Diseases of *Eucalyptus* in Thailand and Options for Reducing their Impact

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Abstract

The most commonly grown *Eucalyptus* species in Thailand is *E. camaldulensis*, with a present plantation area of no less than 400 000 ha. Fungal diseases are a major problem in eucalypts and at least 25 species of fungi have been found to cause damage to foliage, shoots, twigs, branches and stems. The most important diseases in the plantations are leaf and shoot blight caused by *Cryptosporiopsis eucalypti* and branch and stem cankers associated with fungi of the coelomycete and ascomycete groups. Disease management using chemicals was found helpful in controlling the damage to nursery stock. In plantations, the most effective control method is genetic selection for resistance. Promising results were obtained in experimental trials with *E. camaldulensis* for selection of leaf and shoot blight resistant clones.

Introduction

Eucalypts have been extensively planted in Thailand. The total area under eucalypts is now estimated to be 400 000 ha. The most common species planted is *Eucalyptus camaldulensis* while others such as *E. urophylla* and *E. deglupta* are also grown. In addition to industrial scale plantations, commune and farm-scale plantings which make a significant contribution to household incomes are also common. The annual planting rate of *E. camaldulensis* has increased markedly over the past ten years in response to high demand for wood, especially chips and poles, for both domestic consumption and export, and for use in furniture and small construction. This trend will continue in future, but the appearance of severe foliage, shoot and stem diseases is now posing a threat. With continued expansion of planting under monoculture systems, pest and disease management will become extremely important. Such infestation often substantially reduces the quality of wood and the market prices. Though the diseases encountered are not considered serious yet, they have the potential to become a limiting factor in future. It is difficult to assess the economic impact of diseases of eucalypts in Thailand because relevant observations have been made only for the past four to five years. The work described here details some of these observations. The main diseases of eucalypts in nurseries and plantations in Thailand are documented and possible options for their management to minimise the impact are outlined.

Materials and Methods

Survey of pathogens

A survey was made in eucalypt plantations and nurseries across much of Thailand where eucalypts are grown. Provinces east and west of Bangkok, northeastern, lower northern, and some of the southern provinces were covered. Observations were made on the presence of diseases, primarily dieback, leaf spot, blight and stem canker. Reference specimens were collected and microscopically examined in the laboratory. Fungi were

cultured, identified and detailed photographic records compiled. The field observations were made from 1995 to 1998, during the periods most favourable for leaf blight disease. Age of the plantation ranged from first year plantings to stands up to seven years old and also coppice stands up to the second rotation. Observations focused primarily on *E. camaldulensis* but *E. urophylla* and *E. deglupta* were also covered. Across the regions surveyed, the average rainfall ranged from 900 to1 700 mm. To enable the application of site hazard prediction analyses of major foliar blight diseases using climatic interpolation models of the type developed for *Cylindrocladium quinqueseptatum* by Old *et al*. (1998), details of latitude and longitude, elevation above sea level, major pathogens and the severity of disease incidence were collected for the surveyed sites.

Selection of disease resistant clones

Regular visits, strategically timed in relation to the season, were made to eucalypt research plantations and clonal trials and incidence of foliar disease was monitored using a simple scoring index. Selection for disease resistance was made in clones of *E. camaldulensis* plus trees in experimental trials at Ladkrating, Chachoengsao Province. A Clone Bank was established at Ladkrating plantation by planting individual clones, four ramets of each. The planting was done over a three-year period from 1992 to1994: 133 clones were planted in 1992, 140 clones in 1993 and 14 clones in 1994 and there was no replication of clones between years. Shoot blight caused by *Cryptosporiopsis eucalypti* was first detected in October 1995 and disease scoring was done immediately and once a year over the next two years. The severity of disease was graded into four classes and scores were assigned as follows: Score 1, Healthy; Score 2, Slightly defoliated; Score 3, Defoliated but no dieback of shoots; Score 4, Defoliated with shoot dieback.

The total rainfall was 1437mm, 1182mm and 1158mm in 1995,1996 and 1997, respectively.

Results

The main diseases found in nurseries and plantations of eucalypts and their pathogens are listed in Table 1. The more important diseases are discussed below.

Cryptosporiopsis eucalypti

A newly described fungus, *Cryptosporiopsis eucalypti* (Sankaran et al., 1995) causes a severe leaf and shoot disease which occurs commonly in *E. camaldulensis* and *E. urophylla* plantations in Thailand. The leaf lesions vary in shape, colour and size, but can be identified by the light cream-coloured, cupulate fungal fruiting bodies scattered on lesions on the both sides of leaves and by the characteristic conidia. In moist warm environments, a cream-coloured conidial mass at the top of fruiting bodies can often be easily seen with the aid of a hand lens.

E. camaldulensis suffered damage variously described as rapid browning and loss of foliage during the rainy season, followed by partial crown recovery through epicormic growth which was again attacked by the disease. Susceptible species and provenances subjected to chronic defoliation suffered shoot blight and progressive canker development on main crown components culminating in girdling of main shoot and even tree death. Badly affected trees are malformed, suffer severe reduction in growth rate and loss of merchantable volume (Old and Yuan, 1994; Sharma 1994).

Table 1. Diseases of *Eucalyptus* in Thailand

Disease of	Symptom	Associated fungus	Host species
Seedling	damping off	*Cylindrocladium scoparium*	*E. c.*[1]
		Sclerotium rolfsii	*E. c.*
		Rhizoctonia solani	*E. deglupta*
	collar rot	*Cylindrocladium* sp.	*E. c.*
	leaf spot	*Kirramyces* sp.	*E. c.*
		Cercospora sp.	*E. c.*
		unknown (Coelomycetes)	*E. c.*
	leaf blight	*Coniella* sp.	*E. c.*
		unknown (Coelomycetes)	*E. c.*
	top blight	*Phomopsis* sp.	*E. c.*
		Lasiodiplodia theobromae	*E. c.*
		Colletotrichum gloeosporioides	*E. c.*
Cutting	rot	*Phomopsis* sp.	*E. c.*
		Lasiodiplodia theobromae	*E. c.*
		Glomerella sp. (teleomorph) & *Colletotrichum gloeosporioides*	*E. c.*
	top dieback in scion garden	*Dothiorella* sp.& *Botryosphaeria* sp. (teleomorph)	*E. c.*
Plantation	leaf spot&blight shoot blight	*Cryptosporiopsis eucalypti*	*E. c.* & *E. urophylla*
	leaf spot	*Pseudocercospora* sp.	*E. c.* & *E. urophylla*
		Cercospora sp.& *Mycosphaerella* sp. (teleomorph)	*E. c.*
		Mycotribulus sp.	*E. c.*
	leaf blight	unidentified (coelomycetes)	*E. c.*
		Cylindrocladium quinqueseptatum	*E. c.*
		Coniella sp.	*E. c.*
		Coniella fragariae	*E. urophylla*
	shoot dieback	*Cytospora* sp.	*E. c.*
		Phomopsis sp.	*E. c.*
		Dothiorella sp.	*E. deglupta*
	canker	*Coniothyrium zuluense*	*E. c.*
		Cytospora sp.	*E. c.*
		Lasiodiplodia theobromae	*E. c.*
		Dothiorella sp.& *Botryosphaeria* sp.	*E. c.* & *E. urophylla*
		unidentified (coelomycetes)	*E. c.*
		Cryphonectria cubensis	*E. deglupta*
		Valsa sp.?	*E. urophylla*
	heart rot	Basidiomycetes	*E. deglupta*

[1] *E. c.* denotes *E. camaldulensis*
Cylindrocladium quinqueseptatum

The fungus, *Cylindrocladium quinqueseptatum* was very frequently noted on eucalypts in both nurseries and plantations in Thailand, but has not yet caused significant disease in the areas surveyed. Leaf and shoot blight caused by this fungus is the main cause of defoliation in southeastern and central parts of Vietnam (Sharma, 1994). It also causes serious damage to eucalypts in humid parts of India. Sharma (1994) identified an urgent need for selection and screening programs for eucalypts resistant to this pathogen. The preferred eucalypts in Thailand are highly susceptible, with the "Petford" provenance apparently suffering severe impacts.

Botryosphaeria canker

Canker disease caused by *Botryosphaeria dothidea* has a wide host range amongst woody plants in Thailand, including *E. camaldulensis*, *Casuarina equisetifolia* and *Acacia auriculiformis*. The fungus is an opportunistic pathogen that manifests itself under conditions of environmental stress. In *E. camaldulensis* plantation in Phattana Nikhom, Lopburi province, *B. dothidea* infection causes development of stem canker and top dieback.

Cryphonectria cubensis

Cryphonectria cubensis, which is a well-known serious canker pathogen of *Eucalyptus* spp. in many countries (FAO/IPGRI, 1996), has been observed recently in Thailand. It was first recorded in 1995 on basal canker of *E. deglupta* in Si Sa Ket province.

Selection of disease resistant clones

Shoot blight caused by *Cryptosporiopsis eucalypti* was first detected in October 1995 in the Clone Bank established at Ladkrating plantation and disease scoring was done immediately. There was a clear difference in susceptibility between the clones. The results are presented in Table 2. Some of the highly susceptible clones were cut and removed in 1995 (see Table 2 for details) in order to minimize the potential for disease outbreaks in the surrounding operational plantations.

Table 2. Susceptibility of *E. camaldulensis* clones to leaf and shoot blight caused by *C. eucalypti*

Planting year	No. of clones in		Percentage of clones falling under each score category											
			Year 1995				Year 1996				Year 1997			
	1995	[b]1996 &97	[a]1	2	3	4	1	2	3	4	1	2	3	4
1992	133	108	28.6	35.7	28.6	7.1	41.7	50.0	8.3	0.0	66.7	33.3	0.0	0.0
1993	140	113	35.0	32.8	18.6	13.6	35.0	32.8	18.6	13.6	86.7	10.6	2.7	0.0
1994	14	12	34.6	27.1	21.0	17.3	59.3	32.4	8.3	0.0	67.6	24.1	8.3	0.0
Mean			**34.5**	**30.3**	**20.2**	**15.0**	**61.8**	**31.8**	**6.4**	**0.0**	**76.8**	**18.0**	**5.2**	**0.0**

[a] Score 1, Healthy; Score 2, Slightly defoliated; Score 3, Defoliated but no dieback of shoots; Score 4, Defoliated with shoot dieback

[b] In the year 1995, the following number of disease susceptible clones were cut and removed: Six clones with Score 3 and 19 clones with Score 4, in the 1992 plantation; Nine clones with Score 3 and 18 clones with Score 4, in the 1993 plantation; One clone each with Score 3 and Score 4, in the 1994 plantation.

Discussion

There are many potentially serious indigenous or introduced diseases of eucalypts in Thailand. The geographical spread, frequency of occurrence and severity of these diseases, particularly the foliar diseases caused by fungi, have generally increased in the recent decade. This problem may aggravate in the future due to reduced genetic diversity of the stands as many plantation companies are employing vegetative propagation techniques in order to emulate the extremely successful clonal plantation programs, such as those in Brazil (Eldridge *et al*., 1993). Use of resistant selections is likely to be the only means by which these diseases will be minimised in plantations.

The epidemiology of *Cryptosporiopsis eucalypti* leaf and shoot disease requires much more study. From a preliminary survey it is evident that the incidence and severity vary greatly from site to site, but this site-related variation is so far unexplained although environmental factors may have a role
.
There is a need to determine the impact of a range of leaf and stem pathogens on species and provenances, both in the field and under more controlled laboratory and greenhouse conditions. Knowledge of the nature, extent and severity of diseases, the occurrence of resistance mechanisms in trees and how they may be manipulated to our advantage is very important for future disease management. Environmentally acceptable and effective management of economically important diseases through selection and breeding is a preferred approach. The present study indicates that this is a viable option for management of the leaf blight syndrome.

Foliar pathogens are recognised as having the potential to reduce the productivity of eucalypts in many parts of the world. At this stage in our understanding of the problem in Thailand, *Cryptosporiopsis eucalypti* appears to be a primary pathogen. Tree improvement programs are in place in Thailand with advanced generation selection of *E. camaldulensis* through RFD/CSIRO collaboration. In view of the increasing incidence of foliar and stem diseases, it is essential that selection for resistance to major pathogens is included in *Eucalyptus* tree improvement programs as soon as possible. Clones can be rapidly tested for resistance to foliar and stem pathogens using artificial inoculation of young plants or detached leaves in the laboratory. Methods for this purpose are being developed.

Acknowledgments

The kind support of Dr Ken Old, Assistant Chief of CSIRO, Forestry and Forest Products, Australia, through the project “Minimising Disease Impacts on Eucalypts in SE Asia”, is highly appreciated. The Thai Plywood Company and Siam Forestry Company gave access to their plantations and the officers of the Experimental Stations extended kind cooperation. Mr.Mark Dudzinski offered helpful comments on the early drafts. The Royal Forest Department, Thailand and CSIRO/ACIAR provided financial support for this study. Thanks are due to all of them.

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