Ministerial Council for Forestry, Fisheries and Aquaculture

STANDING COMMITTEE ON FORESTRY

RESEARCH PRIORITIES AND COORDINATION COMMITTEE

Meeting Number

Location

Date

Agenda Number

ANNUAL DISEASE STATUS REPORT FOR AUSTRALIA AND NEW ZEALAND

1995/96

INTRODUCTION

1. This report presents the year's annual statement of forest disease conditions throughout Australia and New Zealand. It follows from Outcome 5 of the 1995 Operating Plan of Research Working Group 7 Forest Pathology, and is summarised from the individual state and country reports submitted (Annex A; there was no report from South Australia).

PURPOSE

2. To communicate the annual statement of forest disease conditions in Australia and New Zealand to the Standing Committee on Forestry for its information, consideration and any action deemed necessary.

CONSIDERATION

AUSTRALIA

Plantations:

***Pinus radiata* (and other temperate pines):**

3. Incidence of Dothistroma needle blight (*Dothistroma septosporum* or *D. pini*) increased in younger plantations of *Pinus radiata* in New South Wales and in some areas in Victoria with the return of more normal rainfall patterns this year. However, the disease was generally not prevalent in Victoria where incidence was low in some high rainfall areas where greater levels of disease might have been expected. Recovery from the heavy defoliation in this state in 1993-94 has taken over two years. Trace infection was reported throughout Tasmania, and the disease was also present in a small higher level plantation of *P. radiata* in southern Queensland. Control in New South Wales is being effected by spraying with copper oxychloride, high pruning and thinning, and the planting of resistant stock.

4. In Tasmania Spring needle cast in *P. radiata* was found in a number of areas where it has not previously been reported. Two types of symptom were observed based on the intensity of defoliation and resemblance to diseases attributed to *Strasseria geniculata* and *Cyclaneusma minus*, respectively. Severe Mid Crown Yellowing symptoms were observed immediately after pruning of second rotation stands on some very fertile sites in north western Tasmania.

5. Losses resulting from infection by *Phytophthora cinnamomi* occurred among newly planted *P. radiata* stock in north eastern Victoria and near Stanthorpe in Queensland. In Victoria the disease was also associated with a number of environmental and chemical stress factors. *Sphaeropsis sapinea*

(*Diplodia pinea*) was isolated from wounds following severe storm damage in stands of *P. radiata*, *P. ponderosa* and *P. laricio* in Tumbarumba District in New South Wales, but bluestain has not yet become visible. The fungus *Amylostereum areolatum* and its carrier, *Sirex noctilio*, are continuing to move slowly northwards in stands of *P. radiata* but disease impact is low as a result of the widespread systematic release of a nematode biological control agent.

6. Higher rainfall in 1995 reduced water stress levels in plantations in Western Australia and no major disease problems were reported in stands of *P. radiata* or *P. pinaster* .

Sub-tropical *Pinus* species:

7. Few problems were reported in plantations of *Pinus elliottii* and *P. elliottii* x *P. caribaea* hybrid plantations in Queensland this year.

Araucaria cunninghamii:

8. Root diseases were the main causes of loss in hoop pine plantations established on old rainforest sites in Queensland. *Phellinus noxius* continued to be active, and there were significant occurrences of *Junghuhnia* (*Poria*) *vincta* in a number of second rotation stands. Minor damage was caused by *Rosellinia* sp. and *Dothiorella* sp. Some establishment failures occurred in newly established hoop pine stands. There is concern that chemical stress due to the widespread use of herbicides for successful stand establishment may be causing significant early growth reduction.

***Eucalyptus* species:**

9. Infection of shoots and leaves by *Ramularia pitereka* caused disease in young plantings of *Eucalyptus maculata* or related species in both southern Queensland and New South Wales. Foliage browning and shedding in young stands of *E. tereticornis*, *E. resinifera*, and *E. cloeziana* in parts of Queensland appeared to be caused by adverse site factors possibly aggravated in some instances by the effects of herbicides or infection by *Kirramyces eppicoccoides* (*Phaeoseptoria eucalypti*) and *Cryptosporiopsis* sp. Bacterial wilt caused by *Pseudomonas solanacearum* Biovar 3 was associated with mortality in young planted *E. pellita* in northern Queensland. This is the second occurrence of a disease which could become more significant as eucalypt planting expands in this region.

10. There were few diseases evident in eucalypt plantations in Victoria this year. Although stands in Tasmania were also free of serious disease a large number of fungi were found associated with foliar lesions in *E. nitens* plantations including, among others, *Aulographina eucalypti* and species of *Mycosphaerella*, *Seimatosporium*, *Vermisporium*, *Kirramyces*, *Harknessia* and *Coniothyrium*. Some patch death and butt cankering in *E. nitens* was caused by *Armillaria luteobubalina.* Approximately 15% of trees in four of five plantations of *E. nitens* in Tasmania were found to have decay associated with pruning wounds. Greater amounts of decay were associated with larger wounds and possibly with spring-summer pruning. Decay in one stand was caused mainly by *Aleurodiscus* sp. A stand of *E. nitens* at Tewkesbury, Tasmania, continued to recover from earlier severe stem cankering due to infection by *Endothia gyrosa*. Decays in trees of *E. grandis* and *E. saligna* have been found associated with damage by cerambycids in New South Wales. There were no reports this year of disease problems in *E. globulus* plantations in Western Australia where high rainfall has eased drought stress.

***Acacia* species:**

11. Fungi or algae associated with minor phyllode spotting or distortion of *A. mangium*, *A. crassicarpa*, *A. aulacocarpa*, and *A. auriculiformis* planted at sites in northern Queensland included species of *Pestalotiopsis*, *Meliola*, and *Cephaleuros*. Roots of unhealthy *A. auriculiformis* were infected by *Ganoderma* sp. aff *G. lucidum*.

Managed natural forests:

***Eucalyptus* species:**

12. *Aulographina eucalypti* continued to cause damage in *Eucalyptus regnans* regrowth in the Central Highlands of Victoria in association with psyllid damage. There was significant mortality in wetter gully sites in some areas, but the primary cause of death is not yet clear. Following increased rainfall there was also mortality in naturally regenerating and residual *E. sieberi* associated with infection by *Phytophthora cinnamomi*. In a survey of regrowth stands in Tasmania, 20% of intended final crop trees had decay in more than 5% of the stem volume (equating to a loss in royalties of $650 per hectare). Minor individual or group deaths on poorer sites in Queensland were attributed to effects of the drought. Heart rots due to *Phellinus robustus* and *Piptoporus portentosus* were identified in *E. tereticornis*. Root diseases caused by *P. cinnamomi* and *Armillaria* continued In Western Australia.

***Callitris* species:**

13. Localised areas of mortality appeared during drought conditions in cypress pine stands (*C. columellaris* var. *campestris*) near Chinchilla in Queensland following a thinning operation and in association with adverse soil conditions. There were signs of recovery among surviving trees following periods of rain.

Nurseries:

Conifer species:

14. In nurseries in New South Wales there were outbreaks of disease in pine (*Pinus*) seedlings caused by *Phytophthora cinnamomi*, *P. nicotianae*, *Colletotrichum acutatum* (terminal crook), and *Botrytis cinerea*. *Phytophthora* species were found in one nursery for the first time. Losses due to terminal crook and *Botrytis* were reduced by fungicidal spraying. Seedling production in New South Wales is being reorganised and a new nursery is being established with quarantine and tissue culture facilities. In Victoria nurseries are monitored routinely to prevent further spread of *P. cinnamomi*. Soil sterilisation and urea applications were used to control a complex disease problem in one nursery in this state involving an interaction between fungi, nematodes and nutrient levels.

15. There were losses among young *Pinus* hybrid (*P. caribaea* x *P. elliottii*) cuttings in Queensland as clonal forestry propagation techniques are being refined. Terminal crook (*C. acutatum*) was controlled by fungicidal spraying at two major *Pinus* nurseries.

16. In Queensland hoop pine (*Araucaria cunninghamii*) nurseries there was some frost damage and fungicidal drenching was used to reduce losses from pre-emergent damping off.

Hardwood species

17. *Botrytis cinerea* caused severe losses among eucalypt seedlings being produced by private growers for the New South Wales Eucalypt Plantation Joint Venture Program. *Hainesia lythri* stem and foliage infections also caused problems in stocks of *Eucalyptus pilularis*. Pythiaceous root diseases have not been a problem in these seedlings. Testing in Victoria has revealed infestation by *Phytophthora cinnamomi* of a number of nurseries selling older eucalypt stock that is tolerant to the pathogen. *P. cinnamomi* also continued to be a problem in container nurseries in Tasmania. The likely source of contamination was traced to washed gravel used as a component in the potting mix, and steam sterilisation of the gravel was introduced as a remedy.

18. *C. parasiticum* (syn. *C. crotalariae*) was identified for the first time last year in a nursery in northern Queensland. Further losses among seedlings of *Eucalyptus cloeziana* due to *Cylindrocladium* infection have resulted in the decision to produce this species at a different nursery.

Native plant communities:

19. Among fungi and algae associated with spotting and distortion of phyllodes and shoots of naturally growing acacias in northern Queensland (*A. mangium*, *A. crassicarpa*, *A. aulacocarpa*, *A. auriculiformis*, and *A. flavescens*) were the rusts *Atelocauda digitata* and *Uromycladium tepperianum*, the sooty mould *Meliola brisbanensis*, and species of *Pseudocercospora*, *Pestalotiopsis*, *Cephaleuros*, *Truncatella*, *Guignardia*, *Phoma*, and *Colletotrichum*. Heart rot was caused by *Phaeolus albertinii*.

20. Understory species in eucalypt forests set aside as flora reserves in parts of Victoria again suffered from root disease caused by *Phytophthora cinnamomi* infection. Mortality patches have expanded in an indigenous plant community at Pine Lake on the Central Plateau in Tasmania. The cause of the disorder is not clear, but species of *Pythium* and a *Phytophthora* are implicated. Management actions have included the application of phosphonate and the establishment of a quarantine area.

Urban:

21. There has been media publicity calling for more action on the fungus *Ganoderma* sp. *aff. lucidum* which was again collected from unhealthy shade trees in urban areas throughout Queensland. Most trees have now recovered from the effects of a severe hailstorm that pounded south western suburbs of Brisbane in November, 1995.

NEW ZEALAND

Plantations:

***Pinus radiata*:**

22. Cyclaneusma needle-cast (*Cyclaneusma minus*) and Dothistroma needle blight (*Dothistroma septosporum* or *D. pini*) were the main causes of disease in young stands of *P. radiata* throughout much of the country as a result of high predisposing levels of rainfall and relative humidity. Cyclaneusma needle cast was severe in the northern half of the North Island and also present in the south. In the South Island the disease was widespread in the north and present on the west coast, but appeared later (January-February) in Canterbury.

23. Dothistroma needle blight was also severe throughout much of the North Island and in the northern South Island. In the central North Island disease symptoms were present even in older age classes, and in newly established plantations infection was encouraged by the humid conditions created by operational sowing with *Lotus*. The disease was less prominent on the South Island West Coast after prolonged winter defoliation caused by *C. minus* infection. Aerial spraying to control *Dothistroma* in young plantations was carried out in most regions in the North Island and also in the northern South Island.

24. *Sphaeropsis sapinea* (syn. *Diplodia pinea*) was associated with dieback symptoms in stressed or damaged trees in different parts of the country. These included Northland, after hail damage, Nelson and Marlborough, in trees under stress from root damage, and in Canterbury, after damage to shoot tips by hot, dry, north westerly winds.

25. Failures in young, poorly planted *P. radiata* trees stressed by wind rocking in smaller forests in the Manawatu district (southern North Island) were associated with root infection by *Armillaria* sp. Loss from root disease was also caused by *Phanerochaete sacrata* (syn. *Peniophora sacrata*) in the Coromandel area (north east of Auckland) and *Rosellinia necatrix* in the southern Waikato (south of Auckland). Bacterial cankering occurred in newly established *P. radiata* plantations in Canterbury following infection of frost stressed plants by *Pseudomonas syringae*.

26. Gaps in tree crowns were observed in Westland following symptoms of upper mid-crown yellowing attributed to magnesium deficiency. Mineral deficiency symptoms were also evident in foot hill plantations in the Hawkes Bay (eastern North Island) and Nelson (northern South Island) districts. Symptoms of phytotoxicity appeared in a Canterbury plantation after application of an inappropriate boron fertiliser.

27. Substantial storm damage occurred throughout the country during 1995-96. Heavy snow falls during winter caused mortality and damage in plantations of *P. radiata* and *P. muricata* in parts of the South Island (Nelson-Marlborough, Canterbury and Otago). Severe cold in Central Otago caused foliage burning on "cold resistant" varieties of *P. radiata*. Losses occurred in *P. radiata* shelter belts in parts of Southland following strong westerly winds in October, and there was also wind damage in the northern half of the North Island. Winter storms in the northern South Island resulted in some large areas of wind throw, and there were also losses from lightning strikes in this region. High rainfall and raised water tables led to losses from waterlogging and associated root death in low lying woodlots and shelter belts in parts of Canterbury, and in sand dune forests on the North Island west coast north of Wellington.

28. Severe localised browsing damage was caused by possums (*Trichosurus vulpecula*) in forests in Nelson, Marlborough and Central Otago in the South Island.

***Pseudotsuga menziesii*:**

29. Widespread crown yellowing due to Swiss needle-cast disease (*Phaeocryptopus gaeumannii*) developed in stands of Douglas fir throughout the Nelson district in the northern South Island. Possums also caused damage to Douglas fir in a forest in the South Island.

Other species:

30. Foliar damage associated with a high incidence of infection by *Kirramyces eucalypti* (syn. *Septoria pulcherrima*) occurred in young *Eucalyptus nitens* plantations in the Bay of Plenty district (north eastern North Island). There was also severe leaf spotting associated with infection by species of *Aulographina* and *Septoria* on foliage of eucalypts in Westland in the South Island. Mortality in stands of eucalypts was caused by soil waterlogging after prolonged rain in Canterbury. Severe cold in Central Otago in the South Island caused foliage burning of *E. pauciflora*.

31. Unexplained defoliation and decline of *Chamaecyparis lawsoniana* has continued at several locations on the South Island west coast.

Nurseries:

32. Wet conditions in open rooted nurseries in the Nelson district led to rotting and poor development of root systems. The eucalypt leaf spotting fungus *Hainesia lythri* recently recorded from the Bay of Plenty in the North island was found on *Eucalyptus obliqua* in a Canterbury nursery. It is not anticipated that this fungus will cause a serious disease.

QUARANTINE

33. There have been concerns over the effectiveness of quarantine procedures in Australia and New Zealand, and on aspects of AQIS policy. Examples of specific concerns of both countries were: the risk of pitch canker (*Fusarium subglutinans* f. sp. *pini*) introduction; wood colonising fungi which are often ignored on green sawn timber and peeled logs; imports of fresh wild mushrooms from Europe which may be arriving contaminated by conifer needle debris, and which may not just be restricted to the restaurant trade but used as growth inoculum; unclean material found in second hand equipment such as logging machinery from North America and vehicles from Japan. Methyl bromide is being used to treat living *Pinus* shoot cuttings being transferred from New Zealand to Australia for breeding purposes.

RESEARCH, DEVELOPMENT, EXTENSION AND DISEASE MANAGEMENT

34. The following catalogue summarises research studies or other activities itemised in the respective state and organisation reports (Annex A). Because not all submissions have included such projects the list cannot be taken as representative of current forest pathology research in Australasia. However, it does provide a useful summary of activities being undertaken in some parts of the region. Presentation is by state and organisation.

35. **Queensland (Queensland Forest Research Institute, Queensland Department of Primary Industries Forestry):**

- Forest Health Surveillance; comprehensive systematic surveillance of Queensland forests: commenced with the appointment of new staff in January.
- Decay caused by *Rigidoporus lineatus* in fire-salvaged logs of *Pinus elliottii* stored under sprinklers; intensive research to assist an operation to terminate the facility.
- Documentation of diseases of tropical *Acacia* species in northern Queensland (joint study, CSIRO).
- Effects of silviculture and host genotype on Dothistroma needle blight in *Pinus radiata*.
- Bacterial wilt of eucalypts caused by *Pseudomonas solanacearum* Bv 3; growth chamber study to test resistance of different species and seedlots.
- *Phellinus noxius* root rot of hoop pine (*Araucaria cunninghamii*); monitoring of observation plots, thinning trials, and disease in a second rotation stand after biological stump treatment.

36. **New South Wales (State Forests of New South Wales):**

- Forest Health Surveillance: two officers commenced in January after a training period that included a visit to New Zealand.
- Decay study in plantation-grown *Eucalyptus saligna* and *E. grandis* with a high incidence of cerambycid attack.
- Fungicide screening for the control of significant fungal diseases in eucalypt seedlings being produced by private growers for the Eucalypt Plantation Joint Venture Program.
- Trials in eucalypt plantations in northern New South Wales to measure growth after restricting pests and diseases using fungicide &/or insecticide treatments; there have been gains of up to 30% after two years.
- Study of the biology and aetiology of *Ramularia pitereka*, including the variation in susceptibility to this disease among *Eucalyptus maculata* provenances.
- Study of the infection biology of *Hainesia lythri* on seedlings of *Eucalyptus pilularis*.

37. **Victoria (Centre for Forest Tree Technology, Department of Natural Resources and Environment):**

- Trial to evaluate the effectiveness of aerial spraying against Dothistroma needle blight of *Pinus radiata* under Victorian conditions.
- Glasshouse studies with fungi isolated from roots of recently killed trees of regrowth *Eucalyptus regnans* after defoliation by *Aulographina eucalypti* and psyllid attack: lesions developed only after complete defoliation.
- Artificial defoliation to determine impact on growth of eucalypts in plantations.

38. **Tasmania (Forestry Tasmania):**

- Planting of *Eucalyptus nitens* rather than *E. globulus* to avoid damage to juvenile foliage by *Mycosphaerella molleriana*.
- Surveys of the extent of decay in regrowth eucalypt stands.
- Testing of a torsion drilling device as a guide to the retention of decay-free trees in managed stands.
- Evaluation of the relationships between extent of decay and pruning parameters (branch size, season pruned) in *Eucalyptus nitens* plantations: a provisional silvicultural regime to minimise decay has been produced.
- Development of a model to predict the development of decay with time in plantation grown *E. nitens*.

- Evaluation of *Pinus radiata* selections in the Australasian Plus Tree Progeny Trial in north western Tasmania for susceptibility to Spring Needle Cast disease in order to identify resistant stock for high risk areas.
- Trials to determine if fertilising *P. radiata* with magnesium sulphate eliminates symptoms of mid crown yellowing.
- Delineation of areas containing rare and endangered plant species susceptible to *Phytophthora cinnamomi* on behalf of the Australian Nature Conservation Agency; monitoring of plots with and without application of phosphonate treatment.
- Surveys to find and manage populations of the nine most-endangered indigenous plant species in locations distant from known occurrence of *P. cinnamomi.*
- Formation of a group of land managers to review the management of natural areas affected by *P. cinnamomi* in Tasmania and to develop consistent management; interaction with the new National Threat Abatement Plan for this disease is anticipated.
- Joint study into the cause of a disease affecting areas of natural vegetation at Pine Lake in the Tasmanian Central Plateau; the role of associated pythiaceous fungi is being determined: a number of management actions were implemented by the Department of Environment and Land Management.

39. **Western Australia (Conservation and Land Management, Western Australia):**

- Review of dieback in Western Australia for the Minister of the Environment.
- Preparation of a National Threat Abatement Plan for *Phytophthora* in native vegetation in Australia (Australian Nature Conservation Authority).
- Selection of *Pinus radiata* resistant to *P. cinnamomi*: genetic gains of 22% have been achieved in field trials on infested sites.
- The effects of three *Mycosphaerella* species on planted and indigenous eucalypts.
- Selection of *Eucalyptus marginata* resistant to *P. cinnamomi*: field trials of resistant clonal material have been established.
- Selection of *Eucalyptus marginata* resistant to *P. cinnamomi*; identification of genetic markers linked to resistance genes.
- The interaction between fire and damage to understory plants by *P. cinnamomi* in *E. marginata* forests: no relationship was found.
- Biology, ecology and pathology of *P. cinnamomi* in *E marginata* forests (Murdoch University students); includes the association between water ponding, low oxygen levels, and infection ability; floristic changes over time on diseased sites; the effects of phosphonate treatments on the hosts, mycorrhizas, the plant community, and the pathogen; effects of ectomycorrhizas in inducing resistance; and the genetics of pathogenicity.
- The degree of imprecision in the routine inventory of *P. cinnamomi* in *E. marginata* forests due to the confounding effect of an additional disease of *Xanthorroea* understory species caused by *Colletotrichum xanthorroea*.
- The impact and control of *Armillaria luteobubalina* in *Eucalyptus diversicolor* forests.
- The pathology of six isozymically distinct *Phytophthora* taxa to understory species in *E. diversicolor* forests.
- Routine diagnosis by the Vegetation Health Service: 1300 samples were processed for identification of *Phytophthora* in seven months.
- Improvements to isolation and diagnostic techniques for the identification of *Phytophthora* species: cellulose acetate gel electrophoresis is now in routine use by the Vegetation Health Service.
- Disease of *Banksia coccinea* in natural vegetation caused by *Cryptodiaporthe melanocraspeda*; potential for control using weakly pathogenic isolates as competitors and selection for host resistance.
- Aerial application of phosphonate to control *Phytophthora* in natural vegetation.
- Injection of phosphonate to control *Armillaria luteobubalina* in *Banksia attenuata* and *Eucalyptus wandoo*.

- *Phytophthora citricola* in *Eucalyptus marginata* forests: three subgroups were established using morphological and electrophoretic methods; oospores are important for long term survival; distribution of *P. citricola* is related to roading; phosphonate has potential for controlling the disease in native plant communities.

40. **CSIRO Division of Forestry, Forest Pathology collaborative research:**

- Development of management prescriptions to reduce decay resulting from pruning in plantations of *Eucalyptus nitens* in Tasmania; pruning trials to investigate the effects of season, branch size and type, treatment with sealants, and pruning quality on amount of decay (with University of Tasmania Department of Agricultural Science).
- Determine the identity and nature of the causal agents of an epidemic disease of alpine vegetation, including *Arthrotaxis cupressoides*, on the Central Plateau in Tasmania (with University of Tasmania, Department of Agricultural Science)
- Study to survey, identify, and determine the pathogenicity of fungi associated with stem and branch cankers in Tasmania and investigate their potential to induce disease in eucalypt plantations; investigation of the nature of the variability of canker fungi in different parts of Australia, and their role as precursors of decay (with University of Tasmania, Department of Agricultural Science).
- Study to investigate the nature of the interaction between resistance in forest trees to *Phytophthora cinnamomi* and variability in fungal pathogenicity (with Murdoch University, ALCOA of Australia, and CSIRO Entomology).
- Fungal pathogens as a threat to tropical acacias: surveys of fungi and algae infecting four natural and planted tropical *Acacia* species were conducted in northern Queensland, Indonesia, Malaysia, Thailand and India by respective participants, and a workshop held in 1996 to discuss the findings and prepare a joint report (with Queensland Forest Research Institute; Institute for Horticultural Development, Victoria; Agricultural University, Bogor, Indonesia; Forest Research Institute of Malaysia; Royal Forest Department, Bangkok, Thailand; Kerala Forest Research Institute, India; funded by CIFOR).
- Identity, biology and pathogenicity of *Cryptosporiopsis eucalypti* leaf spot of eucalypts: occurs in Australia, Asia, and Hawai'i on many species; leaf spots were produced 4-5 days after inoculation at 24^{o}C (with Royal Forest Department, Bangkok, Thailand).
- Project to identify the major causes of leaf and stem diseases of eucalypts in Vietnam and Thailand; to determine their biology and aetiology, and select resistant host material (with Royal Forest Department, Bangkok, Thailand; Queensland Forest Research Institute; Kerala Forest Research Institute, India; funded by ACIAR).
- Blister bark disease of *Casuarina equisetifolia* caused by *Trichosporium vesiculosum*: examination and assessment of the disease in India and Thailand, and assessment of its risk to Australia: undertaken, 1995.

CONCLUSION

41. This report is the annual disease statement of Research Working Group 7 recording the 12-month state of forest health in Australia and New Zealand.

RECOMMENDATIONS

42. The annual disease statement be accepted and noted by the Standing Committee.

FOR INFORMATION

Research Working Group 7
(Secretary)

5 August 1996

ANNEX A: Forest disease situation reports 1994/95 by states and country.

ANNEX A

FOREST DISEASE SITUATION REPORTS 1994/95 BY STATES AND COUNTRY

1 Queensland:

Ian Hood, Queensland Forest Research Institute, Queensland Department of Primary Industries, PO Box 631, Indooroopilly, Brisbane Q 4068.

1.1 Introduction

Significant rainfall has continued through the current summer in much of Queensland, easing the drought conditions that prevailed during previous years. Nevertheless, the effects of the protracted drought were still noticeable in some stands during the past year. Forest health surveillance staff were appointed in January, 1996, and it is anticipated that annual disease reports from Queensland will become more systematic as the surveillance system becomes established.

1.2 *Pinus* plantations

Few problems were reported in plantations of *Pinus elliottii* and *P. elliottii* x *P. caribaea* hybrid stands over the past year. Dothistroma needle blight caused by *Dothistroma pini* (*D. septospora*) continued in young *P. radiata* in Gambubal Forest in the Dividing Range, as did infection from *Phytophthora cinnamomi* in young *P. radiata* in Paschendaele Forest near Stanthorpe. Decay caused by the tropical fungus *Rigidoporus lineatus* was found in fire-salvaged logs of mainly *Pinus elliottii* stored under sprinklers at Beerburrum, and an operation to terminate this facility has begun.

1.3 Hoop pine (*Araucaria cunninghamii*) plantations

Root diseases were the main causes of losses in hoop pine plantations planted on old rainforest sites. Root rot caused by *Phellinus noxius* is well distributed but unquantified in planted stands of all ages. A reliable annual estimate of the impact of this disease on plantations should become possible as systematic health surveillance is initiated. Fresh activity by *P. noxius* was observed in a rainforest reserve near Maleny, possibly as a result of the recent increase in rainfall. Further mortality due to *Junghuhnia* (*Poria*) *vincta* was significant in up to 3-year-old plantations at Jimna and Amamoor Forests, and there were also deaths in a young stand near Blackbutt from root disease caused by *Rosellinia* sp. Minor dieback attributable to a species of *Dothiorella* occurred in plantations at Jimna and Amamoor.

Establishment failures in newly planted hoop pine stands at Imbil were attributed to soil drought. Drought also appears to be the cause of mortality in older hoop pine trees at Mount Mee, near Brisbane. Symptoms of injury in crowns of young hoop pine stands less than three years old at Imbil are believed to be due to the effects of herbicides, and there is concern that stress from the widespread use of chemicals for weed control may be causing significant early growth reduction.

1.4 Native hardwoods

Foliage browning and casting occurred on eucalypt trees (*Eucalyptus tereticornis* and *E. resinifera*) in a number of young planted stands in the Mackay district. The symptoms appeared to result from different causes ranging from herbicide damage through to waterlogging and soil salinity on different sites. *Kirramyces epicoccoides* (*Phaeoseptoria eucalypti*) and *Cryptosporiopsis* sp. were also associated with some of these leaf symptoms. Deaths in a young trial stand of *E. cloeziana* at Pomona were caused by severe wind rocking of plants with poorly formed root systems. Symptoms of interveinal yellowing in the same stand appeared to be caused by residual herbicide.

Deaths of individual or grouped naturally growing eucalypt trees (*E. tereticornis, E. grandis, Eucalyptus* sp.) on a number of sites were attributed to the effects of drought, sometimes with additional stress factors such as soil compaction. *Ramularia pitereka* caused disease in a young spotted gum (*E. maculata*) planting in June, 1996. Isolations from a large perennial target canker on the stem of a tall unhealthy spotted gum tree in Brisbane yielded cultures of a distinctive, unidentified fungus. Similar cankers have been seen on other trees, suggesting that further work is needed to identify potentially harmful stem canker fungi in Queensland, and to compare these with those found in other states in Australia. *Phellinus robustus* was a common heart rot fungus seen fruiting on these trees, and *Piptoporus portentosus* was observed fruiting on natural *E. tereticornis*.

In March, 1996, bacterial wilt caused by *Pseudomonas solanacearum* Bv 3 was found in a young plantation of *Eucalyptus pellita* on a farm near Babinda in North Queensland (identified E.B. Akiew, Queensland DPI, Mareeba). This is the second occurrence of this disease (the first being near Ingham in 1992), and is a factor that could have implications for expanded eucalypt planting in this area.

Samples of *Acacia* species (*A. crassicarpa*, *A. aulacocarpa*, *A. mangium*, and *A. auriculiformis*) collected in North Queensland last year from both natural and planted stands as part of a joint CSIRO-coordinated, CIFOR-funded project were found to harbour a range of phyllode-spotting microfungi and other organisms including *Pseudocercospora* sp., *Pestalotiopsis* spp. (two species), a number of unidentified imperfect fungi, *Meliola* sp., three other ascomycetes, *Atelocauda digitata* (*Uromyces digitatus*; uredial and telial stages), and the alga *Cephaleuros* sp. *Ganoderma* sp. aff. *G. lucidum* was found causing root disease in planted *A. auriculiformis* near Ingham, and heart rot in a living natural *A. crassicarpa* tree at Cardwell was caused by *Phaeolus albertinii* and *Phellinus* sp.

1.5 Native cypress stands

The ongoing drought caused mortality in natural stands of *Callitris columellaris* var. *campestris* at Barakula near Chinchilla during the past year. A felling study found that sapwood moisture content decreased with height on affected trees which still bore some green foliage and which had healthy root systems. Full-crowned control trees did not show such a gradient and retained satisfactory sapwood moisture content levels throughout. Cypress is a species that prefers sandy soils and is normally drought resistant. The affected trees occurred on two sites, one with a higher-than-usual clay content beneath the topsoil, the other with a suitable soil type but which had undergone a selective thinning operation shortly before the onset of symptom expression. Adventitious shoots had formed on branches of still living drought-affected trees indicating that the problem should cease with the onset of higher rainfalls.

1.6 Nurseries

Problems have occurred in young *Pinus* hybrid (*P. caribaea* x *P. elliottii*) cutting material as clonal forestry propagation techniques are refined. Only saprophytic microfungi were cultured from non-lignified diseased stem tissue of two-month old cuttings in open beds at Toolara Nursery, suggesting that losses were caused by establishment failures in very young soft cutting stock during warm moist conditions, rather than from primary fungal infection. Terminal crook disease caused by *Colletotrichum acutatum* f. sp. *pinea* was reported in Beerburrum and Toolara Nurseries this past year. This is a regular problem corrected by fungicide application as soon as the problem first appears. Losses in *P. caribaea* and *Eucalyptus citriodora* stock at Ingham Nursery in North Queensland were unexplained, but did not progress further after the first occurrence.

Substantial losses in *E. cloeziana* seedlings caused by *Cylindrocladium* have continued to affect the production of this species at Ingham Nursery. The Ingham allocation is now to be made up by increased production at Walkamin Nursery on the Atherton Tableland. *C. parasiticum* (synonym *C. crotalariae*) causes a disease of peanuts but this is the first time it has been found on eucalypts in the area. Quarantine and control measures were advised last year.

Frost caused losses among hoop pine seedlings at Kennilworth Nursery, and pre-emergent damping off in hoop pine at the nursery at Benarkin was corrected using fungicidal drenching. As hoop pine seedling propagation becomes containerised, there has been concern that mycorrhizal problems may occur, and this is to be investigated. Losses in ornamental *Cupaniopsis* seedlings at a Cooroy nursery were associated with fungal infection, and application of a fungicidal treatment was recommended.

1.6 Urban

There were again numerous enquiries concerning *Ganoderma* sp. aff. *G. lucidum* on unhealthy urban hardwood trees (*Delonix regia*, *Albizia lebbeck*, guava etc.), this year from Townsville, Charters Towers, Longreach, Mount Isa and Brisbane between October and January, and a television news item reported the fungus infecting trees in a park in Rockhampton. Problems in a tourist *Cupressus* maze at Tanawah north of Brisbane were associated mainly with the clipping pattern and light suppression, but *Phytophthora cinnamomi* and cypress canker disease (*Seiridium unicorne*) were also present. A hailstorm stripped trees extensively in several suburbs in south west Brisbane in November. Hailstones ranged ca. 5-8 cm diameter and caused severe damage, but most trees (eg. *Eucalyptus* spp.; *Pinus* excepted) produced epicormic shoots and had recovered after 4-8 weeks.

2 New South Wales:

Jack Simpson, Research Division, State Forests of New South Wales, P.O. Box 100, Beecroft 2119, Australia.

2.1 *Pinus* plantations.

Strong winds and associated hail storms caused severe wind throw and crown damage to plantations of *Pinus radiata*, *P. ponderosa* and *P. laricio* in Tumbarumba District in November 1995. The older age classes are being clear felled. *Sphaeropsis sapinea* can be isolated from wounds made by hail stones but blue stain has not yet developed.

With warm weather and a return to more normal rainfall patterns *Dothistroma septosporum* is returning as a disease problem in younger *P. radiata* plantations. Some 2500 ha were sprayed with copper oxychloride in January at Walcha at a cost of about $24/ha. The stands plantations are being high pruned and thinned to produce saw and veneer logs and to increase air movement in the plantations. New plantations being established in N.S.W. are all of New Zealand GF series seed or of the New Zealand *Dothistroma* resistant line.

Amylostereum areolatum and its vector *Sirex noctilio* are under control through widespread and systematic release of a nematode biological control agent. The pest continues to move northwards but at a slow rate.

2.2 *Pinus* nurseries.

Phytophthora cinnamomi and *P. nicotianae* were isolated for the first time from Bondo Nursery. *Colletotrichum acutatum* was found causing terminal crook disease in Canobolas Nursery. The outbreak was controlled by spraying with prochloraz. *Botrytis cinerea* caused some losses in both pine nurseries but was controlled by spraying with chlorothalonil, ipridione was less effective.

State Forests is in the process of consolidating all its pine nursery activities. A property has been purchased at Tumut and is being prepared for planting this spring. The nursery will have a quarantine glasshouse and tissue culturing facilities.

2.3 *Eucalyptus* nurseries.

Private growers contracted to produce eucalypt seedlings for the Eucalypt Plantation Joint Venture Program had severe *Botrytis cinerea* problems in 1995. Nurseries producing seedlings of *Eucalyptus pilularis* had problems with *Hainesia lythri* infecting stems and leaves. We are at present testing a number of fungicides to find an effective control. Species of Pythiacea have not been a problem.

2.4 *Eucalyptus* plantations.

Field work is almost completed in six large crop loss trials at three locations in Northern Region. Each trial included 25 species and provenances of eucalypts and was sprayed with fungicide (Bravo), insecticide (dimethoate and carbaryl), insecticide plus fungicide, or nil pesticide. After two years the best treatments have a growth advantage of about 30% over the controls.

Species of *Corymbia* have shown a susceptibility to shoot and leaf infections by the white mould *Ramularia pitereka*. We have commenced studies on the biology and infection processes of this fungus and are trialing a large number of provenances of *C. maculata* group for resistance.

We have commenced a study of the biology and infection processes of *H. lythri* on *E. pilularis* seedlings.

We are completing a study of decays in trees of *E. grandis* and of *E. saligna* from areas with chronic infestations of psyllids. The trees have high incidences of attacks by cerambycids.

2.5 Forest Health Survey.

State Forests have started a forest health survey. Two officers commenced duty in January 1996 after a period of training including two weeks in New Zealand.

3 <u>Victoria</u>:

Ian W. Smith, Centre for Forest Tree Technology, Department of Natural Resources and Environment, PO Box 137, Heidelberg, Victoria, 3101

3.1 *Pinus radiata*

3.1.1 *Dothistroma septospora*

Overall, conditions conducive to epidemic disease development have not been prevalent in Radiata Pine growing areas throughout the State resulting in a further reduction from the high levels of disease that occurred in 1993/4. Recovery from the defoliation of 1993/94 however has taken over 2 years where >75% of needles were lost. In the high rainfall areas of the state (Otways and Strzlecki Ranges) the pathogen has not as yet developed to the extent that was expected. The disease has not been found in plantations in the far south-west.

Rapid outbreaks of disease in some areas however, occurred following the mild winter of 1995, with disease levels rising from below 15% in June to around 75% of needles present by August. Disease was confined in this instance to older needles, and the trees recovered quickly during the drier months of spring and summer. An outbreak also occurred following high rainfall during January but again was not sustained due to dry conditions following the outbreak. An aerial spray trial has been established to evaluate the effectiveness of spraying under Victorian conditions.

3.1.2 *Phytophthora cinnamomi*

The pathogen has been associated with planting losses in north-east Victoria combined with a number of other factors including high chloride levels in the foliage, drought and application of herbicide.

3.1.3 Nursery diseases

A complex disease situation involving both fungi, nematodes and nutrition has been investigated in an open rooted *P.radiata* nursery. Sterilisation of the soil using Basamid and the use of high rates of urea have given excellent control of the disease. Outbreaks of *Rotylenchus robustus* and *Pratylenchus penetrans* however have still occurred due to problems with application of the sterilant. Monitoring of nurseries for *Phytophthora cinnamomi* is a high priority so as to reduce the further spread of disease.

3.2 *Eucalyptus*

3.2.1 Foliage and branch pathogens

Very few diseases have been evident in plantation grown eucalypts in Victoria. Trials have been completed using artificial defoliation techniques, to determine the impact of different levels of defoliation on growth of eucalyptus in plantations.

Aulographina eucalypti is still causing damage to *Eucalyptus regnans* regrowth in the Central Highlands in an association with psyllid damage caused by *Cardiospina bilobata.* Significant areas of 1939 *E.regnans* have been affected with significant tree deaths in some areas. The cause of deaths following defoliation is still to be determined however mortality appears confined to wetter gully sites and is associated with wood rot and decay fungi. Glasshouse studies with fungal isolates taken from roots of recently killed trees show lesion development only after complete defoliation.

3.2.2 *Phytophthora cinnamomi*

The disease is still causing significant damage to understorey species particularly in areas set aside as flora reserves. Heavy rain in East Gippsland during summer has resulted in some further deaths of regeneration and retained trees of *Eucalyptus sieberi* in trials evaluating alternative silvicultural systems to clearfelling.

Testing of a number of advanced tree nurseries has revealed many are infested with *P.cinnamomi*. Disease is not being observed as the majority of advanced trees sold are tolerant of the pathogen.

4 <u>Tasmania</u>: Tim Wardlaw, Forestry Tasmania

4.1. Eucalyptus diseases

4.1.1. Defect and decay in eucalypts

4.1.1.1 Naturally-occurring decay in regrowth forests identified for intensive management.

Surveys, sampling about 450 trees from 20 coupes have been completed. There were considerable differences between coupes in the level of stem decay (Figure 1). Overall, twenty percent of ìfinal cropî trees sampled had severe decay (>5% of stem volume decayed). These severely decayed trees would be considered likely to yield little, if any, merchantable sawlog at rotation and represents an estimated loss of 67 m^3 of sawlog at harvest which equates to a loss in royalties of about $650/Ha and a value adding loss to the Tasmanian economy of about $13,500/ha.

Figure 1. Proportion of final crop eucalypts from twenty coupes in each of four decay severity classes.

One of the objectives of the study was to identify ways of better identifying trees likely to contain high levels of decay. Clearly conventional selection criteria for identifying trees for retention during thinning are failing to cull severely decayed trees. The most reliable predictor we have found is a knowledge of the amount of decay in the stem cross-sectional area at some point in the lower stem (1.5-2.5 m). Through the Tasmanian Forest Research Council we have obtained a Resistograph, a torsion drilling apparatus. We are currently evaluating the ability of this machine to detect trees with severe decay by obtaining one-dimensional measurements of the proportion of the diameter at a point in the lower stem with clear and decayed wood.

Work is still (slowly) progressing in a project aiming to develop a model to predict the development of decay over time. At this stage we have done some preliminary data collection from a 16-year-old *E. nitens* plantation in response to a request from North Forest Products to provide predictions of the likely levels of stem decay if the stands were left for a further 5 years until harvesting. The stand is very suitable for initial model development because there are a large number of decay columns of a variety of ages in individual trees and decay is predominantly associated with one fungal species (an *Aleurodiscus* sp.). An interesting finding has been that the outer radial extent of decay columns invariably is outside the growth ring corresponding to the time of branch death. This suggests that either barrier zones are not be produced when branches die or if they are being produced are ineffective in preventing the outward spread of decay.

4.1.1.2 Decay associated with pruning wounds

Five pruned stands of *E. nitens,* totalling 57 trees, were sampled last year to measure the proportion of the pruned branches associated with decay columns spreading into the stem. At four of the five sites about 15% of the pruned branches were associated with decay columns spreading out into the main stem. The fifth site (Camden) had a much lower proportion of pruned branches associated with decay which may be a site effect or a season of pruning effect (Camden was pruned during autumn while the other four sites were pruned during spring-summer). There was a very strong, positive association between the size of the pruned branch and probability of decay spreading into the stem (Figure 2).

Figure 2. Percentage of pruned *E. nitens* branches in each of five branch diameter classes (in mm) associated with spreading columns of decay. Data are presented for four sites (Camden excluded because of low decay levels).

The main findings from this survey have been incorporated into a provisional silvicultural regime for the treatment of *E. nitens* plantations for sawlog production. Some 7500 Ha of *E. nitens* plantation on State Forest will be pruned in Tasmania during the next 5-6 years. A research program, funded by the Forest and Forest Industries Council, has been developed by Caroline Mohammed (CSIRO) to further examine some of the operational measures which may be used to reduce the chance of infection during pruning of *E. nitens*.

4.1.2. Eucalyptus leaf diseases

No major outbreaks have been reported during the past year. Well above average rainfall during the current summer may remedy this situation. Routine sampling of *E. nitens* plantations during the past year has revealed a wide spectrum of fungi associated with foliar lesions. Those identified include: *Aulographina eucalypti* (most common), *Mycosphaerella cryptica, Mycosphaerella* sp., *Seimatosporium samuelii, S. falcatum, S. cylindrosporium, Vermisporium obtusum, Kirramyces eucalypti, Phaeothryolium microthryioides, Harknessia eucalypti, H. ventricosa, Propolis emarginata, Coniothyrium sp., Stilbospora sp., Sporonema sp.* and *Phoma sp.*

4.1.3. Eucalyptus stem cankers

The *Endothia gyrosa* stem canker problem at Tewkesbury appeared to undergoing some remission when inspected last winter with evidence of healthy callous tissue being produce around the margins of many perennial cankers. This remission of symptoms coincided with a PhD student (supervised by C. Mohammed) commencing studies on this and other eucalypt cankers in Tasmania.

4.2. *Pinus radiata* diseases

4.2.1 Spring Needle Cast

Spring needle cast (SNC) susceptibility has been assessed in the Australasian Plus Tree Progeny Trial at Upper Castra in northwestern Tasmania. This trial contains the majority of the selections in the current *P. radiata* breeding program and the susceptibility ratings are planned to be used to cull susceptible genotypes to produce a more uniformly resistant line for use in high risk areas. It is hoped that cuttings from this SNC-culled propagation material would be available for field evaluation in 1998.

In a recent health survey of plantations in southern Tasmania confirmed the presence of SNC in a number of areas not previously known to be affected. The majority of the affected trees inspected during this survey had needle symptoms typical of *Strasseria geniculata* infection. Needles showing characteristic symptoms of *Cyclaneusma minus* infection were found mainly in trees which were casting only 2-3 year-old needles.

4.2.2 Dothistroma

All of the main *P. radiata* regions of the State are now infected with *D. septospora* with the discovery of the fungus in a small number of trees in ANM plantations near Maydena in southern Tasmania. However the disease continues to cause little problems with trace infection levels being the norm.

4.2.3 Mid-crown yellows

Severe mid-crown yellows has recently appeared in some second rotation stands growing on very fertile sites in northwestern Tasmania. Symptoms appear immediately after pruning and in some trees all 1-year and older needles become chlorotic and die prior to shoot growth recommencing in late spring. Symptomatology is consistent with magnesium deficiency and trials have been established to see if fertilising (with magnesium sulphate) ameliorates the condition.

4.3. Nursery Diseases

Phytophthora cinnamomi has been a problem in many nurseries, causing sporadic outbreaks in containerised nursery stock. On behalf of Forestry Tasmaniaís nursery at Perth an extensive survey and evaluation was undertaken to identify possible sources of *P. cinnamomi* causing sporadic infection.

The survey in particular focussed on the constituents of the potting media, which were composted pine bark, washed gravel and coir fibre. The composting of pine bark is a centralised operation, with one operator supplying virtually all of Tasmaniaís nursery industry. It was found that although soil material was present on the pine bark brought into the composting facility, the composting process produced temperatures of sufficient duration to kill any possible contaminating *P. cinnamomi*. Washed gravel which makes up about 10% of the potting media was much more difficult to guarantee freedom from contaminating P. cinnamomi. One of the main quarries supplying the nursery industry was largely free of evidence of infection except for one small area. Clearly this was the most likely source of sporadic contamination, but very difficult to manage unless all gravel was to be sterilised. A gravel supplier agreed to adapt one of his trucks so that steam sterilisation could be done. The sterilisation process, using steam generated for timber kilns in a large sawmill, was able to produce temperatures just below 100^{o}C throughout a 10m^3 load of gravel.

4.4. Diseases of native plant communities

4.4.1. *Phytophthora cinnamomi*

The Australian Nature Conservation Agency (ANCA), for the past 3 years, have been funding two projects, administered by Forestry Tasmania, to mitigate the impact of *P. cinnamomi* towards approximately 50 rare or endangered plant species. The first project which identified, delineated and prioritised (for suitability to manage) areas containing those rare or endangered species shown to be susceptible to *P. cinnamomi* (using a glasshouse inoculation trial) has been completed and reported. The second project focussed on a subset of nine species considered to be under greatest threat from *P. cinnamomi.* Extension surveys were conducted to try and find new populations of the nine plant species in areas offering better prospects for management (to protect against *P. cinnamomi*) than the known extant populations. New populations were discovered for three of the species-*Tetratheca gunnii*, *Pultenaea paleacea* and *Epacris apsleyensis*. *P. cinnamomi* was isolated for the first time from the very rare *Tetratheca gunnii*. Permanent monitoring plots, with and without phosphonate treatment, have been established in a number of infected areas containing several of these threatened species.

Forestry Tasmania is currently reviewing its *Phytophthora cinnamomi* policy which hasnít been changed since the late 1970ís. The policy direction is likely to focus on the objective of minimising adverse impacts of the fungus in plant species or communities of high conservation value and will be initially directed towards areas identified in the ANCA-funded projects.

A group representing most land managers has been convened to review *P. cinnamomi* management in Tasmania. The aim of this group is to develop a consistent approach to *P. cinnamomi* management in Tasmania which will hopefully feed into the National Threat Abatement Plan for *P. cinnamomi* being overseen by ANCA

4.4.2. Pine Lake Dieback

Little progress has been made in determining the cause of dieback at Pine Lake since the original isolation of a *Phytophthora* species from dying *Richea scoparia* in July 1994. Despite repeated attempts we have been unable to reisolate this *Phytophthora* from any other dying plants nor by baiting soil samples (using a large variety of baits) collected from within diseased areas. However, a variety of other Pythiaceae (particularly isolates which look like *Pythium splendens*) were commonly recovered from soil samples taken from diseased areas. A glasshouse pathogenicity test of the *Phytophthora* against seedlings of a number of the species dying at Pine Lake together with a small number of rainforest and eucalypt species had to be abandoned because of contaminating Pythiaceae (all seedlings were purchased from commercial nurseries).

The number and size of affected areas, within the general area of Pine Lake, expanded considerably during the summer of 1994/95. Department of Environment and Land Management (the responsible management agency) have implemented a number of actions to retard further spread of the disease. In doing so they have acted on the assumption that the dieback is caused by a pathogen which acts in a manner expected of a soil-borne *Phytophthora*. Actions DELM have taken include:

- mapping of affected areas;
- imposition of a quarantine area under the State Plant Health Act;
- supervising the sealing and improved drainage of the Lake Highway through the quarantine area (to minimise the transfer of inoculum out of the affected area);
- undertaking an extensive public education program;
- spraying the affected area with phosphonate;
- establishing permanent plots to monitor the development of the disease.

Further research into the cause of the dieback at Pine Lake is now being conducted by a PhD student (supervised by Caroline Mohammed).

5. <u>Western Australia</u>: Mike Stukely, Conservation and Land Management, WA.

5.1 WA dieback review

The review of dieback in Western Australia, being conducted for the Minister of the Environment by Drs Podger, James and Mulcahy, is due for completion this month.

5.2 National Threat Abatement Plan for *Phytophthora* in Australia's native vegetation

Negotiations have commenced between the Australian Nature Conservation Authority (ANCA) and the Department of Conservation and Land Management WA in relation to the legislative obligation of ANCA to prepare a National Threat Abatement Plan for *Phytophthora* in indigenous plant communities.

5.3 Softwood & hardwood plantations

No major pathological problems have been reported in the softwood (*Pinus radiata* and *P.pinaster*) or hardwood (*Eucalyptus globulus*) plantations in the last year. Whilst there have been some localised drought deaths, water stress levels are lower than at this time last year, following higher rainfall in 1995.

5.3.1 Selection of *Pinus radiata* resistant to *P. cinnamomi*

(T. Butcher and M. Stukely, CALM)

968 pedigree selections from Australian, New Zealand and South African breeding programs, and 120 families from native stands in California, have been screened for resistance to *P. cinnamomi*. Heritability of seedling resistance is very high and consistent at both the family and individual level, but maternal inheritance is not significant. Resistance is stable for differing environments and a wide range of pathogen isolates. Field trials of resistant seedlings have produced genetic gains of 22% in stand basal area after 10 and 13 years on *P. cinnamomi*-infested sites. Culling of susceptible lines from the seed orchard will have increased the overall resistance of pollens, which will lead to further gains in the progeny.

5.3.2 *Mycosphaerella*

A report on the occurrence of three species of *Mycosphaerella* and their effects on *E. globulus* plantations and several indigenous eucalypts in the native forests of south-western Australia is in press (Carnegie, Keane and Podger 1996).

5.4 Native forests

No major new pathological problems have been reported. Root rot diseases due to *Phytophthora* and *Armillaria,* together with stem-decaying organisms, continue to command attention.

Colletotrichum xanthorrhoea Shivas *et al*, *nov. sp.*, cause of a newly-recognised and occasionally lethal leaf-spot disease on two *Xanthorrhoea* species, may contribute to inaccurate diagnosis of the presence of *P. cinnamomi* on colour aerial photography routinely used in management of the dieback problem (F. Podger, CALM Consultant).

5.5 Jarrah Forest Region

5.5.1 Dieback-resistant jarrah

Screening for resistance to *Phytophthora cinnamomi* in 90 half-sib families of jarrah (*Eucalyptus marginata*) seedlings, derived from trees surviving in long-term dieback "graveyard" sites in the forest, was completed in 1995. There was a greater proportion of resistant families here than among the progeny of randomly selected parent trees tested previously. Selection of resistant individuals for propagation and further testing prior to their inclusion in clonal seed orchards is progressing (M. Stukely, CALM).

Trial plots of clonal *P. cinnamomi*-resistant jarrah were established in several operational forest rehabilitation sites in the Northern Jarrah Forest in winter 1994 and 1995. Survival has been variable, with significant first-year mortality due to drought occurring particularly where competition from remaining vegetation was high. This planting program is continuing in 1996. Earlier plantings (1988-90) of clonal dieback-resistant jarrah in dieback-affected bauxite mine rehabilitation sites have continued to perform well in terms of both survival and growth (M. Stukely, CALM). Methods of establishing resistant plants on extremely harsh forest "graveyard" sites are being evaluated (G. Stoneman, CALM). Monitoring of large-scale field validation trials of resistant clones on bauxite pits is continuing (I. Colquhoun, Alcoa).

A joint CALM (M. Stukely)/CSIRO (M. Byrne & G. Moran) project, supported by RIRDC, Alcoa and Western Collieries, aims to develop molecular markers linked to the genes controlling resistance to *P. cinnamomi* in jarrah. Good progress has been made by M. Byrne and G. Moran in developing DNA markers, and crosses of selected jarrah lines have been carried out to provide full-sib seedlings for testing of resistance and assessment of the linkage of markers.

5.5.2 Interactions between fire regimes and damage due to *Phytophthora cinnamomi*

(F.D. Podger, CALM Consultant & N. Burrows, CALM).

Sources in the local conservation community and academia have been critical of the regimes in the use of fire for fuel reduction in the jarrah forests. This is based *inter alia* on argument that damage due to root rot of native species will be exacerbated by fire regimes currently employed by CALM.

The strong relationship between fire and the activity of *P. cinnamomi* reported earlier in Tasmania for rainforests (Podger & Brown 1988) and other seral communities is not evident in the jarrah forests. Data from a range of infected stands which differ in time since last fire (1-80 years), fire frequency and fuel loads (2-20 tonnes/ha) provide no evidence of a fire effect upon the ability of *P. cinnamomi* to destroy important elements of the understorey and ground cover.

The difference in the Tasmanian and Western Australian experience is attributed to the effects of fire on soil temperature following canopy reduction in the normally cool soil environment of Tasmania and the warmer soil regimes of Western Australia. Lower thresholds of temperature for sporangial production are rarely obtained under canopy in Tasmania but are exceeded for long periods in Western Australia.

5.5.3 Biology, ecology and pathology of *Phytophthora*:

A number of student projects at Murdoch University are active in this area.

P. cinnamomi zoospores are able to infect through the suberised tissue (periderm) of jarrah collars. This is associated with temporary ponding of water in riplines on bauxite pits undergoing rehabilitation (E. O'Gara, G. Hardy & J. McComb).

Floristic changes across a range of forest sites over time, as a direct and indirect consequence of *P. cinnamomi* infestation, are being studied to determine the long-term impact on jarrah forest plant communities (K. McDougall, G. HaRdy & R. Hobbs).

An investigation of the distribution of phosphonate in a range of jarrah forest understorey species and control of *P. cinnamomi* is looking at phytotoxicity, plant health, flowering and seed set, in addition to the effects on ectomycorrhizal fungi (R. Bennallick, G. Hardy, MU, & B. Shearer, CALM).

The genetics of pathogenicity in *P. cinnamomi* is being investigated by D. Huberli, G. Hardy, MU, & I. Tommerup, CSIRO.

Biochemical defence mechanisms in jarrah to *P. cinnamomi* in the presence or absence of phosphonate are being examined, with emphasis on the key enzymes of the isoflavonoid and lignin pathways (T. Jackson, G. Hardy & T. Burgess).

A study aimed to determine whether *P. cinnamomi* can sporulate from infected but phosphonate-treated plants is being conducted on a range of susceptible and resistant plant species. It is also examining whether zoospores of *P. cinnamomi* can infect phosphonate-treated tissue (C. Wilkinson, G. Hardy MU, & B. Shearer, CALM).

The possibility that inoculation with ectomycorrhizal fungi systemically induces resistance of jarrah to *P. cinnamomi* is being tested by G. Hardy & B. Dell.

The effect of low oxygen levels and temporary waterlogging on the biochemical pathways of clonal jarrah resistant and susceptible to *P. cinnamomi* is being examined by J. McComb, G. Hardy, I. Colquhoun, G. Roos, T. Burgess & F Alamassi.

5.7 Karri Forest Region

5.7.1 *Armillaria*:

Monitoring of the long-term effects of *Armillaria* on a 16-yr-old regrowth karri plot has continued (M. Pearce). A second experiment testing chemical and biocontrol methods against *Armillaria* in regrowth karri was established in 1995. Final assessment of the first trial (established by M. Pearce & E. Davison in 1992) is due this year (M. Stukely, CALM).

5.7.2 Karri rot

Work has been temporarily suspended following the resignation of Dr Davison.

5.7.3 *Ganoderma*:

Ganoderma was found on several "landing logs" in regrowth karri forests (M. Pearce; B. Smith, UWA).

5.7.4 Relative pathogenicity of *Phytophthora* species in Southern Forest vegetation types

(S. Carstairs, CALM Contractor & F. Podger, CALM Consultant).

The pathogenicity of six distinct *Phytophthora* taxa, isozymically identified, is being evaluated on a total of 11 higher plant taxa of understorey and ground flora in four native forest communities in the karri region. The experiment involves the introduction of inoculum via the soil system and at one site compares this analogue of natural infection with stem wound-inoculation of *Banksia grandis*.

5.8 Diagnostic work

Between June 1995 and January 1996, 1300 samples were processed for *Phytophthora* identification by CALM's Vegetation Health Service (VHS). *P. cinnamomi* was detected in 270 samples, *P. citricola* (92), *P. cryptogea* (11), *P. drechsleri* (22) and *P. megasperma* (2). There were 11 pine, eucalypt and other samples for general diagnosis in this period (F. Tay, CALM).

5.8.1 Rapid identification of *Phytophthora* spp using isozyme analysis

(S. Carstairs, CALM Contractor & M. Stukely, CALM)

Cellulose acetate gel electrophoresis (CAGE) was compared with the traditional morphological method for accuracy, efficiency and cost in identifying the *Phytophthora* spp found in WA plant communities (*P. cinnamomi*, *P. citricola* complex, *P. cryptogea* complex, *P. drechsleri* complex, *P. megasperma* complex, *P. nicotianae*).

The CAGE method consistently gave very high levels of accuracy, whilst the morphological method was more variable. Routine diagnosis only to either *P. cinnamomi* or "*Phytophthora* sp.", based on hyphal morphology alone, was most efficient. To identify species other than *P. cinnamomi*, CAGE required 38% less time than the morphological method and was 12% cheaper. CAGE is now in routine use in CALM's Vegetation Health Service for these species.

The WA population of *P. cinnamomi* was compared isozymically with that in the eastern states and to a world-wide survey of isolates. The Western Australian "A2" mating type was more polymorphic than the other two populations.

5.8.2 Factors affecting recovery of *Phytophthora* from soil samples

(S. Carstairs, CALM Contractor, M. Stukely, CALM & F. Podger, Consultant adviser).

Modification of baiting techniques has increased the level of confidence of retrieving Phytophthoras from soil samples which are infested with more than one species of *Phytophthora*. The effects of pH on bait recoveries of *Phytophthora* have been examined.

The probability that samples found negative at first baiting will also be negative at second baiting has been calculated.

5.9 Native plant communities

5.9.1 Use of debilitating factors and host resistance to control *Cryptodiaporthe melanocraspeda* of *Banksia coccinea*:

Weakly pathogenic isolates have been identified and will be tested in simultaneous inoculations with pathogenic isolates this year to determine their potential as biocontrol agents. In controlled inoculations, variation between plants in lesion development by *C. melanocraspeda* has been observed; the level of intraspecific variation in response will now be determined. Isozymic variation has been compared for over 100 isolates and compared to known species of *Cryptodiaporthe*. (B. Shearer, CALM).

5.9.2 Control of *Phytophthora* with phosphonate

Trials testing rates of application and duration of protection are continuing. While 10% phosphonate protects plants for up to 2yr, higher concentrations (20, 40%) currently being tested are expected to ensure longer protection. Follow-up applications have boosted phosphonate levels in plant tissue. Droplet size is one of the most important factors determining the success of application (B. Komorek, CALM). An experimental system has been established to allow economical testing of a range of options for aerial application of phosphonate, using a combination of miniplopts, a hand-held applicator and controlled introduction of inoculum. Plot establishment is proceeding (B. Shearer, CALM).

5.9.3 Control of *Armillaria luteobubalina*:

Phosphonate injection trials have been established in *Banksia attenuata* and *Eucalyptus wandoo*. Isozymic variation has been compared for over 100 isolates (B. Shearer, CALM).

5.9.4 *Phytophthora citricola*:

Using isozyme analysis, three electrophoretic subgroups were resolved, and these were aligned with morphological and cultural variation in the species. There was an association of *P. citricola* with roads surveyed in the jarrah forest, with recovery declining with distance away from the road into adjacent forest. Oospores were produced in both soil and plant tissue. Oospores remained viable after 6mo at two field sites and after 18mo in soil in the laboratory, indicating that they are important for the long-term survival of this species in soil. Phosphonate is regarded as the most promising method of controlling *P. citricola* in native plant communities. It inhibited lesion growth of both major electrophoretic subgroups *in vivo*, but only one subgroup *in vitro* (F. Bunny, CALM).

6. South Australia:

No report presented

7 New Zealand Peter Gadgil, Forest Research Institute, New Zealand

7.1 Northland and Auckland (ND, AK)

Cyclaneusma needle-cast continues to be a problem in these regions. Continued high humidity coupled with heavy clay sites have also contributed to ill-health. The *Dothistroma* spray programme went exceptionally well this season and was completed with no problems reported from this area.

7.2 Coromandel, Waikato, BOP and Taupo (CL, WO, BP, TO)

Cyclaneusma and *Dothistroma* continue to affect radiata pine plantings throughout these regions. Cyclaneusma needle-cast is the main disease causing needle loss in the 5- to 18-year-old age range.

Monitoring for *Helicoverpa armigera* (tomato fruitworm) caterpillars on lotus oversown areas has continued. A couple of forests have indicated that numbers are increasing and causing concern.

7.3 East Coast, Gisborne, Hawkes Bay (GB, HB)

There have been no reports of major problems from the Gisborne and East Coast regions to date. However, the *Ophelimus* gall-wasp was confirmed as being present around Gisborne on *Eucalyptus botryoides* and *E. saligna*.

7.4 Wairarapa, Wellington, Wanganui, Taranaki (WA, WN, WI, TK)

Cyclaneusma and moderate to high *Dothistroma* levels are the main forest health concerns in these regions. As with other areas high humidity levels have promoted these diseases in most forests.

7.5 Nelson and Marlborough (NN, MB, SD)

From September levels of *Cyclaneusma* and *Dothistroma* needle cast were increasing noticeably. Fairly high incidences of *Cyclaneusma* were also evident in October and November. On one ex-pasture site 4-year-old *P. radiata* had heavy infection levels, which is unusual for trees at this early age.

Assessments indicate a significant *Dothistroma* spray programme will be required.

The Swiss needle cast fungus *Phaeocryptopus gaeumannii* was causing widespread yellowing in Douglas fir throughout the Nelson area.

Lightning strikes continued to be a prominent feature in hill country forests. Large strikes were found to have up to forty trees either dead or in decline.

Winter storms also resulted in some large areas of windthrow.

7.6 Canterbury (NC, MC, SC)

With the onset of spring growth bacterial cankers affecting 1- to 2-year-old *P. radiata* were noted in some mid- and north Canterbury forests. Bacterial infection is often facilitated by frost damage.

The wet winter in north Canterbury and associated water logging, resulted in numerous patches of *P.radiata* and *Eucalyptus* mortality. This often involved root rot. Low lying shelterbelts and woodlots were the main type of plantings affected.

Periods of warm north-westerly winds in September and October resulted in early flights of *Hylastes* and *Hylurgus* bark beetles, grass grub beetles and burnt pine longhorn insect *Arhopalus tristis.* Large numbers of *Arhopalus* larvae were found in logging debris in most mid- and north Canterbury forests.

A number of incidences of boron toxicity to *P. radiata* after fertilising were observed, these were usually on light sandy or stony sites. In all instances the toxicity was associated with a sub-standard batch of boron fertiliser.

Generally the incidence of Cyclaneusma needle-cast was low throughout Canterbury.

With the onset of drier weather populations of the *Eucalyptus* scale insect *Eriococcus* sp. are building in Canterbury, particularly on *Eucalyptus nitens,* the juvenile foliage of which is very susceptible.

7.7 Westland (BR, WD)

A large area (10 km^2) of beech forest south of Reefton experienced an outbreak of the native moth *Epichorista emphanes* in late November. The caterpillars of this insect defoliated predominantly hard beech. This same area was subjected to an outbreak of native bag moth two years earlier.

Exotic forest inspections on the West Coast started in December and will be covered in the next report.

7.8 Dunedin (DN)

Apparent increases in the incidence of Rata scale *(Anoplaspis metrosideri)* and Totara Scale *(Madarococcus totarae)* were found in the Dunedin metropolitan area. Suggestions to spray these scales are ill-advised as it may affect their natural parasites. The build up of parasite populations is lagging behind due to the colder than usual winter.

Also on the subject of winter, scattered individuals and groups of Cherry *(Prunus* sp.) have undergone dieback of foliage and scattered branches since late winter. Samples have "revealed" *Monilinia* sp., *Pseudomonas* and a possible viral association.

7.9 Otago Lakes (OL)

Nothing new to report.

7.10 Central Otago (CO)

Possum damage to *P. radiata* and Douglas Fir in one forest is more prevalent at this time than is usual.

7.11 Southland (SL)

On or about the 20th of October, much of Southland experienced extremely strong westerly winds. This has resulted in varying degrees of damage. Shelterbelts of *P. radiata* in the Waimea Plain and the Te Anau Basin which have been in existence for many years have succumbed to these winds.

7.12 Fiordland (FD)

Nothing to report.

7.13 NOTES ON THE LIST OF DISORDERS

a. Biological Regions: AK - Auckland; BP - Bay of Plenty; BR - Buller; CL - Coromandel;
CO Central Otago; DN - Dunedin; FD - Fiordland; GB - Gisborne; HB - Hawkes Bay; MB - Marlborough; MC - Mid Canterbury; MK - Mackenzie; NC - North Canterbury; ND - Northland; NN - Nelson; OL - Otago Lakes; RI - Rangitikei; SC - South Canterbury;
SD - Marlborough Sounds; SI - Stewart Island; SL - Southland; TK - Taranaki; TO - Taupo;
WA - Wairarapa; WD - Westland; WI - Wanganui; WN - Wellington, WO - Waikato)

b. Disorder/Pest/Pathogen: Only the generic name of an organism is given. Leaflets are available on the more common pests and pathogens.

c. Severity:
H - High. More than 70% of the crown affected or tree mortality has been known to occur as a result of infection.
M - Moderate. 30-70% of the crown affected and some loss in growth can be expected.
L - Low. Less than 30% of the crown affected. Growth loss negligible.

d. Incidence:
WR - Widespread throughout the region.
WL - Widespread locally through individual forests.
SR - Scattered small groups of affected trees throughout the region.
SL - Scattered small local groups.
I - Isolated few trees in one or a few locations.

When there is more than one record of a disorder, the severity and incidence notations are based on an average subjective value.

7.14 Disorders recorded on major plantation species in New Zealand from September 1995 toNovember 1995

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
AK	*E. polyanthemos*	Leaf destruction	M	I	2
	Eucalyptus spp.	Leaf destruction	M	I	1
		Leaf blotching	L	I	1
		Leaf discolouration	M	SL	2
		Leaf surface blight	M	SL	1
BP	*Eucalyptus fastigata*	Nutrient deficiency	M	I	1
		Sawfly	L	I	1
		Stenopotes	M	I	1
		Trimmatostroma	L	I	1
	E. nitens	*Ctenarytaina eucalypti*	H	WL	1
		Foliage dieback	H	WL	1
		Phylacteophaga frogatti	H	SL	1
		Possum damage	M	SL	1

		Septoria	H	SL	1
	E. regnans	*Aulographina eucalypti*	L	SL	1
		Cercospora eucalypti	L	SL	1
		Leaf spots	M	WL	1
		Microthyrium eucalypti	L	SL	1
	E. saligna	Sawfly	L	SL	2
		Scale insects	L	SL	1
	P. radiata	Animal damage	M	SL	5
		Armillaria	H	SL	33
		Branch dieback	L	SL	1
		Butt sweep	M	SR	25
		Butt sweep/Toppling			
		Cattle damage	M	SL	2
		Chemical damage (Herbicide)	H	I	1
		Cicada Damage (old)	L	I	1
		Cyclaneusma	M	WR	146
		Diplodia tip dieback	L	SL	3
		Dothistroma	M	WR	91

(contd)

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
		Helicoverpa armigera	M	WL	1
		Hylastes ater	M	I	2
		Hylurgus ligniperda	L	SL	2
		Magnesium deficiency	L	I	4
		Mid-crown yellowing	L	SL	1
		Old *Helicoverpa* defoliation	M	WL	1
		Peniophora sacrata	M	I	1
		Phosphorus deficiency	M	SL	10
		Pineus laevis	L	I	1
		Possum damage	M	SR	96
		Resin bleeding	M	SL	4
		Rhizoctonia sp.	L	I	1
		Root rot	H	I	2
		Rosellinia	M	I	1
		Socketing	M	I	4

		Upper mid-crown yellowing	L	WL	27
		Whorl canker	M	SL	8
		Wind damage	H	WL	21
BR	*P. radiata*	*Armillaria* infection of stumps	H	WL	1
		Dothistroma	M	WL	1
		Needle cast	L	WL	1
DN	*E. delegatensis*	*Mycosphaerella cryptica*	L	SL	1
	P. radiata	*Armillaria*	L	I	2
		Ctenopseustis obliquana	L	SL	4
		Cyclaneusma	M	SL	11
		Diplodia	M	WL	16
		Dothistroma	L	SL	5
		Grass grub	L	I	1
		Hail damage	L	I	1
		Hylastes - mortality	L	I	2
		Liothula omnivora	L	SL	4
		Magnesium deficiency	L	SL	2

(contd)

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
		Mid-crown yellowing	M	SR	26
		Pineus laevis	L	WL	23
		Possum (terminal damage)	L	I	3
		Pseudocoremia suavis	L	SL	7
		Snow damage	M	WL	25
		Spray damage	M	SL	3
		Upper mid-crown yellowing	M	SR	23
		Windthrow	H	SR	6
	P. menziesii	*Ctenopseustis* chewings	L	I	1
		Phaeocryptopus gaeumannii	M	WL	4
		Roadside spray damage	M	I	1
GB	*P. radiata*	*Armillaria*	H	SL	3
		Butt sweep	H	SL	5
		Cyclaneusma	H	WL	9

		Diplodia	M	SL	3
		Dothistroma	M	SL	1
		Goat damage	M	I	2
		Magnesium deficiency	L	SL	3
		Possum damage	L	WL	16
		Resin bleeding	M	I	1
		Snow damage	L	SL	2
		Upper mid-crown yellowing	M	WL	19
		Wind damage	H	WL	5
	Pseudotsuga menziesii	*Phaeocryptopus gaeumannii*	M	SL	1
		Wind damage	M	SL	1
HB	*E. delegatensis*	*Aulographina eucalypti*	L	I	1
	Eucalyptus spp.	Leaf spots	M	WL	1
	P. radiata	Animal damage	L	SL	3
		Armillaria mortality	H	SL	2
		Cyclaneusma	M	WL	12
		Diplodia	H	WL	7
		Dothistroma	M	WR	8
		Heliothrips	L	I	1

(contd)

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
		Hylastes ater	M	SL	3
		Limestone yellowing	M	SL	8
		Mid-crown yellowing	M	WL	10
		Pineus laevis	L	SL	3
		Possum damage	M	WL	7
		Pseudocoremia suavis	L	I	1
		Resin bleeding	H	WL	9
		Sirex mortality	H	I	2
		Spray damage	M	SL	3
		Storm damage	M	SL	4
		Tortricid damage	L	I	1
		Upper mid-crown yellowing	M	I	1
		Windthrow	H	SL	3
MB	*P. radiata*	Possum damage	L	SL	1
	P. menziesii	*Phaeocryptopus gaeumanni*	M	WL	1

		Possum	L	SL	1
MC	*P. radiata*	*Cyclaneusma*	H	SL	1
NC	*P. radiata*	Animal/Goat browse	L	I	1
		Bark borer	L	WL	2
		Cyclaneusma	M	SL	3
		Diplodia	M	WL	4
		Hare damage	H	WL	1
		Rabbit browse	H	WL	1
		Stem/Branch cankers	H	SL	1
ND	*Eucalyptus* mixture	*Phylacteophaga froggatti*	M	SL	1
	P. radiata	*Cyclaneusma*	M	WL	1
NN	*Eucalyptus* spp.	*Armillaria*	H	I	1
		Leaf spot	H	WL	2
	P. radiata	*Armillaria*	H	I	3
		Boron deficiency	H	SL	1

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Biological region	**Host species**	**Disorder/pest/pathogen**	**Average severity**	**Average incidence**	**No. of records**
		Cyclaneusma	M	WR	8
		Dothistroma	M-H	WR	20
		Magnesium deficiency	L	SL	4
		Nutrient deficiency	H	WL	5
		Possum damage	H	SL	5
		Resin bleeding/stem canker	H	I	1
		Root rot	H	I	3
		Snow damage	H	WL	1
		Stem canker	H	I	1
		Upper mid-crown yellowing	M	WR	13
		Whorl canker	H	SL	2
	P. menziesii	Needle yellowing	M	I	1
		Phaeocryptopus gaeumannii	M	WR	5

TK	*P. radiata*	Club root	M	SL	2
		Cyclaneusma	M	WL	4
		Limestone yellowing	M	I	1
		Mid-crown yellowing	M	I	1
		Old possum damage	M	SL	1
		Possum damage	H	WL	5
		Sheep damage	M	I	1
		Upper mid-crown yellowing	M	SL	1
		Windthrow	H	I	1
TO	*E. nitens*	*Eriococcus eucalypti*	H	SL	1
		Sawfly	L	SL	1
		Septoria pulcherrima	L	WL	1
	E. regnans	*Aulographina*	L	WL	6
		Cercospora	L	WL	1
		Cicada damage	M	SL	2
		Frost damage	L	SL	1
		Hendersonia	L	WL	1
		Mycosphaerella cryptica	L	SL	1
		Nitrogen deficiency	M	SL	1
		Phosphorus deficiency	H	SL	1

(contd)

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
		Possum	L	I	1
		Sawfly	H	SL	2
		Trimmatostroma	M	WL	4
	P. radiata	Animal damage	M	SL	7
		Armillaria	H	SR	22
		Boron shoot dieback	H	SL	1
		Butt sweep/toppling	M	SL	2
		Cicada damage	L	SL	8
		Cyclaneusma	M-H	WR	99
		Diplodia	L	I	2
		Dothistroma	L-M	WR	62
		Frost damage	M	WL	14
		Helicoverpa	M	WL	5
		Hylastes damage	H	WL	9

		Hylurgus	L	I	1
		Kaka damage	M	SL	1
		Magnesium deficiency	L	WL	11
		Old *Helicoverpa* defoliation	M	WL	6
		Old possum damage	M	WL	10
		Phosphorus deficiency	M	SR	11
		Possum damage	L	WR	70
		Rabbit chewing	H	I	1
		Resin bleeding	L	I	1
		Spray damage	I	SL	2
		Stock damage	H	I	1
		Toppling/socketing	H	SL	6
		Upper mid-crown yellowing	L-M	WR	67
		Whorl canker	L	SL	5
		Wind damage	M-H	WL	12
WA	*P. radiata*	*Armillaria*	H	I	1
		Chlorosis	M	SL	11
		Cyclaneusma	M	WR	10
		Diplodia	M	SL	3
		Hylastes ater	L	I	2

(contd)

Biological region	**Host species**	**Disorder/pest/pathogen**	**Average severity**	**Average incidence**	**No. of records**
		Hylurgus ligniperda	L	I	1
		Mid-crown yellowing	M	SL	7
		Nutrient deficiency	M	WL	1
		Pineus laevis	L	I	4
		Pseudocoremia suavis	L	I	1
		Resin bleeding	M	SL	2
		Toppling	M	SL	4
		Tortricids	L	I	1
		Wet feet	M	SL	10
		Windthrow	H	I	2
	P. menziesii	Branch breakage	L	I	1
		Phaeocryptopus gaeumannii	L	I	1
		Phomopsis pseudotsugae	L	I	1
		Windthrow	H	I	1

WI	*E. ficifolia*	Leafspot	M	I	1
	P. radiata	*Armillaria* mortality	H	SL	2
		Cankering	M	I	1
		Cyclaneusma	L	SL	2
		Deer damage	M	I	2
		Diplodia	H	SL	3
		Hare damage	M	I	1
		Hylastes ater	M	I	1
		Hylurgus ligniperda	M	I	1
		Liothula omnivora	L	I	2
		Resin bleeding	M	SL	4
		Sirex mortality	H	I	1
WN	*E. globulus*	Leaf spots	M	I	1
	Eucalyptus spp.	Leaf spots	L	I	1
	P. radiata	*Armillaria* mortality	H	SL	4
		Ctenopseustis obliquana	L	I	2
		Cyclaneusma	M	WR	16
		Deer damage	M	WL	7
		Diplodia	L	I	1

(contd)

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
		Dothistroma	M	WL	3
		Hylastes ater	H	I	1
		Hylurgus ligniperda	M	WL	2
		Kalotermes brounii	L	I	1
		Liothula omnivora	L	I	1
		Possum damage	M	L	1
		Resin bleeding	L	SL	3
		Salt burn	L	WL	4
		Sublethal *Armillaria*	M	I	1
		Windthrow	H	I	1
	P. menziesii	Defoliation	H	I	1
WO	*E. delegatensis*	*Aulographina*	L	WL	3
		Cicada damage	L	WL	1

		Trimmatostroma	L	I	1
	E. fastigata	*Aulographina*	L	SL	2
		Cicada scars	L	WL	1
		Mycosphaerella nubilosa	L	I	1
		Sawfly	M	I	1
		Strepticrates	L	I	1
		Trimmatostroma	M	WL	1
	E. nitens	*Armillaria*	H	I	1
		Mycosphaerella cryptica	L	I	1
		Old Paropsis browsing	L	I	2
		Phosphorus deficiency	M	I	1
		Septoria pulcherrima	L	SL	4
	E. regnans	*Aulographina*	L	WL	8
		Cercospora	L	I	1
		Cicada damage	M	I	1
		Frost damage	L	I	1
		Hendersonia	L	WL	2
		Mycosphaerella	L	WL	2
		Sawfly	L	SL	3
		Strepticrates	L	I	1
		Trimmatostroma	L	WL	5

(contd)

Biological region	Host species	Disorder/pest/pathogen	Average severity	Average incidence	No. of records
	P. radiata	Animal browse	M	WL	7
		Antler damage	H	WL	8
		Arhopalus	M	I	1
		Armillaria	H	WR	39
		Cicada damage	L	WR	23
		Cyclaneusma	M-H	WR	94
		Diplodia	M	SL	5
		Dothistroma	M	WR	68
		Frost damage	M	WL	16
		Gregarious tineid	L	I	3
		Hare damage	M	SL	3
a		*Hylastes*	L	I	3
		Hylurgus	L	I	1
		Magnesium deficiency	L	SL	12

		Old *Helicoverpa* defoliation	H	WL	6
		Old wind damage	H	WL	7
		Phosphorus deficiency	M	SL	15
		Possum damage	L	SL	30
		Resin bleeding	L	SL	4
		Spray damage	M	I	4
		Sublethal Hylastes attack	M	I	3
		Upper mid-crown yellowing	L	SR	12
		Whorl canker	L	I	1

7.15 NEW ZEALAND BIOGEOGRAPHIC REGIONS

8 Quarantine report

Discussion occurred on the effectiveness of quarantine procedures in Australia and New Zealand. Considerable concern was raised over AQIS policy in regard to risk assessment. Decisions by AQIS were reported to be based on bio-economic risk analysis with biological risks placed first. Examples were raised in relation to Pitch Canker and green timber imports. Wood fungi on timber often ignored. New Zealand also allows green sawn timber and logs into the country. Traditionally if bark is removed the risk is considered to be sufficiently reduced however it can be re–examined if considered a problem. Risk analysis needs to be examined in context with AQIS review.

An example also of import of fresh wild mushrooms from Europe was raised with the possibility of needle fragments with them. Can't be sure that they were clean. Concerns that they also were being used as inoculum to grow in Australia and not just for the restaurant trade. Difficult to police and may possibly invade native ecosystems with unknown consequences. Would not be permitted in New Zealand.

Discussion on transfer of genetic material (scions) from New Zealand to Australia. Methyl Bromide found to be effective without killing scions.

Concerns were raised with the import of second hand logging machinery from North America and vehicles from Japan. New Zealand looking to powers to return vehicles and machinery if dirty. Australia also requires clean machinery and option given to importer to clean or return.

9 CSIRO, Division of Forestry and Forest Products.

Caroline Mohammed, CSIRO Tasmania.

REPORTS FOLLOWING

9.1 Development of management prescriptions to minimise pathological effects of pruning in *Eucalyptus nitens* plantations
Caroline Mohammed and Milton Savva

9.2 A Pathological Investigation of the Dieback of Pencil Pines and Alpine Flora in the Central Highlands, Tasmania
Kylie Shanahan and Caroline Mohammed

9.1 Development of management prescriptions to minimise pathological effects of pruning in *Eucalyptus nitens* plantations

Caroline Mohammed[1,2] and Milton Savva[1]

Collaborative organisations:

Forest and Forest Industries Council (Funding agency)

[1]CSIRO Division of Forestry and Forest Products

[2]University of Tasmania, Dept. of Agricultural Science

Background

The forest industry in Australia is increasingly applying more intensive silvicultural regimes to timber production, involving thinning in native forests and establishment of plantations. However, of the 145,000 ha of eucalypt plantations established in Australia to date, most are intended for production of pulpwood on short rotations of 15 to 20 years. Once established, these plantations receive little or no treatment apart from occasional protection from pests and diseases.

Some plantations of *E. nitens* have been established in Tasmania primarily for veneer and sawing on longer rotations (30 to 35 years). Without additional treatment, these plantations would produce practically no appearance grade sawn material and structural grades would only have low strength characteristics (Waugh & Yang, 1994). It is anticipated that by adopting appropriate silvicultural treatments, a significant improvement in grade out-turn could be achieved. In particular, the ability of plantation-grown *E. nitens* to shed branches is poor, leading to unacceptably high levels of defects in timber from sawing trials. Since most of the defects in solid wood are associated with branches, pruning would be necessary to produce clear-wood. There is little information available on which to base provisional management prescriptions for pruning of eucalypts, with most research undertaken in South Africa and New Zealand.

The need for guidelines is urgent. Between 1991 and 1994, 5000 ha of *E. nitens* plantations were established in Tasmania by the Forest and Forest Industry Council, primarily destined to produce high quality wood for sawing and veneer (final crop trees pruned to 6 m log length with a maximum knotty core diameter at any part of the log of 15 cm). By the end of 1995 this figure will be approximately 7500 hectares.

A wide range of silvicultural regimes for plantation *E. nitens* is currently being tested in Tasmania, from early age (3-5 years) thinning and pruning (similar to clearwood regimes in *P. radiata*) to a simple commercial thinning at age 10-15 years. It is important that this type of research be carefully targeted at providing provisional management prescriptions or operational tools in the short term (2 years). If correct practices are adopted in the short term this should immediately reduce any adverse consequences of pruning and avoid the need for long term research. Existing provisional guidelines for immediate plantation management decisions advocate non commercial thinning and pruning (in 2 lifts) in years 3-4 and 5-6. Medium term research (4 years) will be required to answer the involvement in pruning associated decay of factors such as site and provenances.

Compared with pulpwood plantations, those intended for production of solid wood require substantial extra investment in pruning and thinning so they are more sensitive to losses incurred by damaging agents including stem-degrading insects and fungi. Decay columns in the stem can originate through 'courts' of fungal infection when protective outer bark is removed during thinning or pruning operations. Studies in Tasmania (White and Kile 1991) and Victoria (Old *et al* . 1993) have demonstrated that stem wounds are very effective in initiating decay columns in several eucalypt species. However, recently the use of cable thinning in Tasmania has dramatically cut the incidence of wounds from thinning operations.

The only reported pathological studies of infections that resulted from pruning wounds in eucalypts were carried out by Gadgil and Bawden (1981) with *E. delegatensis* in New Zealand. They found that nearly 50 percent of trees examined had decay which could be attributed to either fungal entry through pruning wounds or entry through branches which had died due to suppression. The incidence of infection from pruning wounds was lowest in those branches pruned in winter. The influence of length and diameter of branch stubs on the incidence of infection by decay fungi was found to vary with fungal species colonising the wounds. Treatment with *Trichoderma*, a fungus antagonistic to the decay fungi, did not reduce the level of infection by decay fungi but chemical treatment by Captathol was more successful.

Recent surveys in Tasmania (Wardlaw, 1995) in pruned 8-16 year *E. nitens* plantations indicated that up to 15% of the branches in the pruned section of the stem may be associated with spreading columns of decay. As found by Gadgil and Bawden (1981), the proportion of branches with spreading columns of decay increased progressively with increasing branch size. High angle branches were often associated with spreading decay columns. It also appeared that the pruning of small, live branches carried a higher risk of establishing decay than did the pruning of dead branches. At one relatively dry site (Goulds Country), serious defect was associated with a high proportion of small branches which had died before pruning and formed an abscission zone, allowing them to break, but with their stubs retained in the bark. As the stem grew, a plug of kino had formed between the branch trace in the stem and the stub held in the bark. Pruning had not removed the base of the stub and the kino trace had continued its formation.

These preliminary investigations highlight an immediate need for further short term practical research to answer several important management questions:

In comparison with live pruning, does natural branch senescence prior to pruning significantly reduce the risk of spreading columns of decay becoming established?

Is there a window of opportunity for pruning between the onset of natural senescence and the separation of a branch from its branch trace?

Is branch size or angle a factor?

Does rate of growth in diameter influence the ability to form an abscission layer and thus the opportunity for infection to occur?

Is there a time of year when the risk of decay from pruning is significantly reduced?

Can the stubs of pruned branches be treated to reduce the risk of their becoming infected with decay fungi and if so, can such treatment be applied economically?

Are there genetic or site factor variables at play?

Objectives

A number of high priority short term practical objectives will be addressed over the two year project timeframe which will aim to develop pruning guidelines for plantation *E. nitens* based on an assessment of the decay risk at various sites with different provenances. Studies will include:

1. **pruning at different times of the year**

   Suitable sites and trees will be selected from 3-4 and 8-16 year-old unpruned *E. nitens* plantations, including where possible a range of provenances. A number of trees will be pruned at the same time each month over a 12 month period, with careful observation of branch status (live, senescent or dead) when pruned and climatic conditions just prior to, at and just after the time of pruning. Twelve months after they have been pruned, trees will be felled and examined for the incidence of decay associated with pruning wounds. Branch angle and diameter will be noted at this stage. Fungi associated with decay will be isolated and those most frequently observed will be identified.

2. **pruning dead, senescent or live branches, especially in relation to their diameter and angle**

   Suitable sites and trees (showing variation in the factors under investigation) will be selected from 3-4 year and 8-16 year-old unpruned *E. nitens* plantations, including wherever possible a range of provenances. The trees will be pruned, carefully noting the stage of branch development (live, senescent or dead). Unpruned controls will be set up for comparison. Twelve months later, a proportion of the trees in the trials will be felled and examined for the incidence of decay associated with pruning wounds. The angle and diameter of pruned stubs will be noted at this stage of decay assessment.

Further surveys to quantify the incidence of decay in relation to branch characteristics will be made by felling and sectioning trees in pre-existing pruned plantations in Tasmania. Assessment of decay incidence will also be made in unpruned trees, preferably of the same age and at the same site as the pruned trees.

Fungi associated with decay will be isolated and those most frequently observed will be identified.

3. **treating or not treating pruning wounds with fungicides or sealants**

   In the trials set up to investigate "time of pruning", some of the wounds will be treated with a copper based fungicide or with a sealant. Untreated wounds will be left as controls. Trees with treated and untreated wounds will be assessed for decay after a period of 12 months.

4. **poor pruning (projecting stubs left, flush cuts which damage branch collar, stem *etc.*)**

   In the trials set up to investigate "time of pruning", certain of the branches will be deliberately poorly pruned (projecting stubs left, flush cuts damaging either branch or stem collar). The correctly pruned branch wounds will act as controls. Trees with correctly and poorly pruned wounds will be assessed for decay after a period of 12 months. Trees already first lift pruned with secateurs and second lift pruned with saws will be cut down and the amount of decay assessed.

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9.2 A Pathological Investigation of the Dieback of Pencil Pines and Alpine Flora in the Central Highlands, Tasmania

Kylie Shanahan[1,2] and Caroline Mohammed[1,2]

Collaborative organisations:

Parks and Wildlife Service, DELM (Funding Agency)

[1] **CSIRO Division of Forestry**

[2] **University of Tasmania, Dept. of Agricultural Science**

Background

A dieback of epidemic proportions across a range of plant species (including Pencil Pines (*Athrotaxis cupressoides*)) has been recently observed in the area of Pine Lake on the Central Plateau. This dieback is very similar in appearance to that caused in other native vegetation communities by *Phytophthora cinnamomi.*

An undescribed fungus belonging to the *Phytophthora* genus has been isolated once from the dieback area and is a possible candidate causal agent of the dieback. This is the first record of this fungus in Australia. Overseas records indicate this fungus may cause disease in fir trees, apples, pears, and raspberries. The isolation of the *Phytophthora* "Pine Lake" from diseased areas is proving to be very difficult. Another possibly pathogenic *Pythium* sp. is also commonly present in samples from the diseased areas.

The *Phytophthora* "Pine Lake" is cold tolerant which gives the fungus the potential to cause epidemic disease in wet forest and rainforest as well as alpine areas. This is a new disease threat to which these environments have not previously been exposed. Many of the species in these environments may be susceptible to the fungus. A number of these species which are very slow to mature could become locally extinct in diseased areas. The Tasmanian endemic conifer communities are likely to be severely impacted upon by this disease.

Agricultural crops grown in Tasmania are known to be susceptible to the *Phytophthora cinnamomi*. Some commercial forestry species are susceptible to infection by *Phytophthora cinnamomi*, at least at the seedling stage. A *Phytophthora* "Pine Lake" disease could pose a serious threat to these commercial industries.

Climatic conditions in the Central Plateau were unusually hot in the summer of 1995. It is known that Pencil pine is very sensitive to drought. The effect of drought on the different native species which form the understorey to Pencil Pine is under investigation. Conditions this summer are unusually wet.

All dieback areas (with the exception of one) were aerial sprayed with phosphonate (assuming *Phytophthora*) in the summer of 1995. Recent surveys indicate that the dieback has stabilised in certain areas and there is a degree of recovery. The dieback focused around the northern end of Pine Lake and the area nearest to the road around the boardwalk still appears to be actively spreading.

Objectives of current research:

A. High priority short term objectives

1. Establish presence/absence of pathogen(s)
    - analysis of field samples (from plants, soil, water)
    - establishment and maintenance of culture collection from the field
        - identification of isolates (by induction of sporulation)

2. Define plots (eg. 10 x 10m) to be studied in detail over a period of three years. Plots will be located, if possible, within the following categories of dieback area:
    a) never sprayed with phosphonate
    b) sprayed once with phosphonate (summer 1995)

   Where possible these plots will be sub-plots of the dieback areas already subject to detailed monitoring by the Parks and Wildlife Service. When choosing plots careful consideration is to be given to such features as topography, drainage, ease of sampling.

   Control plots without evidence of dieback will also be selected for study from those control plots already being monitored by the Parks and Wildlife Service.

   The following will be carried out in each research plot established:

   regular photographs to map disease development
   regular soil sampling programme
   setting up of disease baits in soil and water
   monitoring early symptoms of dieback
   removal and examination of dead plants for cause of death

B. Medium - long term objectives

1. Characterise major isolates

   effect of temperature on growth
   water potential tolerance
   DNA analytical comparison of any *Phytophthora* isolates obtained with original isolate obtained by Tim Wardlaw from Pine Lake and certain other *Phytophthora* isolates (including reconfirmation of similarity with *Phytophthora* isolate from Oregon as determined by CALM)
   genetic analysis (assuming *Phytophthora* is isolated) to investigate if species is a hybrid
2. Susceptibility trials with native and commercial plants involving preliminary "shotgun" approach by transferring plants to be tested into soil taken from active dieback sites. Bioassays of infected/non infected soils.
3. Glasshouse phosphonate control trials (assuming a) dieback symptoms can be reproduced in pot trials and b) dieback is due to *Phytophthora* or where control of another pathogen by phosphonate is feasible).
4. Susceptibility trials inoculating with pathogen(s) isolated and identified from field samples.
5. Total biological activity assays to compare diseased and healthy sites; comparisons between diseased sites

   if possible, some more complicated assays of component fungal microorganisms

9.3 Potential stem canker diseases in Eucalyptus plantations in Tasmania

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Background

An increasing number of eucalypt plantations have been established in Tasmania. Changes in environmental conditions and tree conditions such as the change from regrowth forestry to plantations and the change of the tree species from *Eucalyptus regnans* to E. *nitens* in Tasmania are generally believed to be predisposing factors in the occurrence of tree diseases. Canker fungi are known to be important on some eucalypts in native forests (Old *et al.,* 1986), but in the much more intense silvicultural regimes of plantations they are more severe. In subtropical countries such as Brazil, canker fungi have been perhaps the most damaging pathogens of plantation grown eucalyptus, with *Cryphonectria cubensis* (Bruner) Hodges influencing the selection of eucalypt species and their management. *Endothia gyrosa* (Schw.: Fr.) Fr., a closely related fungus is widely associated with damaging cankers on native trees in south eastern and western Australia (Old *et al.,* 1986), and recently found to cause significant levels of tree death in some provenances of *E. nitens* plantations in Tasmania (Wardlaw, 1995). This mirrors experience in South Africa where some clones of *E. grandis* Hill ex Maiden were badly affected by *E. gyrosa.* (Brits & Grey, 1992; Westhuizen *et al.,* 1993).

Stem cankers associated with *Endothia gyrosa* and other fungi recorded so far may become a significant disease problem in eucalypt plantations in Tasmania. Earlier studies with *E. gyrosa* have indicated a degree of variation in pathogenicity in different isolates (Old *et al.,* 1986). In addition, differences between rough barked *E. nitens* and smooth barked trees in resistance to *Endothia* canker disease were noticed (Wardlaw, 1995). These suggested a possible variation in resistance of eucalyptus species and provenances, and in pathogenicity in the pathogen population. Further studies including screening of resistant eucalypt species or provenances are badly needed in order to alleviate future losses associated with E. *gyrosa* and other stem canker fungi, such as *S. eucalypti* and *H. eucalypti.*

Objectives

1. To survey, identify and classify fungi associated with stem and branch cankers of eucalypts in Tasmania
2. To determine the pathogenicity of these canker fungi and to understand the potential of these pathogens to cause disease on eucalypts under a plantation regime
3. To understand the population structure and dynamics of key pathogens, including comparisons of variability in populations in different regions of Australia and the role of the sexual stage in pathogenic variability and the infection process
4. To determine the role of canker fungi as pioneers of sapwood infection and as avenues for infection by decay fungi

Current progress

Fungi associated with stem cankers of eucalypts in Tasmania have been collected from a wide variety of locations. Several different fungi have been found associated with canker diseases of eucalypts. About 140 specimens have been obtained and are being examined. Two new species of canker fungi, *Seiridium papillatum* and *Wuestneia episporiata* have been described and manuscripts prepared for publication. The growth variation of colonies of the different fungi collected plus isolates of *Endothia gyrosa* have been compared.

Glasshouse pathogenicity tests with *E. gyrosa* isolates and other canker fungi against *E. nitens* will be completed in March.

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9.4 *Phytophthora cinnamomi* disease in forests
Biocontrol of *P. cinnamomi*

Inez Tommerup, CSIRO Division of Forestry

Research collaborators: K. Old, M. Dudzinski, CSIRO Forestry and Forest Products; G. Hardy, M. Dobrowolski, P. O'Brien, Murdoch University; I. Colquhoun, ALCOA of Australia; J. Scott, CSIRO Entomology;

Biocontrol in this research includes host resistance factors and therefore fungal-plant interactions and selection for resistance.

Evidence is accumulating that *P. cinnamomi*-woody plant interactions are the result of resistance-pathogenesis gene interactions.

Although *P. cinnamomi* has a wide host range, isolates vary in pathogenesis and several tree and shrub species have now been shown to have varying degrees of resistance (Old, Dudzinski, others).

Therefore Research Targets are :

To develop a rapid screen for levels of pathogenesis in *P. cinnamomi* isolates and ultimately host differentials to discriminate pathogenesis

To identify pathogen differentials to discriminate host resistance

Develop tools to distinguish *P. cinnamomi* isolates/lineages particularly in relation to pathogenesis. Tools being developed are those which can be used to analyse disease in natural ecosystems, plantations and nurseries.

9.5 Preliminary report on progress of ACIAR/CIFOR "Fungal Pathogens as a potential threat to Tropical Acacias"

Kenneth M. Old CSIRO Division of Forestry (project coordinator)
Ian Hood, QFRI

Background

During the year commencing Jan 1 1995 a collaborative project has been commenced between forest pathologists in the following countries in the SE Asia/Australasia region;

- **Australia**: Ken Old, Mark Dudzinski (CSIRO Division of Forestry; Ian Hood (QFRI); Ian Pascoe, Institute for Horticultural Development, Victoria.
- **Indonesia:** Soetrisno Hadi, Simon Taka Nuhumara, Agricultural University Bogor.
- **Malaysia:** Lee Su See, FRIM
- **Thailand:** Krisna Pongpanich, RFD
- **India:** Jyoti Sharma, Kerala Forest Research Institute.

Each counterpart has undertaken a survey of diseases of some or all of the following tropical acacia species, in their countries.

Acacia mangium
A. auriculiformis
A. crassicarpa
A. aulacocarpa

The strategy has been to focus on provenance and species trials to maximise the range of species/provenance/pathogen combinations.

The objective is to conduct a workshop in Indonesia at the end of the project and produce a bench mark report. The workshop will also give the opportunity to expose findings to several major Indonesian plantation and wood processing companies, one of which (Musi Hutan Persada) is to sponsor the workshop at Subanjeriji in southern Sumatra. It has been agreed with CIFOR to allow the project to extend to June 1996, to allow surveys to be made at the most favourable periods for disease development across a wide range of climates.

As part of the program, in 1995 the coordinator Dr Ken Old has made visits to Indonesia, Malaysia, and Thailand, in addition to carrying out surveys in Northern Queensland with Ian Hood of QFRI.

This interim report primarily contains information gained during these visits. Regions visited and participants are indicated for each visit. The major outputs of the project will be the workshop presentations and reports at the Subanjeriji meeting to be held at the end of April 1996.

Ken Old, Ian Hood, Yuan Zi Qing

Visit to Trials and Native stands in North Queensland (April 1995)

As part of the Australia component of the project, in April 1995 a visit was made by Ken Old, Ian Hood, Krisna Pongpanich to Northern Queensland

Field inspections were carried out in species and provenance trials of all four tropical acacia species at Lannercost (Shell trial), seed orchards of *A. mangium* and *A.aulacocarpa* at Cardwell and Kuranda, Ingham nursery and a small species trial at Mareeba. Native stands of all four species were visited by an overland route through the coastal stands of *A. mangium,* and *A. crassicarpa* between Ingham and Innisfail and inland to the Atherton Tablelands. The southern range of *A. auriculiformis* was included by a detour from Rifle Creek near Mt Malloy (the southernmost occurrence of A. auriculiformis) up the Peninsular Development Road (PDR) to Laura River, north west of Cooktown. Collections were made on several other native acacia species, including *A. flavescens, A. holoserica, A. polystachys,* and a *A.polystachys/ A. mangium* hybrid. The trip continued to Cooktown and returned to Cairns via Daintree and Mossman

A total of 84 collections of diseased acacia and eucalypts were made and these are under mycological examination by Yuan Zi Qing (University of Tasmania), Ian Pascoe, and Paul Cannon, IMI.

Pathology

Some highlights to date are as follows

- *A. mangium* in seed production areas (SPAs) and species trials was remarkably free of significant disease, algal leaf spot and black mildew being the only notable symptoms.
- Some foliar disease was seen in native stands of *A. mangium,* notably rusts, but generally the stands were relatively healthy.
- *A. crassicarpa* showed more diseases than *A. mangium,* even when both species occurred together. Diseases included leaf rusts, and spotting caused by *Pestalotiopsis* and *Pseudocercospora.*
- *Pseudocercospora* was found at Lannercost, on native *A. crassicarpa* nearby or within the Shell trial, and at several locations on the road from Cooktown to Cape Tribulation. This fungus has also been found on *A.crassicarpa* at Melville Island, Northern Territory (Yuan Zi Qing). It seems likely that the fungus is indigenous to N. Queensland, especially on *A.crassicarpa.*
- As seen in the Melville Island SPA, by Yuan Zi Qing, unlike *Pestalotiopsis,* which tends to be more prevalent on older foliage, and probably causes little damage, *Pseudocercospora* infects the upper part of the crown of young treesand has a propensity to cause crown damage. Some loss of shoot form has been observed, both on saplings in native stands and in the *A. crassicarpa* SPA on Melville Island.
- The most common diseases on *A. aulacocarpa* were rusts *(Atelocaudata digitata)* and another as yet unidentified leaf rust. Again native stands showed more disease than the SPA's.
- There were few canker diseases if any to be found on the coastal acacia species. Deforming stem and shoot cankers were however seen on *A. aulacocarpa* (dryland form) at Station Creek, also on *A. auriculiformis* and *A. holoserica* in the dry (semidesert) environment which prevails along this stretch of the PDR.
- *Acacia flavescens,* a non- target species, which occurs with *A aulacocarpa,* and *A.mangium* on the Cooktown -Daintree road was infected by a severe unidentified leaf spot disease. Neither of the other two species were affected.
- None of the trials on native stands showed impacts of diseases which warranted detailed impact assessment.
- Collections will form a very useful reference herbarium for the future.

Visit by Ken Old to Indonesia (Subanjeriji) in the company of Dr Soestrino Hadi and Dr Ken Gales, Research Advisor, Musi Hutan Persada 1-4 July.

Musi Hutan Persada have established 150,000 ha of *A. mangium* on a 300,000 ha estate in southern Sumatra, with an eventual planting target of 200,000 ha. The plantations are all less than 5 years old and have been established using locally available seed (originally Cairns/Mossman provenance), at a plantation establishment rate of about 30,000 ha per annum. The sites were *Imperata* grasslands and scrub, on deep, well drained sandy or clay loams generally acid (pH 4-5) high Al, P limited, with some evidence of K and Mg deficient soils. Rainfall averages 16002000, with a dry season from June-September.

The stands are generally healthy but are overstocked, typically 4,000 stems per ha and are growing at a CAI of 33cu m/ha/year. The form is poor with a very high proportion of multiple stems. The company currently has about 100 ha of Spa's and has established a very large provenance trial at Gamaulang close to Subanjeriji.

Pests and diseases have not been a major problem to date. Pink disease is the only significant disease so far recognised. As for insects, army worms, bagworms, *Xyleborus* and termites have been recognised as possible problems (bagworm damage is currently very severe on *Paraserianthes* in trial plantings).

Sumatra experienced a very severe drought (possibly the worst on record) and consequent bushfires last year.

Pathology

Generally the stands appear to be healthy with very little foliar disease in evidence. Provenance trials and fertiliser trials (1 year old) appear to be virtually free of disease. We found powdery mildew and rust on *A. auriculiformis* regeneration, but not on *A.mangium.* Some small trials of eucalypts were very badly affected by leaf blight, stem cankers and black mildew.

The only pathological conditions seen on *A. mangium* were pink disease *(Corticium salmonicolor)* which occurs in small patches across the plantation, some stem decay and a blue stain associated with quite severe *Xyleborus* damage. In these less than 5 year old stands there was little evidence of heart rot, although the poor form of the trees, multiple stemmed, heavy branched and poor branch sloughing may give rise to problems of this nature in future.

Of most concern was the borer attack which may be more widespread than so far appreciated. We were shown a small quarter ha patch with a high proportion of dead or dying trees. Several trees with a high incidence of borer damage had epicormic growth from stems which otherwise looked dead. Dissection of stems showed blue stain in the sapwood and associated with pin holes. In two trees the stain extended into the root system. We were told that some patches of mortality were as large as 5ha.

Another area was examined and two trees felled to examine for stem decay. Although the crowns were apparently healthy, mid stem borer damage was quite extensive on both trees and more damage could be seen on other trees in the stand. This condition needs close monitoring. It is possible that the severe drought combined with heavy crowns and overstocking has stressed trees and predisposed them to borer damage.

Visit to Malaysia by Ken Old, and field trip with Dr Lee Su See (FRIM)

5-9 July

The objective was to discuss progress with the project and to carry out joint inspections of provenance trials of *A. mangium* at Kemasul (Pahang state) and Rantau Panjang (Selangor State).

These trials were a strong contrast to the plantations in Sumatra as they were planted on cut over forest as part of the "Compensatory Planting Program", a joint Federal State programme, funded partly by a World bank loan to provide an alternative supply of hardwood to native forest sources. About 52,000 ha have been planted in Malaysia mostly A. *mangium.* The programme seems to have run into some difficulties, and planting targets have fallen behind. This is partly due to heart rot incidence in peninsular Malaysia, which led to a temporary ban on its planting and partly due to hesitation on the part of private concerns to take up the initiative.

Pathology

Kemasul

One stand of *A. mangium* was set up as a seed production area but advice was that the seed source was unsuitable. Trees showed a high level of crown dieback and root and butt rot was in evidence . No fruiting bodies were found but symptoms resembled *Ganoderma* infection. Regrowth was profuse and cankers were relatively common on young shoots. Perithicia resembling *Nectria* were found associated with cankers and these are under examination. As found elsewhere foliage of *A. mangium* was very clean of infection, with black mildew being the only commonly encountered symptom. The provenance trial plantation was about 10 years old with some missing trees, woody weeds and regrowth made movement difficult and plot location would be very difficult.

Rantau Panjang

The 11 year old provenance trial is well laid out and maintained. Some root rot was present with symptoms of *Ganoderma* . Root systems of several trees with some crown dieback adjacent to dead trees were excavated and found to be infected with root rot. No foliar diseases were present on *A. mangium,* but trees with crown cankers were reasonably common scattered through the trial. Two trees were felled, and diffuse cankers were found in affected crowns. The older cankers had bark stripped away, and it is not clear whether mechanical damage to trees, possibly by squirrels or monkeys had preceded the canker development, or the bark had been stripped from old cankers caused by pathogen. The *Dothiorella* anamorph of *Botryosphaeria* was found fruiting profusely on affected branches.

A visit was made to a small sawmill on the plantation estate where flitches and palings for pallets were being cut from thinnings of *A. mangium,* despite the common occurrence on heart rot in stems. Considering the small diameter of the trees recovery of sawn product was adequate, and sawing properties were acceptable.

Note that diseased material collected in Sumatra and Malaysia was divided between myself and the local counterpart and herbarium specimens sealed in packets and boxes for return to Australia. The samples have been gamma irradiated to sterilise before being opened, and the specimens are being examined and will be added to the herbarium.

Visit by Ken Old and Yuan Zi Qing to Thailand 3/10/96-13/10/96

The visit had a dual function, firstly to carry out a survey of acacia and eucalypt plantations in eastern Thailand in the company of Krisna Pongpanich, and secondly to participate in an FAO workshop organised by IPGR to develop guidelines for safe movement of eucalypt germplasm. We were fortunate to be accompanied on the 4 day field trip by Professor Mike Wingfield of The University of The Orange Free State, South Africa who was in Thailand for the IPGR workshop. Visits were made to trials at 4 main locations, namely Nong Khu experiment station, Huai Tha Forest Experiment Station, Sakaurat Experiment Station (Nakhouratchasima Province), and the Thai Plywood Co Research Station at Chacheongsao.

Pathology

As in other countries visited, *A mangium was* generally free of significant disease. Algal leaf spot and black, irregular lesions which were said by Krisna to be caused by a *Colletotrichum* sp were the pathogens most commonly found. These two organisms often occurred on the same leaves with the alga sometimes growing profusely on *Colletotrichum* lesions.

At Sakaurat a 4 ha trial of *A. aulacocarpa* was very badly affected by a severe stem canker disease and top dieback . The trial was an outplanting of progeny selected trees of very good form in a species trial at the same station. The etiology of the disease was complicated by borer damage. The evidence of insect damage had attracted the attention of the station manager, however there has been no serious attempt to determine the cause of the condition.

Preliminary mycological investigation showed the fungus *Cryptovalsaria* to be present on cankers but it has not been possible to determine whether this fungus is behaving as a primary pathogen . Further mycological investigation of material collected from *A. aulacocarpa is* being carried out at Canberra.

Botryosphaeria has been found associated with similar cankers on *A. auriculiformis* in western Thailand, and there may be an opportunity for Krisna to carry out field inoculations with both of these putative pathogens at the Sakaurat station. The impact of the disease in the 4 ha plantation of *A. aulacocarpa* was very severe and data will be collected on the level of disease.

Attention was diverted on many occasions on this field survey to diseases of other plantation trees of Australian origin, especially eucalypts and casuarina. The climate has been very wet in Thailand during mid 1995 and eucalypt leaf diseases were at epidemic level, especially in the Chacheongsao area, the region with a major plantation resource based mainly on *E. camaldulensis. Casuarina equisetifolia* was found to be severely diseased with the blister bark disease *(Trichosporum vesiculosum)* and *Botryosphaeria* canker very damaging in the international C. *equisetifolia* provence trial.

As on other field trips a set of herbarium specimens of the diseases seen in the field was brought back to Australia for gamma irradiation and inclusion in the collection at CSIRO.

Conclusion

The project is proceeding very well in the three countries that have been visited. The participating scientists are putting a major effort into the project and there should a be a wealth of information to draw on at the workshop next April.

A number of diseases have been found on plantation acacias, but with the exception of heart rot (a condition which is very difficult to gather information on in the time frame of this project) and tree death associated with borer attack and sapwood invasion of A. *mangium* in Sumatra, few foliar and stem diseases have yet been found to have major impacts on tree health.

The highest incidence, and variety of diseases have been found in native stands in northern Australia, with *A. crassicarpa* appearing to be more susceptible to foliar pathogens than either *A. mangium* or *A. aulacocarpa.* Rust diseases which are common and readily found in native stands were not been found so far in plantations in the three countries visited (even in

Australia). A leaf rust was found on *A.auriculiformis* in Sumatra but not on *A. mangium* in a nearby stand. Since my visit to Sumatra, Lee Su See has visited southern Sumatra where leaf gall rust occurred last wet season in epidemic levels. Canker diseases on *A. auriculiformis* and *A. aulacocarpa* in Thailand are a cause for concern and the etiology of these diseases requires a significant effort.

An application has been made to ACIAR for follow up funding for a further year. The research priorities emerging for further attention are as follows:

- Etiology of heart rot of *Acacia mangium,* including root and butt rots in Malaysia
- Sapwood stain associated with tree death and borer attack of *A. mangium* in Sumatra
- Stem cankers of *A. auriculiformis* and *A. aulacocarpa* in Thailand.
- Susceptibility of *A. crassicarpa* to leaf and shoot disease.

This preliminary list will be modified in the light of the presentations at the workshop in April

Kenneth M. Old

9.6 *Cryptosporiopsis eucalypti* leaf and shoot blight a newly described and damaging disease of eucalypts.

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Cause

Cryptosporiopsis eucalypti K. V. Sankaran, B. C. Sutton & M. Balassinaran is a newly described coelomycete (Sankaran *et al.,* 1995). It is characterised by having light-coloured, cupulate stromatic conidiomata, enteroblastic conidiogenous cells and by having hyaline, one-celled (rare 2-celled) conidia which are thick-walled, ellipsoid to elongated ellipsoid with bases abruptly tapered to distinct protuberant scars, and measured 11-26 x 4.5-10 mm in size, depending on the collections. Small, hyaline, thin-walled, ovoid, one-celled microconidia were also found in the collection from Australia.

Significance

Cryptosporiopsis leaf spot disease is found to occur commonly and severely in plantations of *Eucalyptus* spp. in India, Thailand and Vietnam. The infection can result in severe defoliation and dieback of young shoots

Symptoms

Symptoms develop on leaves, sometimes on twigs of eucalypts. Spots on leaves occur on both sides of the leaves (hologenous) and vary in size, shape and colour with or within tree species. Basically, there are four types of lesion patterns: circular spots (brownish to blackish brown, discrete, circular or sub-circular, 1-1.5 cm in diam), large irregular spots (brownish to brown, large spreading necrotic lesions), small irregular spots (grey, brownish to dark brown, sometimes with darker margins, irregular or somewhat angular, discrete, small, up to 0.5 cm in diam) and irregular rusty spots (rusty, rough-surfaced, irregular, discrete or diffuse along veins). Leaf infection can extend to small twigs. Discoloured necrotic lesions with light-colored fruitbodies are formed on affected twigs This fungus forms characteristically triangular to almost cupulate, light-colored fruitbodies (conidiomata) on both sides of spots (amphigenous). The fruitbodies scatter irregularly on the spots and appear as pustules on surface. At maturity, they open widely or as a slit with accumulating cream-coloured conidial mass at the top in high moisture conditions.

Hosts

- Natural: The fungus has been found on a number of eucalypt species including *E.camaldulensis* Dehnh., *E. camphora* R.T. Baker, *E. cinerea* F. Muell. ex Benth., *E. cypellocarpa* L.A.S. Johnson, *E. globulus* Labill., *E. grandis* Hill ex Maiden, *E. microcorys* F. Muell., *E. nicholii* Maiden & Blakley, *E. nitens* Maiden, *E. nova-anglicae* H. Deane & Maiden, *E. robusta* Schlecht., *E.tereticornis* Sm. and *E. viminalis* Labill.
- Experimental: In artificial inoculation tests, the fungus is able to induce leaf spots on several eucalypt species, *E. amplifolia, E. blakelyi, E. camaldulensis, E.grandis* and *E. tereticornis.*

Geographical distribution

Australia (Canberra, Danbulla, Jimna, Kenmore, Queensland, Southport), India (Andhra Pradesh, Kerala), Japan (Mie, Shizuoka), Thailand (Chachoengsao, Ratchaburi), Vietnam (Hue, Dong Nai, Quang Tri, Song Be), USA (Hawaii).

Biology and transmission

Little is known of the biology of the pathogen. Growth rate of colonies on cultures varies with temperature and isolates. The Udon Thani isolate from Thailand, for example, grows faster than the Chacheongsao isolate at the same temperature. Both isolates grow faster under 10-16 °C than under 24 °C (unpublished data). In inoculation tests, the fungus induced characteristic leaf spots at 24 °C after 4-5 days of inoculation, but did not produce any symptoms at 32 °C even in one month after inoculation. Low ambient temperature (16-25 °C) is a predisposing factor for initiation of the disease. The fungus infects leaves of eucalypts either through stomata or small mechanically inflicted wounds. Period of symptom development requires about one week (more often 4-5 days). The disease is most active during periods of heavy rain and high humidity. Rain and wind are probably the major factors involved in the fungus dissemination over both short and long distances. Seeds or seed chaff could be means for transmission internationally, but there are no records of the fungus from seed.

References

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Sankaran, K.V., Sutton, B.C. & Balasundaran, M. 1995. *Cryptosporiopsis eucalypti* sp. nov. causing leaf spots of eucalypts in Australia, India and USA. *Mycological research.* (submitted)

9.7 Leaf blight of eucalypts in Vietnam and Thailand

An ACIAR project commencing 1996

Ken Old,

Mark Dudzinski,
Ian Hood,
Yuan Zi Qing

Eucalypts and other Australian species are of major economic, social and environmental importance to countries of the S. E. Asian region. These species are now making significant contributions to household income in some of the poorer parts of the region such as north-east Thailand, Laos and central Vietnam, where they are grown and sold as poles, fuelwood and export woodchips. The opportunities for generation of employment and domestic income have been put at risk through attack by a suite of pathogens. The disease syndrome was recognised as a problem by staff of the Forest Science Institute of Vietnam (FSIV) in 1989. Badly affected trees are malformed, suffer severe reduction in growth rate and loss of merchantable volume.

The disease is not now restricted to the SE of Vietnam. Small plantations and larger forestry projects by communes in the central Vietnam provinces of Hue and Quang Tri are also showing significant disease. So far plantings in the north appear to be relatively unaffected suggesting that spread may be influenced by climate. A disturbing aspect of the disease is that several provenances of E. *camaldulensis,* the preferred eucalypt in the region, are highly susceptible, with the Petford provenance apparently suffering severe impacts. However there have been consistent observations of genetically based differences in susceptibility with some provenances (Laura River, Kennedy River, Morehead River and Katherine) less susceptible than others such as Gibb River and Petford.

The project also has high relevance for plantation forestry in the humid tropics of Australia and possibly the health of native eucalypt forests. In 1989, species and provenance trials which formed part of a major set of eucalypt plantation trials in north Queensland were very severely damaged by C. *quinqueseptatum.* With the burgeoning interest in plantation forestry in Australia, establishment of tropical hardwood plantations on a small operational scale is already underway in north Queensland, and foliar pathogens may limit potential productivity. A major objective of this project is to develop screening methods and locate sources of resistance which would be tested in complementary trials, in Queensland and Vietnam.

So far the major disease agents found in Vietnam have also been recorded in Australia. The project will, however, give the opportunity for an "over the horizon " survey of diseases on eucalypts under ideal conditions for symptom expression.

Outputs of the proposed project can be grouped as follows:

- Identification of the major causes of leaf blight and stem canker of eucalypts in Vietnam and Thailand, and a knowledge of their epidemiology and etiology.
- Prediction of regions of high disease hazard. This will be done by combining epidemiological and climate data into microcomputer-based interpolation mapping programs available for Vietnam, Thailand and Australia.
- Resistant planting stock tested for reaction to a range of genotypes of major pathogens. Selections will be made at the species, provenance, and clonal level and screened against a range of populations (pathotypes or races) of major pathogens in SE Asia and Australia, with C. *quinqueseptatum* being the initial target pathogen.
- Increase in skill levels of Vietnamese counterparts in forest pathology, through a series of attachments to CSIRO, QFRI, and KFRI and extension of information on disease management and minimising impacts of pathogenic fungi to provincial forestry staff in Vietnam.

Ken Old

20 February 1996

9.8 Blister bark disease of *Casuarina equisetifolia* in the tropics

Mark Dudzinski, CSIRO Division of Forestry

Mark Dudzinski visited India and Thailand in Nov/Dec 1995 to familiarize with blister-bark disease of *Casuarina equisetifolia*, following recent serious incidences of mortality in the species in Vietnam, Thailand and Kenya. This disease has been known in India since 1903 but there are few other reports (Mauritius, Sri Lanka, Indonesia).

It is associated with the hyphomycetous fungus *Trichosporium vesiculosum* Butler (nom. illegit.) which has been proven in recent pathogenicity studies at IFGTB, Coimbatore, India to be causal and is considered to be a facultative parasite on *C. equisetifolia*. Trees initially yellow and then rapidly wilt, brown and dieback. Some resprouting may occur but this usually dies off. The fungus is thought to infect by spores through wounds (or even lenticels) in stem, collar or roots and spread can be aerial or by root to root contact and hence mortalities are commonly in groups. It primarily spreads lengthwise in the live bark tissues killing these and the cambium. Trees from 6mo - 17 years have been affected.

The major diagnostic signs, which often are not widely evident in an affected stand, are raised firm blistering of young bark of stem or branch caused by the pressure from conidial formation in the bark and these blisters or vesicles can coalesce up the stem. On rupturing these expose a conspicuous black sooty spore mass which can be disseminated very easily. Where bark is thicker or around the tree base the spore mass may be exposed by cracking or flaking of bark.

Where root infection, only, has occurred characteristic symptoms are not seen on the stem but the sooty spores can be observe in the lateral roots by stripping the periderm layers with a sharp knife. Sporulation levels are variable and sometimes may be difficult to discern.

The disease varies in its impact, from low incidence ranging through to as much as 80-90% of the stand affected. There is no real management of the disease in India and there has been no attempt to select for resistance. In fact the level of knowledge of it among growers seems to be low. Management recommendations by researchers involve site selection, minimizing of wounds, sanitation removal of the entire tree where mortality occurs or if severe the removal of the entire plantation, shortening rotations, wider spacing etc. Curative use of chemicals is unlikely to be effective. However, these recommendations are based on intuitive understanding of the disease and their effectiveness has not been evaluated in practice. There appears to be some evidence of predisposition being important.

In Thailand 35% mortality was observed in two provenance trials of *C. equisetifolia*, which were severely canker affected (*Botryosphaeria* sp.) and blister-bark symptoms were seen on 6% of trees. Blister-bark symptoms were seen on a few dead trees of the putative hybrid *C.equisetifolia* ∞ *C. junghuhniana*.

A recent consultant's report (W. Ciesla 1995) on the Kenya incidences has concluded that tree deaths have been caused primarily by a root-infesting mealybug (*Dysmicoccus brevipes* (Cockerell) (Homoptera:Pseudococcidae)) common in the tropics and causing mortality of pineapples and other crops but not previously associated with tree deaths.

Another recent IMI consultancy report (Boa & Ritchie 1995), on mortalities at one site near Bangalore India showing blister-bark disease symptoms, has tentatively suggested that the sooty fungus from that site and from other collections held at IMI is in fact a common saprophyte, however Indian scientists disagree and there is obviously more work required to clarify the identity of the fungus and its status as a pathogen.

In view of the potential seriousness of the pathogen and the uncertainties that exist about its identity and distribution worldwide, it is recommended that special caution should be taken with any intended importation into Australia of *C. equisetifolia* seed or vegetative material, until further information comes to light.

Mark Dudzinski
22/2/96