Control of Crown Dieback Disorders in Eucalypt Forests

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Contents

1. INTRODUCTION

Jarrah dieback and phasmatid defoliations of alpine ash (Readshaw, 1965) have emphasised to foresters in Australia the fact that disease is and can be a major problem in native eucalypt forests. Concern at the gradual accumulation of information regarding a series of eucalypt crown disorders (Hopkins, 1973) led to convening this seminar to assess ways in which these disorders may influence general forest management.

Up to the early 1960s professional training in Australia was noticeably deficient in its accent on eucalypt pathology or the training of future managers to handle major eucalypt forest disorders. This situation ,with one notable exception, that of fire, was largely the result of lack of precedent in the field to warrant detailed attention. Generally, native eucalypt forests were considered to be remarkably free from major diseases, apart from heart rots, and in balance with natural agencies.

Fire is the greatest controllable agent impairing values within indigenous eucalypt formations. Control of fire is essential before sound management can be envisaged and it takes precedence.

Research, operational techniques and available manpower are now adequate within most States to control wildfires in forests. Fire control is receiving separate attention through working groups, committees, seminars and special research teams and is not treated in this review.

The forester, unlike his agricultural counterpart, is in an unfortunate position because he can rarely control disorders by direct measures. His main hope of disease control lies in his ability to identify methods of altering the forest environment or avoiding disease.

The object of this review is to consider the requirements for control and to outline approaches which may be applicable in general instances of forest disease in Australia.

2. ECONOMIC SIGNIFICANCE

Before control procedures can be applied to a eucalypt crown disorder it is essential to demonstrate current or future economic significance. Loss of forest values due to the malady must justify some flow of finance and manpower to alleviate the condition. This has been demonstrated for jarrah dieback (Hopkins, 1972; Shea and Hopkins, 1973), phasmatid damage to alpine ash (Readshaw and Mazanec, 1969), high-altitude dieback in Tasmania (Ellis, 1964) and currently appears to be implied for disorders in eastern Victoria (Marks *et al.*, 1972) and potential damage to regrowth in Tasmania (Felton, 1972). A preliminary evaluation for gully dieback in Tasmania (Felton and Bird, 1972) suggests that at present, expenditure on control may be unwarranted.

It is essential, however, for managers to have flexible attitudes to economics of control. Public realisation that areas of indigenous forest are limited and increased demands for amenity values of forests have placed new importance on the requirements for control of dieback disorders. Wood production is no longer the sole criterion and aesthetics and reserve values (Weste and Taylor, 1971; Weste and Law, 1973) must be considered.

3. CAUSAL AGENCIES

Successful control cannot be contemplated without a full appreciation of the aetiology of the disease. Decisions as to whether control procedures are warranted do not lie purely with the value of benefits lost or threatened by the disorder. It is essential to know of the process and possible course of the disease. This requires a knowledge of the causal agencies and their potential to function within the environment. Such a situation refers to regrowth dieback in southern Tasmania (Felton, 1972) and dieback of *E. saligna* at Ourimbah in New South Wales (Hartigan, 1969). Before control measures can be contemplated it is essential to ensure that the problem is adequately researched.

Control of a disorder requires knowledge of some basic process or 'weak link' within the disease process or forest situation which can be modified by practical procedures.

4. CONTROL OBJECTIVES

Many eucalypt crown disorders appear to result from physical intervention by European man. This may be direct as in the case of the introduction of *P. cinnamomi* to Western Australia (Podger *et al.*, 1965) or Victoria (Marks *et al.*, 1972) or indirect as in the disturbance of the sequence of burning (Ellis, 1964). In the case of crown deterioration in the jarrah forest (Wallace and Hatch, 1953) and regrowth dieback (Felton, 1972) the conditions may have to be accepted for the forest formations involved possibly cannot withstand disturbance due to logging without some expression of crown deterioration.

When considering control of eucalypt crown diebacks it is essential to determine the objectives of control. Preservation of high amenity values may require reservation of unlogged wilderness areas. Jarrah dieback control aims to decrease damage in currently healthy stands but cannot restore the original forest values in areas that are diseased (Hopkins, 1972; Batini and Hopkins, 1972). Often the choice is limited and the disease effects can only be mitigated. For example, for much of the coastal east Gippsland forest threatened by *P. cinnamomi* (Marks *et al.*, 1972), a practical approach may be to remove the derelict native forests (by chipwood operations) and replace them with a high proportion of resistant species such as *P. radiata* and *E. globulus*. Such decisions cannot be made without a thorough knowledge of the disease process, the ecology of the tree-type and the land-use alternatives involved.

5. CONTROL PROCEDURES

A number of established control procedures can be considered for eucalypt crown dieback situations.

5.1 Quarantine and hygiene

Podger (1972), Weste and Taylor (1971), and Weste and Law (1973) have shown from theoretical considerations that dieback caused by *P. cinnamomi* can be limited by restricing movement of inoculum by man.

Quarantine and hygiene can be specified to prevent harmful agents (such as *P. cinnamomi*) from entering healthy, susceptible stands (Hopkins, 1972). Shea has shown that soil conditions are unfavourable to *P. cinnamomi* in the prime jarrah forest and quarantine and hygiene procedures may effectively restrict dieback in these situations (Shea and Hopkins, 1973). Batini (1973) has demonstrated that the simple process of washing down vehicles moving from diseased areas can be effective in slowing down the movement of inoculum.

The major problems associated with quarantine and hygiene procedures in forest situations are to see that they are enforced satisfactorily and to monitor their effectiveness. In Western Australia, quarantine and hygiene to control jarrah dieback are practised within State forest boundaries (Batini and Hopkins, 1972). However there is no control in national parks or in other diseased areas outside the authority of the Forests Department. Demands for road gravel from diseased areas outside State forests could result in infected private vehicles entering the forest and gravel pits to obtain the material. There is no authority to insist that private vehicles must be cleaned and if there was, the enforcement of this activity would place severe demands on Departmental staff. It would, for instance, require careful and regular mapping of all diseased areas outside of the State Forest.

The alternative, to refuse to supply gravel, is not necessarily acceptable, as gravel is about a third of the cost of alternative material available to shires for road construction.

Quarantine and hygiene may only slow the rate of spread of the disease, and not eliminate it. Logic shows that this control must appreciably reduce spread of the fungus (Hopkins, 1972) but no satisfactory monitoring system to demonstrate this reduction has yet been devised. Unfortunately, without such evidence of beneficial effect it is often difficult for a divisional forest officer to keep faith with control policy. He is still dismayed by the extent that the disease continues to spread within his management division.

Although quarantine and hygiene measures need to be complete for full effect, it is however, rarely possible to achieve this degree of control in a forest situation.

5.2 Chemical procedures

Chemical treatment may be effective in the case of insect damage such as for the phasmatid defoliation in southern New South Wales and northern Victoria. Weste and Law (1973) report some possibilities for chemical use in localised control of *P. cinnamomi*, but generally chemicals have restricted application in the control of eucalpt crown diebacks. The disadvantage of further environmental pollution from the chemicals is also important. Generally it is felt that chemicals can only have applications in high-value situations such as nurseries or plantations (Hopkins, 1972).

5.3 Cultural procedures

Canopy maintenance, host reduction and fertiliser addition may offer appropriate control procedures for specific circumstances of eucalypt crown dieback. Shea and Hopkins (1973) have shown that the maintenance of low soil temperatures by canopy and litter manipulation has significant effects on reducing damage by *P. cinnamomi* in the jarrah forest. Ellis (1972) suggests that for *E. delegatensis* dieback, understorey removal to increase soil temperatures at these high altitudes will effectively control dieback. Restricting water-logging by controlling drainage is also necessary to ameliorate disorders associated with water-logging and *P. cinnamomi* (Hopkins, 1972).

Among cultural control methods consideration must be given to natural species resistance (Podger and Batini, 1971; Marks *et al.*, 1973; Weste and Law, 1973). Regeneration treatments for diseased or threatened forest should be aimed to increase the proportion of resistant species where this is practicable.

Biological control procedures are also important. As most eucalypt crown dieback disorders appear to result from interference from man, the reservation of certain forest types as true 'wilderness' to preserve ecosystems intact for biological study deserves attention. This is the simplest form of biological control.

Pratt (1971) has evidence of antagonism from native basidiomycetes to *P. cinnamomi*, and Broadbent (personal communication) is carrying out interesting work with respect to natural control of this pathogen. Malajczuk (1973, personal communication) has shown in glass house studies that tolerance of *E. calophylla* to *P. cinnamomi* is conferred in part by some rhizosphere micro-organisms. In forestry, biological control of soil-borne, root pathogens has limited application.

Biological control of defoliating insects offers far more promise. Such a control procedure appears to be the only effective approach to jarrah leaf miner (Wallace, 1970). The habits of the insect render it immune to external chemical treatments. It is also possible that regulated burning of the litter and diseased foliage could offer effective control procedures.

6. SALVAGE

Losses incurred from eucalypt dieback can be reduced by selling diseased trees. Such is the case with high-altitude dieback on alpine ash (Felton, 1972) and jarrah dieback (Hopkins, 1970).

The word 'control' is often considered to be synonymous with eradication, and salvage is not always viewed as part of control procedures. It is pertinent to emphasise that most conditions of eucalypt crown dieback reported probably refer to irreversible conditions which

result from past practice. Crown dieback is an indication that the natural ecosystem has been unbalanced and, in part, destroyed. Applicable control methods need to salvage as many of the forest values as is possible, or desirable.

7. CONCLUSION

Dieback diseases in eucalypt forests can only be controlled adequately by making a careful study of the natural forest and the changes produced by logging. The areas of forest involved and value per unit hectare make it unreasonable to rely on empirical approaches founded mainly on good ideas and optimism. Biological and chemical control measures will have only limited usage in native forests because of the size of the areas and costs involved. Partial disease control has merit if it will slow down the rate of spread of disease.

Control of disease situations in native forest is a relatively new concept for foresters. There are some indications suggesting that foresters should discard ideas that problems can be solved by the discovery of one simple technique. Forests are large and complex ecosystems which must be relatively effectively buffered against disease to survive. Many of the crown diebacks considered in this seminar reflect an imbalance which is probably uncontrollable, if restoration to some semblance of the natural ecosystem is the objective sought.

In the northern jarrah forest in Western Australia, which has been heavily exploited by past cutting and damaged by fires and is now ravaged in parts by *P. cinnamomi*, consideration has been given to rehabilitating the refractory soils of the heavily diseased areas by sowing or planting resistant species, i.e., a future timber function is envisaged. It is far more economical and efficient to meet this future wood function by growing *P. radiata* or *P. pinaster* in alternative areas. Following salvage and some cleaning up, the park-like stands which remain after heavy disease development are satisfactory for recreation and water catchment purposes. These are the most desirable and obvious forest values to be developed in the area and are now major considerations in control and management policy.

Control procedures must often be regarded as making the best out of a bad situation. Once faced with the alternatives, the manager will often find from a full analysis of land-use resources and the disease situation that useful and publicly-acceptable procedures are available.

It is suggested that disease control in eucalypt forests should be viewed initially from the point of management alternatives prior to conservationists, research workers or timber millers looking for a panacea.

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9. SUMMARY OF DISCUSSION

The potential for biological control of pathogens causing crown dieback was discussed by workers in this field. Mention was made of recent advances in manipulation of soil microfloral populations for the control of fungal root pathogens. It was thought that procedures such as the induction of beneficial mycorrhizae in the nursery, fertilisation or burning in the field might allow establishment of biological control, though much more investigation is necessary.

There is considerable evidence that satisfactory growth and wood production can be achieved by using disease-tolerant eucalypt species.

Chemical control of root pathogens was also thought to be an area worth further research and some work specifically with *P. cinnamomi* was reported. Attempts were being made to synthesise analogues of naturally-occurring antagonistic compounds isolated from basidiomycetes . The importance of selecting the correct stage of the life cycle of the pathogen for treatment was stressed.

Quarantine or hygiene practices were thought a relevant control measure in the case of introduced pathogens. Report was made of the successful chemical disinfection of gravel which could assist in easing quarantine restrictions. The need for knowledge of the ecology of the pathogen was stressed, particularly if such information identified high risk environments.

Some speakers wished to take up points in the review paper; in particular it was felt that control could be so absolute as to restore original forest values and all that implied in the form of land-use alternatives. It was pointed out that multiple-value areas such as virgin forest could only be maintained by reservation and could not be restored.

The validity of the generalisation that many diebacks are due to physical intervention by man was questioned by one of the delegates. Many recent occurrences of jarrah, gully, regrowth and high-altitude dieback have been recorded in areas undisturbed by man for many decades. In other places vigorous and healthy regeneration grows on sites which have experienced severe physical disturbances in the past. In the latter areas causal agents of dieback must have been absent or remained under very powerful environmental control. Undoubtely there are areas in which physical disturbance is likely to accelerate the activity of pathogens such as *P. cinnamomi*. In such places forest managers must exercise considerable restraint, but extension of this caution to areas in which such pathogens do not occur or are powerfully buffered is unwarranted and will unnecessarily reduce the choice of silvicultural methods available to forest managers.

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