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FORESTS DEPARTMENT

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28th September 19 84
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Reference-H.O.

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SUBJECT: TREATMENT OF DIEBACK FREE AND UNDERSTOREY AFFECTED FOREST - F.I.R.S.

INTRODUCTION

This report concentrates on Forest which has been treated under the F.I.R.S. prescription for 'other forest' ie. where the overstorey has not suffered extensive mortality and the site is either dieback free or only the understorey is infected. Forest which has received the F.I.R.S. rehabilitation treatment for advanced dieback is considered in a separate report.

The specific objective of F.I.R.S. in 'other forest' has been to improve the health and vigour of these stands so as to render them less susceptible to dieback impact. There are three main components to the treatment:

- Banksia grandis removal
- Legume regeneration
- Thinning of jarrah. (not done in Recreation M.P.A.s).

My particular investigation of F.I.R.S. arose out of fears that overstorey jarrah deaths in F.I.R.S. treated areas indicated that F.I.R.S. was not doing its job ie. it wasn't rendering stands less susceptible to disease. Two areas of possible confusion need to be cleared up:

Firstly, areas that have been classified as advanced dieback, requiring a rehabilitation treatment, are seldom denuded of live jarrah and in some cases there substantial live jarrahs remaining. The treatment of these 'graveyard' areas is not designed to protect remaining live jarrah, in fact the prescription says that they be salvaged or fallen to provide ashbeds. In practice the nonmerchantable jarrah are retained and the rehabilitation treatment is, if anything, likely to hasten their death by increasing soil moisture and heating of the soil. When these trees have subsequently died the correct question is "was the rehabilitation treatment correct?" not "is the protection treatment failing?" The protection treatment, ie. B. grandis removal etc, is not being applied in these situations and cannot therefore succeed or fail.

Secondly, for many years it has been recognized that road and pit drainage have been causing overstorey collapse in downslope forest. As more is known about the role of site in jarrah's susceptibility to dieback disease it becomes easier to put these deaths into context. These collapse sites are a combination of high impact features (eg concave landform or Hypocalymma angustifolium) and the increased water shed from pits and roads. Being wise after the event is relatively simple, but the existence of similarly positioned jarrah forest which hasn't collapsed indicates that prediction, at this stage, is not possible. For these reasons areas of forest below pits and roads are placed at greater risk than other forest within the mining envelope.

Similarly if a protective treatment such as F.I.R.S. is applied to such areas the chances of failure are higher as there are drainage factors which encourage disease. Failure of F.I.R.S. to prevent jarrah collapse in these high risk areas below roads and pits must be seen in a different light to deaths in low risk areas such as these above or alongside pits and roads.

I have resolved my task into answering a number of questions. These are:

- Is the removal of B. grandis going to significantly reduce the spread and/or impact of dieback disease in forests adjacent to mining?
- Are the other parts of the F.I.R.S. 'other forest' prescription effective in protecting against disease?
- Has the B. grandis removal operation been efficient?
- Is the level of failure, ie. jarrah deaths, too high?

B. grandis removal, how effective in protecting against dieback disease?

It remains a hypothesis that removing B. grandis reduces the spread and/or impact of dieback disease on the jarrah overstorey. This hypothesis is based on the knowledge that B. grandis is very susceptible to the dieback fungus and its tissue readily supports sporulation of the fungus. It is hypothesised that in an ecosystem containing B. grandis, P. cinnamomi can increase its inoculum potential as well as spread along the B. grandis roots. Removing B. grandis, or a large part of a dense population, should therefore decrease the chances of the fungus spreading, and of causing severe damage to the root system of jarrah.

The hypothesis has not been tested and, if it is possible to test it properly then it should be tested. Dieback researchers will be able to advise on the testability of the hypothesis and the time and money it may require. They have addressed the problem before and assessed it as difficult. Up until now dieback research funds have been directed towards other hypotheses, some of which have a bearing on the B. grandis removal hypothesis.

One possible test of the B. grandis removal treatment is to set up sufficient numbers of paired areas where disease, site and human impact are equal. On one of each pair B. grandis is removed. This is only a valid test if all other things are equal and this is difficult, if not impossible, given present knowledge on site factors, and having no guaranteed method of baiting the fungus in the soil. Disease would probably have to be introduced to each of the paired areas to equalise disease factors and to make sure there is a test of the treatment. The areas would need to be carefully chosen and set up, and regularly photographed to monitor overstorey deaths. Disease spread would be difficult to measure on the areas where B. grandis is removed. It would not be possible to measure the sub-lethal effects on the overstorey without a lot of pre and post measurement of individuals on the ground.

The fact that the hypothesis has not been, and may not be, testable is not sufficient reason to discard it. If it cannot be tested it may be proper to present Alcoa with our present knowledge and ask them if they think it is sufficiently sound to spend their money on B. grandis removal. They can assess the risks themselves. The Forest Department must periodically ask itself "Is the hypothesis testable now?" and "Is the hypothesis still valid from present knowledge?" As with any hypothesis there is a risk that significant factors in disease ecology are not yet known or fully appreciated.

It is not possible to say whether or not B. grandis removal to date has reduced the spread or impact of dieback disease. Trying to answer such a question immediately begs the question "what would the disease situation have been like without B. grandis removal?"

The use of a machine to push B. grandis risks spreading P. cinnamomi, but if proper hygeine is practiced and the operation is carried out when the soil is dry the risks are as low as any forest operation can be. The machine does not have to pass repeatedly over the same area, so wheel contact with mineral earth is minimal.

There are some fears that by reducing B. grandis density the rate of transpiration of a site is reduced, and that this, on some sites may increase susceptibility to dieback. This theory is being investigated with respect to jarrah thinning and the results should be pertinent to B. grandis removal. An effort should be made, over the next few years, to get some basic information on B. grandis transpiration rates on a range of stands. For now the probable benefits of B. grandis removal are judged to outweigh possible disbenefits from transpiration reduction.

In summary, the hypothesis that B. grandis removal reduces a forest's susceptibility to dieback disease spread and/or impact is still valid, though the fact that it has not been tested leads to some inevitable and healthy questioning. Its testability should be re-examined. Any operation to remove B. grandis should be hygeinic. Like any operation in jarrah forest it should try to minimise unnecessary impact on the soil, the canopy and the moisture flow. There is no reason why the use of a machine in dry soil conditions to push down B. grandis will be a major vector of the disease.

Other aspects of the F.I.R.S. treatment in reducing susceptibility to disease

The two other treatments which have been included in the F.I.R.S. 'other forest' treatment are legume establishment and jarrah thinning.

Legumes have been thought to be antagonistic towards P. cinnamomi. This theory has now lost favour. A second arguement for their encouragement is their nitrogen fixing abilities. Following observations that dense acacia thickets came from hot fires, attempts were made to plan hot fires both within and outside F.I.R.S. areas. Some of these fires caused significant damage to the overstorey and it was considered that the establishment of legumes was insufficient reason to accept such damage. Natural acacia regeneration after fire was found to be more successful in open areas. Under a canopy it seemed necessary to use seeding and fertilizing to get acacia thickets, but the use of phosphate fertilizer was suspected to increase jarrah's susceptibility to dieback disease. Acacia seeding and fertilizing was discontinued in F.I.R.S. 'other forest' and dry soil burns favoured so as to encourage natural acacia regeneration as well as kill B. grandis regeneration.

Divisions should still be encouraged to burn in autumn dry soil conditions so as to encourage natural acacia regeneration and kill B. grandis regeneration. If suitable autumn conditions don't occur then there is a cost of holding these areas over until the following year. This cost should be balanced with the costs of follow up poisoning of B. grandis regeneration and establishment of legumes using seed.

Jarrah thinning was included in the F.I.R.S. 'other forest' prescription and has been applied over water production areas. The intention is to improve the health and vigour of the remaining trees and to increase water yield. As mentioned earlier, research is currently under way to determine if, on particular sites, the increased 'wetness' of the jarrah tissue increases its susceptibility to fungal invasion. However, jarrah thinning operations have not been stopped because of it.

My recommendation is that jarrah thinning be applied to F.I.R.S. forest on a similar basis to that applied in the Forests Department's other thinnings ie. that areas of dense 'pole' regeneration be thinned, plus some selected 'freeing' of individual trees in areas where good potential crop trees are not so plentiful.

It would also seem logical to apply this treatment after mining so that moisture relations had stabilised and that chances for introducing the disease were low. This would mean that B. grandis removal could be up to five years ahead of mining with the jarrah thinning some years after mining.

Has the B. grandis removal operation been efficient?

The use of either pushing or poisoning, followed by fire, has been shown to be effective in substantially reducing the population density of B. grandis. There is no reason why all of the mature (ie seeding) trees cannot be killed. This should remove a seed source for at least 10-15 years in most situations. Neither poisoning or pushing has been effective against small plants (those up to about a metre in height) mainly because they get missed, but a large proportion of them are killed by using fire. Work by D.F.O. Burrows (Manjimup Research) showed a direct relationship between fire intensity and the number and size of stems killed to ground level, so the hotter the F.I.R.S. burn, the more likely it is that more and larger stems are killed. However, there is a size class of B. grandis, those with lignotubers around 4-7cm in diameter, a large proportion of which survive a reasonably hot fire and coppice vigorously. If original populations of these intermediate sized plants are up to 1000 per hectare there may be residual populations of several hundreds per hectare after treatment and fire.

A follow up poisoning of surviving coppice and seedlings is necessary and should reduce the numbers of B. grandis below 250 per hectare. This should kill vigorously growing plants, though some smaller coppice and seedlings will escape notice unless the treatment is very thorough and consequently costly. The appropriate poison to use and its correct application need to be further investigated by Divisions. The knowledge that a follow up poisoning is scheduled may allow costs on the first treatment to be reduced eg. plants difficult to deal with on the first treatment may be left and debris piled on them, if they don't die they can be poisoned later, after the burn.

The objective of the operation is to get a substantial reduction in B. grandis populations at a reasonable cost. The use of an initial poisoning or pushdown, a fire as hot as practical and a follow up poisoning is a system that has produced results. Periodic discussions between Divisions, Region and Research, and between Alcoa and the Forests Department should keep costs at a reasonable level and produce suggestions for improvements that can be tried out.

D.F.O. Burrows' research indicated a potential to use fire to reduce the basal area and density of B. grandis populations. He said that allowing fuels to accumulate to 12-14 tonnes per hectare and burning for complete fuel consumption is preferable to implementing moderate intensity fires in lighter fuels and under more dangerous weather conditions. This can be looked at within the 25 year envelope.

In areas where B. grandis populations have been reduced subsequent burning should aim to maintain this suppression. This problem will arise over the next five years as early F.I.R.S. areas accumulate litter.

Is the Level of Jarrah Deaths in F.I.R.S. 'other forest' too high?

The short answer to this question is no, jarrah deaths are not sufficient to suggest that the B. grandis removal operation is a waste of effort.

The bulk of the jarrah deaths in forest given the 'other forest' treatment are in situations where deaths can be anticipated ie. below bauxite pits or haul roads or below existing advanced dieback. But even in these areas the occurence or non-occurence of jarrah collapse is not predictable, and there is no way of knowing if B. grandis removal has tipped the balance in favour of the forest in situations which seem at risk but which haven't collapsed. The areas below roads, pits and existing advanced dieback have a higher risk of failure, but also a higher chance that the treatment will be tested. As we cannot yet identify those areas that are highly

at risk which will collapse despite B. grandis removal, then the safest bet is to treat all of these high risk areas but recognize that the failure rate is going to be relatively high.

Deaths outside of these 'high risk' areas are scattered. When they do occur there are sometimes site factors pointing towards high impact (eg. concave slope), other times there appears to be no obvious cause. Most of these areas have been mapped as having disease widespread, and have been logged in the past 15 years prior to strict hygeine and without comprehensive disease mapping. The occurence of isolated jarrah deaths in F.I.R.S. is not therefore surprising. Whether or not there would have been more without B. grandis removal is impossible to say. I have already discussed the difficulties of proving or disproving the hypothesis that B. grandis removal reduces the spread and impact of dieback disease. My assessment, after observing all of these deaths in lower risk areas as well as deaths in areas that haven't been F.I.R.S. treated, is that they are no more than elsewhere. Concern that B. grandis removal is actually introducing disease and/or increasing disease impact, is not supported by my investigations.

SUMMARY

I have sought to answer the four questions posed in the introduction.

The hypothesis that B. grandis removal reduces the spread and/or impact of dieback disease is well supported, but has not been proven. Its testability should be re-assessed. The hypothesis is not that it cures the forest of dieback but that it tips the balance in favour of the forest. In some situations this cannot prevent disease as other factors are overwhelmingly in the disease's favour, but at this stage we are unable to target the treatment to those forests where it can tip the balance.

Other facets of the F.I.R.S. prescription, legume regeneration and jarrah thinning, are not thought to be strong factors in protection against disease but should be done as improvement treatments. Legume regeneration can be done by a combination of natural regeneration and seeding, as part of the B. grandis removal operation. Jarrah thinning can be applied in appropriate stands after mining.

The B. grandis removal operation has been efficient in removing the seeding population and a large number of small plants, but a follow up treatment is required to significantly reduce the numbers of an intermediate size class.

The level of jarrah deaths in F.I.R.S. 'other forest' is not too high. Deaths in high risk areas such as below pits, roads and advanced dieback are anticipated, if not predictable at this stage. The level of B. grandis deaths outside of these high risk areas is not high and does not cast serious doubts over the B. grandis removal treatment.

RECOMMENDATIONS

1. Develop techniques for draining pits and roads more directly into the watercourses so as to lessen the collapse of downslope healthy forest.

2. Re-assess whether or not the B. grandis removal hypothesis is testable and if so what is required.

3. If the hypothesis is not to be tested Alcoa should be asked if, on the basis of present knowledge, they think that it is a sound basis for spending money on B. grandis removal.

4. Over the next few years gather some basic information on B. grandis transpiration rates on a range of stands.

5. Discuss with Divisions and Research the occurence of autumn dry soil conditions and the costs of delaying burning versus follow up B. grandis poisoning and the use of seeding to establish legumes.

6. Plan to thin jarrah pole stands and free from competition selected individuals in non-pole stands several years after mining.

7. Develop an efficient technique for follow up poisoning of regenerating B. grandis.

8. Look at using prescribed burning within the 25 year mining envelope to prepare areas for the impact of disease through mining.

9. Apply these recommendations to a rewrite of the F.I.R.S. prescription for what has been termed 'other forest'.

Ian Rotheram

I. Rotheram
A.D.F.O.

Joanna

Please Stewart
copy to

Please find enclosed a copy of my report on FIRS treatmen of healthy or low impact jarrah forest aswell as a copy of th parts of the current FIRS prescr for those forests. As page 2a of the prescription shows this treatment (N°2) is only one of fo prescribed treatments in the FIR scheme the others being stream zone protection ie cautious, rehabi of graveyard dieback, and improven treatment of healthy forest after treatment (2) where this is justified

Ian Rotherm