EMERGING DISEASE PROBLEMS IN EUCALYPT PLANTATIONS IN LAO PDR

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Abstract

Surveys of nurseries and plantations of *Eucalyptus* species were conducted within Lao PDR in 2009. A range of pathogens were isolated including species within *Phytophthora, Pythium, Fusarium, Colletotrichum, Neofusicoccum, Lasiodiplodia, Pilidiella, Calonectria, Cryptosporiopsis, Corticium* and *Teratosphaeria.* Some diseases caused significant defoliation and loss of stock within nurseries and plantations. The presence of these diseases in combination with a changing climate poses many challenges for the future sustainable and profitable management of plantations in Lao PDR.

Introduction

Lao PDR is a small landlocked country surrounded by neighbouring countries Thailand, Vietnam, China, Myanmar and Cambodia. The eucalypt plantation industry in Lao PDR is in its infancy when compared to these neighbouring countries, only becoming established over the past decade. With the recent introduction of planting stock from nearby countries comes the risk of entry of pests and diseases with the potential to cause significant losses if not managed correctly. Few surveys have been carried out across plantations throughout Lao PDR to determine the presence and extent of diseases of eucalypt plantations. In 2009 we carried out a survey of 16 nurseries and plantations within Lao PDR.

Materials and Methods

A total of sixteen nurseries and plantations were surveyed across central Laos PDR along a north-west to south-east gradient during the wet season (June) 2009. At each site a survey of signs and symptoms of disease was undertaken, samples collected, and transported back to the laboratory for further analysis. Samples included foliage, soil, stems, roots and water. All samples were collected, transported, examined and fungi and oomycetes isolated using a variety of methods previously described (Barber *et al*., 2011, Scott *et al*., 2009, Taylor *et al*., 2011, Taylor *et al*., 2009). DNA was extracted, sequenced and phyologenetic analysis undertaken using the methods described previously (Andjic *et al*., 2011, Scott *et al*., 2009, Adair *et al*., 2009).

Results

Nurseries

The three nurseries surveyed had small to significant losses through plant death and reduced vigour of cuttings and seedlings. Three *Phytophthora* species and one *Pythium* species were isolated from irrigation water, soil and diseased roots. The presence of these pathogens combined with sub-optimal hygiene procedures in some nurseries compromised the quality of planting stock and probably increased seedling mortality (Fig. 1). The *Phytophthora* species were undescribed based on morphological characters and DNA, with alignment based on DNA sequence nearest to *Phytophthora alticola, P. parsiana* and *P. citrophthora.* The *Pythium* species isolated from five separate collections in the same nursery all aligned closely based on DNA sequence with *Pythium* aff. *vexans/chamaehyphon.*

A range of stem and foliar diseases caused by species within the genera *Fusarium, Colletotrichum, Pilidiella, Calonectria,* and *Teratosphaeria* were identified on eucalypts, some causing significant defoliation of seedlings and mother plants. *Calonectria* and *Fusarium* species were isolated most frequently, being found in all three nurseries from necrotic lesions occurring on cuttings, causing death and significant losses when the severity of disease was high (Fig. 2). Disease was observed in the clonal cutting gardens and was the likely source of entry into the seedling trays. Poor hygiene and soil media resulted in sub-optimal conditions for strong plant growth, but ideal conditions for disease development.

Figure 1. Significant losses of nursery stock caused by the presence of root pathogens *Phytophthora* and *Pythium* in combination with poor hygiene.

Figure 2. *Fusarium* and *Cylindrocladium* species were isolated from necrotic lesions on cuttings as indicated by the circles and arrows.

Plantations

A range of diseases was observed on stems of eucalypts during surveys of plantations including measle canker disease caused by *Teratosphaeria zuluensis* (Fig. 3). Severe basal cankers were observed on one clone of eucalypt only (Fig. 3). The following species were isolated and identified during surveys of eucalypts exhibiting symptoms of stem canker diseases: *Hypocreales* sp., *Lasiodiplodia parva*, *L. pseudotheobromae, Neofusicoccum* aff. *ribis, Pseudofusicoccum kimberleyense* and *Valsa fabianae.* A number species not previously described based on existing DNA sequence databases were recorded, including *Hypocreales* sp. and *Neofusicoccum* aff. *ribis.*

Figure 3. Bark canker symptoms observed on eucalypt clones included measle canker (left) and large basal lesions (right).

The bacterial pathogen *Ralstonia solanacearum* that causes bacterial wilt disease in eucalypts and other tree species, was observed on young (1-2 year old) trees in plantations, but was mostly confined to low-lying sites prone to water-logging. Symptoms observed included streaking within the vascular tissues, bacterial ooze from the wood, necrotic vein-limited lesions on leaves, wilting of foliage, and patches of tree death within plantations (Fig. 4).

A number of foliar pathogens were identified from plantations within Lao PDR. One of the most serious was *Calonectria quinqueseptata*, causing large necrotic blights of foliage (Fig. 5). The two serious eucalypt plantation pathogens, *T. destructans* and *T. epicoccoides* were both observed and were widespread throughout the plantations surveyed, causing severe defoliation in some clonal lines during the wet season. *Cryptosporiopsis, Pilidiella, Calonectria,* and other *Teratosphaeria* species with *Pseudocercospora* anamorphs were observed within plantations at low incidence. *Cryptosporiopsis* was associated with the characteristic dark purple lesions (Fig. 5) and the *Teratosphaeria* spp. were associated with a range of disease symptoms, dependent upon the species of pathogens causing the disease.

Figure 4. Disease symptoms associated with infection of eucalypts by the bacterial wilt pathogen *Ralstonia solanacearum*.

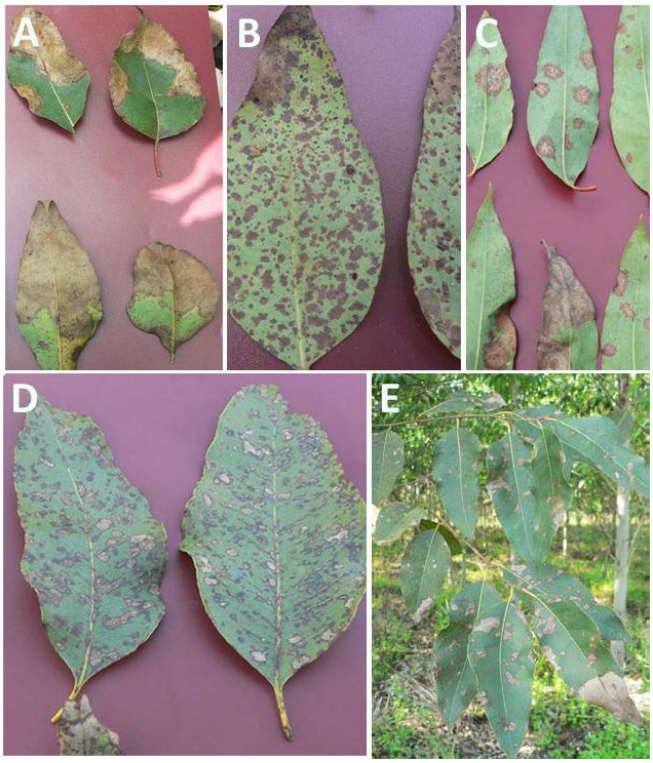

Figure 5. Foliar disease symptoms associated with infection of eucalypts by the foliar pathogens belonging to the genera *Calonectria* (A), *Cryptosporiopsis* (B), and *Teratosphaeria* (C-E).

Discussion

This survey has identified a range of diseases throughout nurseries and plantations within Lao PDR. Based on experience from surrounding countries (Dell *et al*., 2008, Dell *et al*., 2012), and the symptoms and disease incidence levels observed, we suspect a number of these diseases are likely to cause economic loss. We can ascertain that many of the diseases present within the plantations are also present within nurseries and mother plants, suggesting these diseases are being introduced into plantations with diseased planting stock. Findings from this study also suggest that disease in the nurseries could be greatly reduced by the improvement of soil media, sterilization of irrigation water, and improved hygiene practices such as sterilization of equipment and removal of seedlings from the ground.

Given that industrial eucalypt plantations are recent in Lao PDR, it is likely that the extent of damage, the incidence of particular fungal taxa and their population composition and size will change with time. Hence, it is important that permanent monitoring plots are established for the purpose of monitoring the changes in disease incidence and severity over time. A database of photographs of disease symptoms and herbarium specimens has been initiated during the present study. It is imperative that this is expanded upon to facilitate the ongoing monitoring of these diseases, and assist with the identification of new pathogens. A number of new species were identified during the present study and further research is required to describe them and determine their pathogenicity to clonal lines.

Temperatures are likely to increase across Asia as is the frequency of extreme weather events, leading to an increase in the spread and impact of pests and diseases in the region (Dell *et al*., 2012). It is therefore imperative that abiotic and biotic threats are managed under a prolonged period of climate change, with a focus on matching the species to the site and breeding for optimal growth but also for disease resistance as has been adopted in countries like South Africa and Brazil, and suggested previously for south-east Asian countries like Indonesia (Barber, 2004).

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