PROJECT 6

CONTROL AND MANAGEMENT OF *DIPLODINA* CANKER THREATENING *BANKSIA COCCINEA*

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NB. This report covers the period February 27, 1994 to September 15, 1994

SUMMARY

Diplodina canker is a serious threat to the survival of *Banksia coccinea*. This report summarises field studies and experiments aimed at establishing major factors linked to disease spread and options for disease control. An evaluation of factors which may influence the response of diseased stands to burning has been commenced. Results will provide insight into the appropriate fire regimes for disease control. The identity of the fungus has been fully investigated. It is a new species of *Cryptodiaporthe* and the new name *C. melanocraspeda* has been proposed. Sampling of airborne spores is continuing and aims to identify the importance of airborne spores in the epidemiology of the disease. Preliminary results from an inoculation trial, confirmed that *C. melanocraspeda* can produce lesions in unwounded stems, although development was delayed to 6 to 12 months after inoculation and the frequency of lesion production was less than wounded stems. Assessments of disease progress in permanent transects showed seasonal increases in the rate of disease development. The rate of disease development in stands with low levels of infection was much less than that in severely infected stands.

INTRODUCTION

Banksia coccinea is a plant of both conservation and commercial importance. It occurs on deep white sands from Albany, north to the Stirling Range and east to Young River in south-western Western Australia. *Diplodina* canker was first identified as a serious disease of *B. coccinea* in 1989. The disease is responsible for the death of large numbers of *B. coccinea* and has been found throughout the geographic range of *B. coccinea*. Research has commenced to identify the factors affecting spread of the disease and evaluate options for disease control.

1. CONTROL MEASURES

1.1 Burning

Aim: to understand the characteristics of stands which may influence the outcomes of burning for disease control.

New work has concentrated on determining optimum fire regimes for disease control and stand regeneration. This has involved investigations of factors such as the reproductive biology of *B. coccinea*, fuel levels in stands, inoculum survival, and sources of inoculum which may be affected by disease and influence the regeneration and health status of burnt stands.

1.1.1. Seed bank dynamics of *B. coccinea*

Aim: To determine the dynamics of seed storage of *B. coccinea* with increasing plant age and disease.

Cones were sampled from three populations to determine the yearly reproductive output of the stands. Data will be analysed to determine whether there is an age dependant decline in reproductive output or whether differences between stands are related to disease incidence. The impact of disease on seed storage has been assessed through comparing cone samples from high and low disease portions of one stand and through yearly assessments in permanent plots. Data from this study are yet to be analysed. The health of seeds from diseased and healthy plants will also be assessed to determine whether seedborne infection occurs and whether it affects seed viability.

1.1.2. Burning Study

Aim: to determine the relationships between disease and fuel load, cone incineration and inoculum survival in a *B. coccinea* stand after fire.

A site in Stirling Range National Park was burnt in October 1993. To determine the influence of disease on fuel levels, fuel was sampled from high and low disease sections of the stand, within and outside the burnt site. The percentage of fuel consumed was estimated. Data are yet to be analysed, but preliminary results suggest there was almost three times more litter fuel in the high disease part of the stand. Differences in levels of litter fuel probably account for higher fire intensity in the high disease part of the stand.

High fire intensities in stands with high disease levels may result in the incineration of cones stored on dead plants. This has been examined by assessing cone and seed survival at different fire intensities and char heights. Results are yet to be analysed.

Canker samples were collected at intervals after the fire to determine whether inoculum survives burning and whether inoculum survival is affected by fire intensity. A laboratory study was also conducted to examine the survival of conidia and ascospores of *C. melanocraspeda* heated at different temperatures for different lengths of time. Data from these experiments are yet to be analysed.

1.1.3 Sources of inoculum in regenerating stands.

Aim: to determine whether unburnt remnants act as infection foci in regenerating stands.

Small patches of older plants which have escaped the most recent fire may act as infection foci in the younger stands. The influence of unburnt remnants on the distribution of infections in young stands was assessed through disease ratings at varying distances from older plants. Preliminary results suggest there may be a strong relationship between disease incidence and the proximity of the young stand to patches of older plants. Burning which results in a mosaic of small patches of unburnt vegetation could be a factor contributing to the rapid introduction of disease into regenerating stands. Further assessments are vital to the understanding of the dynamics of inoculum release as this will have major implications for management strategies.

1.2 Fungicides

No further studies have been conducted.

2. DISEASE MANAGEMENT

2.1 Identity of the fungus

Further study on the identity of the pathogen has established that it is an undescribed species of *Cryptodiaporthe*. A paper describing the fungus, discussing its taxonomic position and giving it the new binomial *Cryptodiaporthe melanocraspeda* J.A. Bathgate, M. E. Barr and B. L. Shearer has been submitted for publication. This is the first *Cryptodiaporthe* reported in Australia and on the Proteaceae worldwide.

2.2 Means of spread

2.2.1 The role of ascospores and conidia in disease spread

Aim: to determine the extent of ascospore dispersal of *C. melanocraspeda*.

A spore trap has been used to determine the spore dispersal patterns of *C. melanocraspeda*. Weather conditions have also been monitored over the same period. The samples will be used to determine the seasonal pattern of release of ascospores of *C. melanocraspeda* and the association of spore release with weather conditions. Assessments of the seasonal production of perithecia by the fungus have been made from cankers sampled over the same period. Sampling will continue until late spring 1994. An understanding of the spore release patterns is required for formulation of control strategies.

2.3 Infection of *B. coccinea* by *C. melanocraspeda*

Aim: to determine whether *C. melanocraspeda* can infect *B. coccinea* through unwounded shoots.

Data are being collected from plants inoculated seasonally and harvested up to 12 months after inoculation to determine the means of infection. Preliminary results indicate the fungus can invade unwounded plant tissue, but there is a 6 to 12 month latent period between infection and symptom production. The frequency of infection 12 months after inoculation through unwounded tissue was less than through wounded tissue. Additional harvests are required to examine seasonal effects on lesion formation.

There has been much speculation over the cause of this disease, whether it is linked to environmental extremes and therefore episodic, or if the pathogen can invade healthy tissue directly to cause the disease. These results, demonstrating disease development without wounding, indicate the fungus is aggressive and able to penetrate healthy plant tissue, however the reasons why lesion development was delayed 6 to 12 months after inoculation are unknown.

2.4 FACTORS INFLUENCING DISEASE INTENSITY

Aim: to determine the major factors influencing disease intensity in *B. coccinea* populations.

Disease progress was monitored in permanent transects and showed a seasonal pattern of development. The period of greatest increase in disease incidence was between late spring and autumn. Disease incidence increased slowly during late autumn and winter. Mortality increased rapidly during summer 1992/93 and spring to early autumn in 1993/94. The increase in mortality was dependant upon the initial level of disease in the stands. Mortality increased in the stands with low mortality (<3%) by less than 5% during the study. In comparison, mortality in stands with high initial levels of mortality increased more than 25%.

Further study of disease progress in the stands with low levels of infection will indicate the time period between the first signs of infection and the exponential phase of disease development. The ability to predict this interval is essential for planning the management of diseased stands. If burning is to be used for stand management, it should be implemented at the start of the exponential phase of disease development, which is when reproductive output and stand survival starts to be threatened, rather than when disease first appears in the stand.

DIPLODINA CANKER PROJECT
Budget Report
Period 1 September, 1994 to 31 October, 1995

ITEM	$	$ TOTAL
SALARY		
- 1 September 1994 to 31 October 1994 (43 days @ $1 406.57/fortnight)	6 048	6048
MATERIALS		
General		11 300
Laboratory / Greenhouse supplies Cultures, Petri plates, agar, microscope slides and coverslips, compressed air, light globes, potting mix, pots fertilizer	1 700	
Tissue Analysis	800	
Photographic charges	400	
Publications ($2 000 to be reserved from other sources)		
Travel Allowances		
2 field trips @ $450 each	900	
Outstanding travel claims	2 000	
Technician (1/2 time, Level 2/3 + 14%)	4 500	
Casual Assistance	1 000	
PLANT		
2 field trips @ $350 each	700	1 400
Outstanding	700	
	GRAND TOTAL	**18 748**