diseases is enhanced by the planting of single species or clones over wide areas (Wingfield, 1984). This leads to a lack of genetic diversity which could result in extensive infection of a plantation. Preliminary surveys clearly indicate that there are distinct differences in susceptibility of *P. eucalypti* between clones of *E. grandis*. It is obvious that if this disease is not taken into consideration when selecting for clones, severe losses could occur in subsequent plantings.

There are indications that variation in conidial morphology and pathogenicity occurs within *P. eucalypti* (*Figure 1*). The conidial morphology of *P. eucalypti* isolated from a completely defoliated *E. grandis* stand in the Natal midlands appeared to be somewhat different from the typical conidial morphology (present authors, unpublished data). It is possible that more pathogenic forms exist or that the particular weather conditions at that time contributed to this disease outbreak. At this stage insufficient information is available to evaluate the situation but conditions favouring disease development clearly deserve consideration.

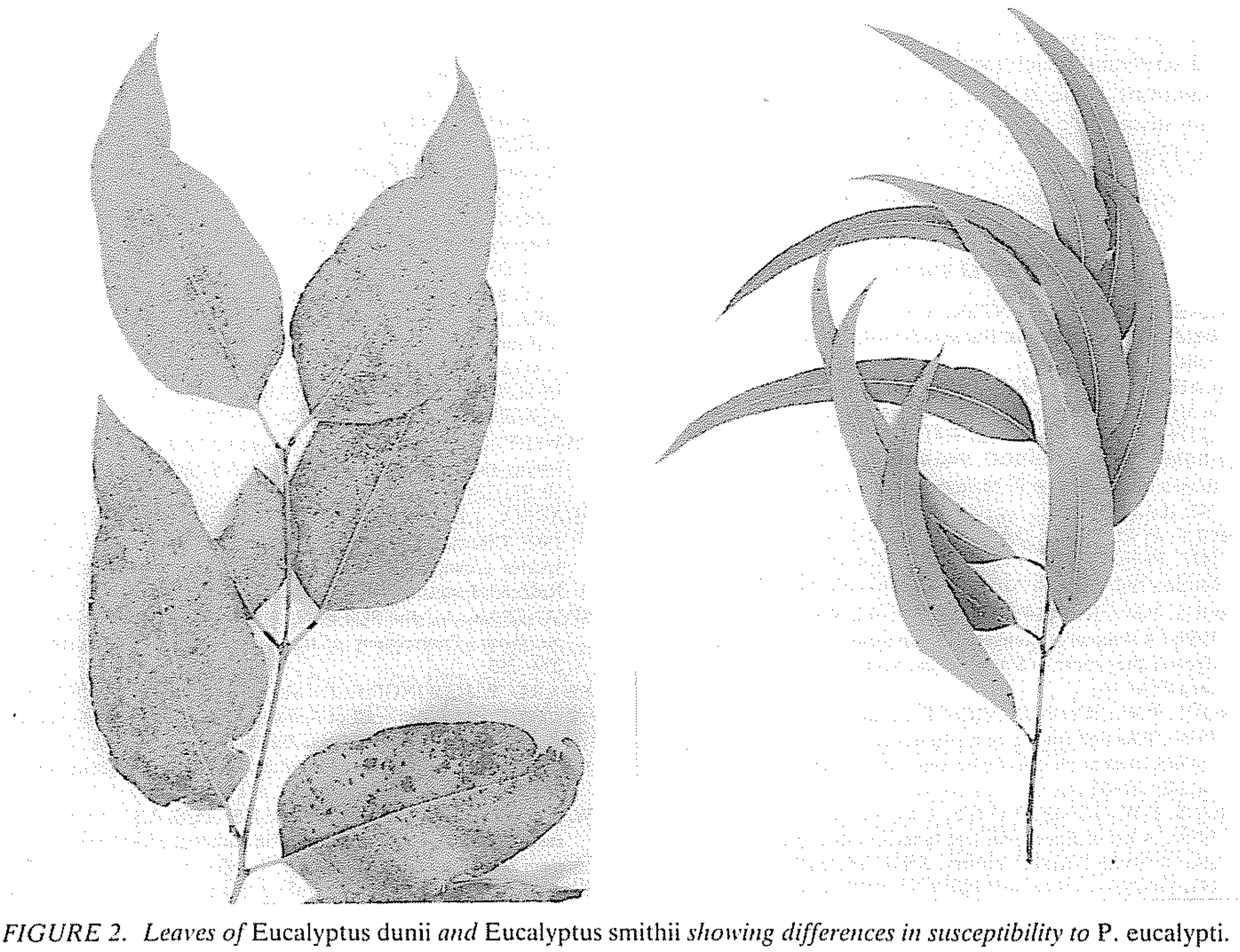

FIGURE 2. Leaves of Eucalyptus dunii *and* Eucalyptus smithii *showing differences in susceptibility to* P. eucalypti.

FUTURE PROSPECTS AND CONCLUSIONS

Although *P. eucalypti* was only relatively recently discovered (Wingfield, 1987), it is not known how long it has actually been present in South Africa. It is therefore difficult to estimate the potential threat of the disease as its progress has not been monitored. It is clear that very little is known about the biology and importance of the pathogen and that it is deserving of further study.

A research strategy is therefore needed to assess the importance of *P. eucalypti* and to develop appropriate control measures. Sharma, Mohanan and Maria Florence (1985) tested a number of chemicals against *P. eucalypti* and found Benlate, Bavistin and Tecto to be the most effective. Chemical control is only appropriate under nursery conditions as it is usually not feasible to spray a plantation because the desired penetration of the fungicide would not be obtained for the fungicide to be effective. This is especially true since the disease occurs predominantly on the lower leaves.

It is necessary to know when and under what conditions the conidia of *P. eucalypti* are formed and dispersed. This will then provide information on when plantations and nurseries are the most susceptible to P. *eucalypti*. Spore trapping (Cheah and Hartill, 1987; Fitt, Creighton and Bainbridge, 1985; Lawrence and Meredith, 1970; Pawsey, 1967; Swart, Wingfield and Knox-Davies, 1987) provides an effective method of relating weekly spore counts to weather data and periodicity. Data collected from spore trapping will also ensure that chemical control is applied at appropriate times.

Variation within the pathogen must be identified to establish whether virulent strains of the pathogen exist. Factors influencing the occurrence of virulent strains should also be determined.

A rating scale must be developed by which species and clones of eucalypts can be evaluated for resistance. Such a scale should be versatile and effective when comparing different species and ages of trees. Lundquist and Purnell (1987) developed a rating scale for rating *Mycosphaerella* leaf spot. Ostry, McRoberts, Ward and Resendez (1988) developed a method of rapid screening which uses *in vitro* methods for rating. Evaluations using a rating scale should ensure that highly susceptible trees are not planted on a wide scale in the future.

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