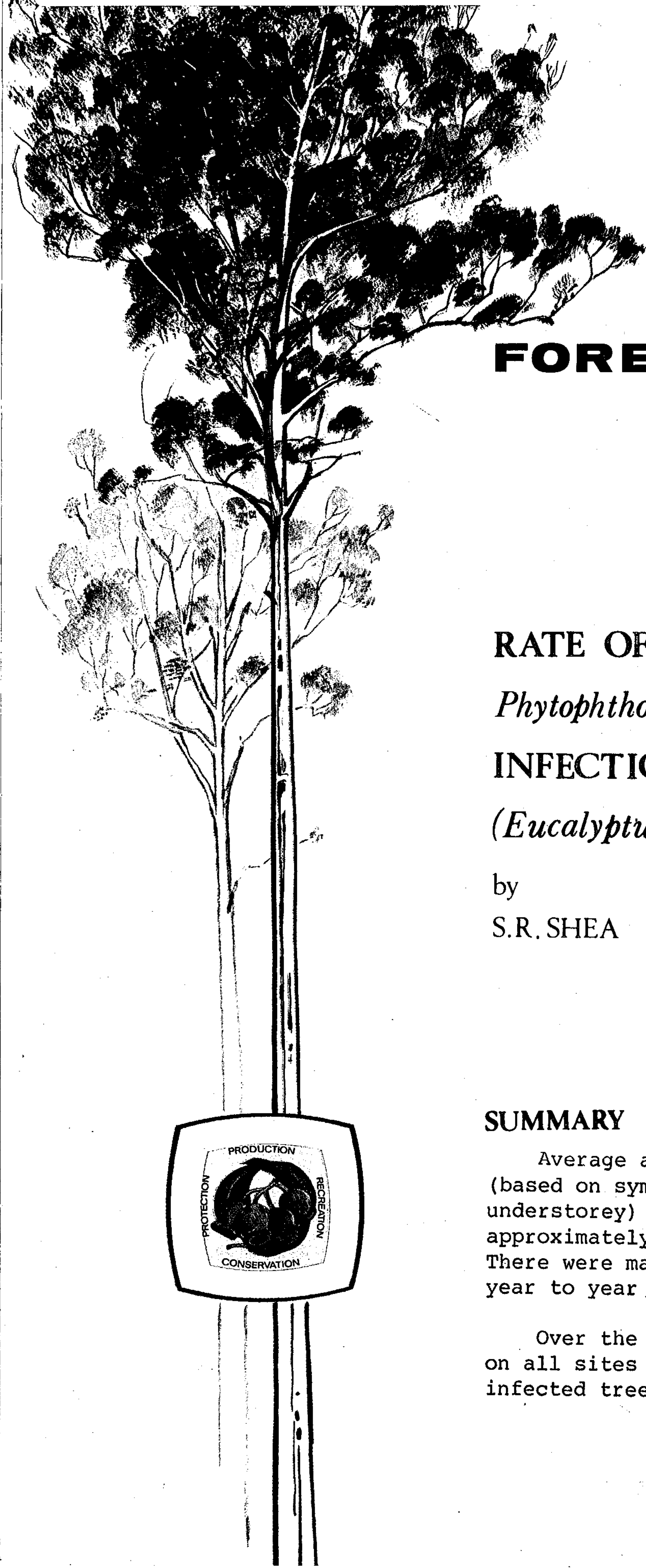
ODC 443.3:178.6

Research Paper 65

1980



FORESTS DEPARTMENT
OF WESTERN AUSTRALIA

RATE OF SPREAD OF *Phytophthora cinnamomi* Rands INFECTIONS IN THE JARRAH (*Eucalyptus marginata* Sm.) FOREST

by

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SUMMARY

Average annual upslope extension of *P. cinnamomi* (based on symptoms developed in the *Banksia grandis* understorey) in the northern jarrah forest was approximately 77 cm during the period 1967 to 1977. There were marked differences in disease extension from year to year and between sites.

Over the period of study average jarrah mortality on all sites was 17 per cent. Crown deterioration of infected trees was variable.

INTRODUCTION

In 1967 a series of plots was established to monitor upslope extension of *Phytophthora cinnamomi* Rands (jarrah dieback disease) infections in the northern jarrah (*Eucalyptus marginata* Sm.) forest (Shea, 1975). Infections occur predominantly in lower topographical situations where the soil physical environment favours survival and sporangial production of the pathogen. Although the soil physical environment on upland sites is only marginally favourable for *P. cinnamomi* it can still cause extensive damage on these sites. Infections on these sites originate from the movement of pathogen-containing soil and roots as a consequence of disturbance by machinery, and the extension of the disease upslope through highly susceptible roots from existing infections in the lower topographical situations. Once an infection has been established in an upper topographical site downslope spread can be rapid. *Phytophthora cinnamomi* propagules have been detected in water passing downslope as subsurface and overland flow (Shea, unpublished data).

Upslope extension from existing infections is much slower but this type of spread could be significant in the long term. In this paper we summarise data on the extension of the disease upslope from existing infections and variation in overstorey mortality in a range of sites during the period 1967 to 1977.

METHOD

Disease extension was monitored by recording changes in the health status of the understorey and overstorey annually. Plots consisting of a 66 to 110 m base line were established at the perimeter of existing infections on a range of soil and slope types. Changes in the disease status of *Banksia grandis* Willd., the principal understorey species and main indicator of disease presence, were recorded in relation to the base line. As *B. grandis* is the principal indicator species of *P. cinnamomi* infections all plots were located in areas where there was a recently diseased understorey of this species. Approximately ten jarrah trees adjacent to the base line in each infected area were tagged and the health status of their crowns was recorded. In five of the plots the condition of the crown of the tree was recorded using black and white photographs.

The *Banksia* understorey of one of two plots adjacent to each other was thinned to a 5 x 10 m spacing for a distance of approximately 40 m upslope from the infection.

The annual increase in the area of forest infected on each plot was measured by assuming that the line joining the most recent understorey deaths to the nearest death of the previous year defined the area of newly infected soil. The average disease extension (infection area divided by length of plot) and the maximum linear extension for each plot were recorded for each year.

RESULTS

The majority of the study plots were established in 1967 and 1968. An additional five plots were established in 1973. During the study period some of the plots were destroyed or disturbed by various forest management practices. However, a complete record of disease extension existed for ten of the plots. Mean annual extension of the disease on the ten plots for which there was an undisturbed record of disease progression from 1967 to 1977 is shown in Figure 1. Mean annual disease extension of all plots is shown in Figure 2. The overall mean annual rate of extension on these plots was 77 cm.

Average annual extension rates for the thinned and unthinned plots were 56 and 64 cm respectively. Disease extension occurred in only five of the nine years since establishment in the thinned plot whereas extension occurred in every year in the unthinned plot.

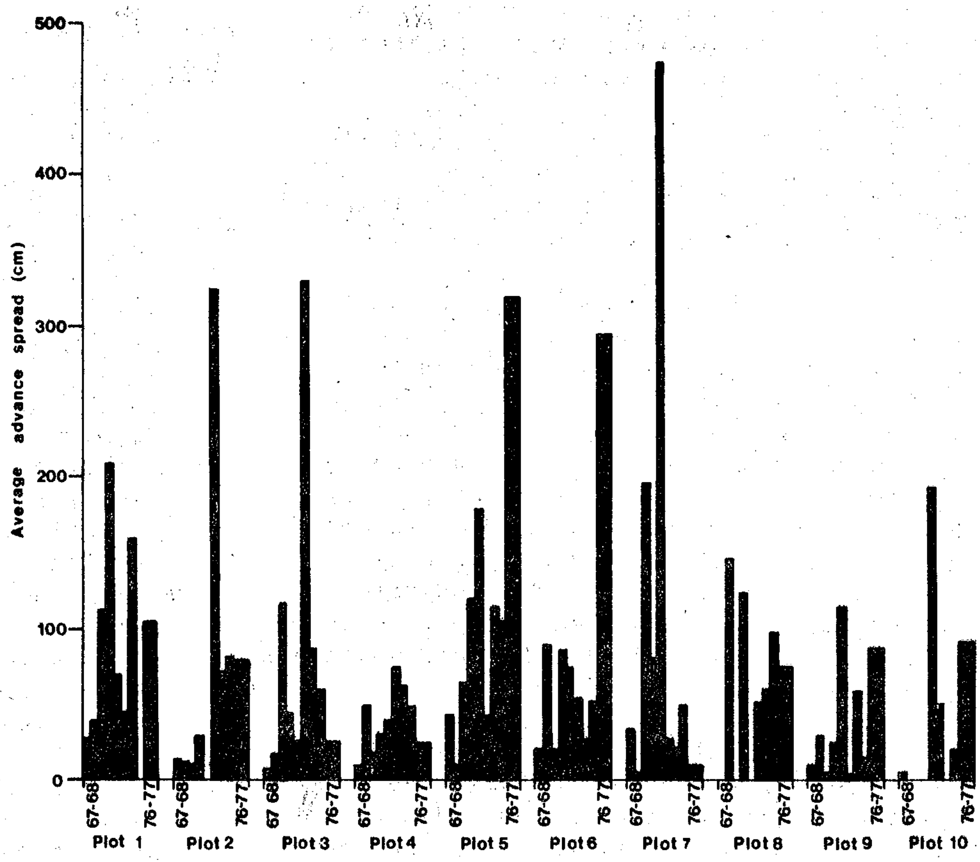
Only 17% of the tagged jarrah trees died during the study period. The change in crown vigour of the trees which were photographed is shown in Table 1.

TABLE 1

Crown status of jarrah trees in study plots

Improved vigour (per cent)	Unchanged (per cent)	Deteriorated (per cent)	Dead (per cent)
17	39	27	17

FIGURE 1: Average annual spread of P. cinnamomi from 1967-68 to 1976-77 in the ten plots for which there is a complete record.



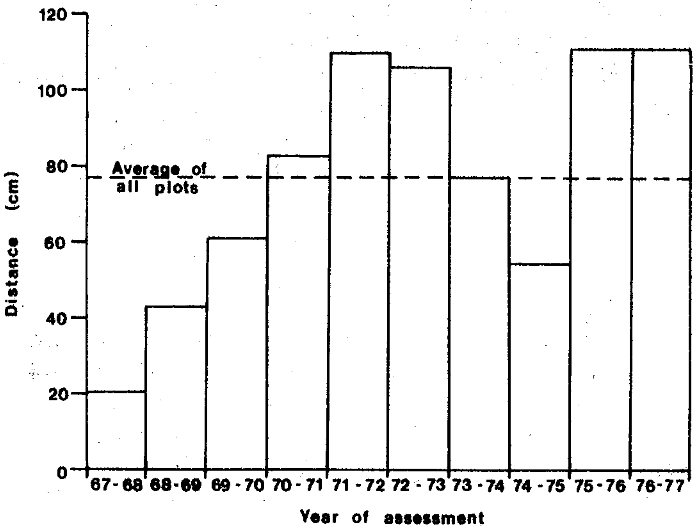


FIGURE 2: Average annual spread of P. cinnamomi on all plots in cm.

DISCUSSION

These measurements of disease extension confirm previous observations that upslope spread of the disease is relatively slow. The low rate and irregular pattern of extension suggest that the fungus is extending through the roots of the highly susceptible understorey and that mycelial extension through soil is insignificant. Even though the annual rate of extension upslope is slow, this form of disease extension would be significant in the long term.

The rate of extension varies from year to year but the record is too short and the sample too small to correlate disease extension rates with climatic factors. Although there are differences in disease spread between plots it is difficult to correlate the variation in disease intensity with specific site factors because of the small sample size. However, the observed differences in disease spread do not appear to be associated with either soil physical factors (soil moisture and temperature) or the density of highly susceptible hosts. All of the plots were located on freely drained sites with similar canopy densities and similar soil moisture and temperature regimes (Shea, 1975). Since all of the plots were located in areas with a dense *Banksia* understorey it is unlikely that the differences observed could be attributed to differences in the density of the susceptible forest understorey.

The reduction in the density of the *Banksia* understorey was not sufficient to significantly reduce overall disease extension. It is probable that, even though *Banksia* density was substantially reduced, there was sufficient overlap of lateral roots between the residual trees to permit fungal transmission in roots.

The low rate of disease extension and the slow decline of infected jarrah on freely drained upland sites, even when a dense, highly susceptible understorey is present, supports the hypothesis that jarrah on these sites is only marginally susceptible to *P. cinnamomi* (Shea, 1975). It may thus be possible to reduce fungal pathogenicity significantly by reducing the density of the *B. grandis* understorey and modifying the soil environment on these sites (Shea *et al.*, 1976; Shea and Malajczuk, 1977; Shea *et al.*, 1979).

The slow decline of jarrah makes assessment of potential control treatments difficult. It would be necessary for treated areas of forest to remain healthy for periods considerably longer than ten years before successful control of the disease could be claimed if the criterion used to assess control is health of the overstorey.

REFERENCES

SHEA, S.R. (1975). Environmental factors of the northern jarrah forest in relation to pathogenicity and survival of *Phytophthora cinnamomi*. Bulletin 85, Forests Department of Western Australia.

SHEA, S.R., MALAJCZUK, N. and KITT, R.J. (1976). Promotion of understorey native legumes - a possible method of control of *P. cinnamomi* in the northern jarrah forest of W.A. Abstract of papers, 2nd National Plant Pathology Conference, Brisbane, May 12-14, 1976. Supplement to Australasian Plant Pathology Society Newsletter 5.

SHEA, S.R. and MALAJCZUK, N. (1977). Potential for control of *Eucalypt* dieback in Western Australia. Annual Conference Seminar Papers, Australian Nurserymen's Association Limited, Hobart, 1977, 13-19.

SHEA, S.R., GILLEN, K.J. and KITT, R.J. (1979). Variation in sporangial production of *Phytophthora cinnamomi* Rands of jarrah (*E. marginata* Sm.) forest sites with different understorey compositions. Australian Forest Research 8, 219-226.