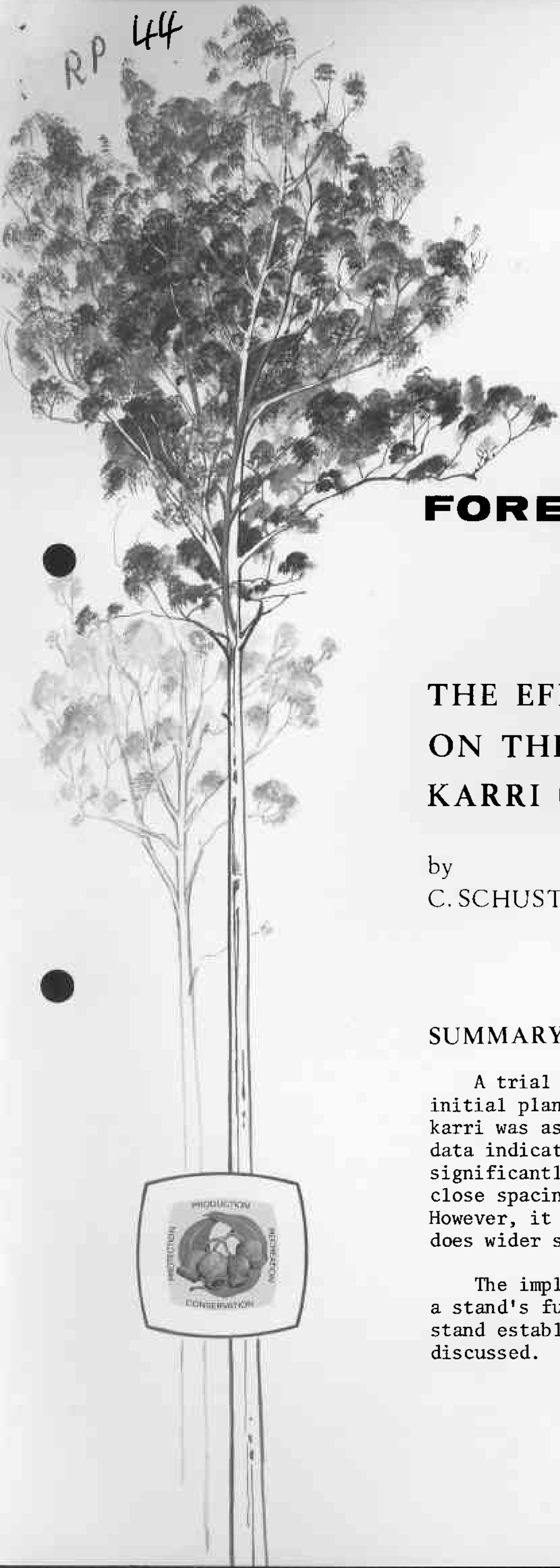

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THE EFFECT OF PLANT SPACING ON THE EARLY DEVELOPMENT OF KARRI (*Eucalyptus diversicolor* F. Muell.)

by
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SUMMARY

A trial established to determine the effect of initial plant spacing on the growth and form of karri was assessed after 6 years. Analysis of the data indicates that whereas spacing does not significantly affect the total height of karri trees, close spacing leads to significantly higher crowns. However, it also leads to higher mortality rates than does wider spacing.

The implications of these findings in relation to a stand's future sawlog value and consequently to stand establishment and management practices are discussed.

INTRODUCTION

In 1971 a trial was established on abandoned farmland in Muirillup Block, approximately 15 km east of Northcliffe, to examine the effect of initial spacing on the growth and stand development of karri (Eucalyptus diversicolor F. Muell.).

In artificially planted karri stands there is a choice between close spacing of the trees, which promises strong inter-stem competition at an early age, and wider spacing, which is less costly since it avoids the need for early thinning and concentrates the stand growth on fewer stems, but which may lead to heavy low branching and consequently to poor form and low sawlog value.

This paper reports measurements taken 6 years after the trial plots were established and discusses some implications with regard to operational planting.

METHOD

The spacing trial was established in a randomised block design of four replications. Six initial spacings were chosen: 1.22 m, 1.83 m, 2.74 m, 3.66 m, 4.57 m and 6.09 m. This range includes not only the spacings most appropriate for field planting in terms of cost and production, but also the two extremes of spacing to allow interpolation of the trial's results over the full range of spacings.

Each plot covers 0.32 ha, with a central 0.04 ha sub-plot within which the measuring was carried out. Stem numbers in these sub-plots varied from 12 (the widest spacing) to 272 (the closest spacing). In each sub-plot, 12 trees were chosen for measurement by dividing the plot into areas each equivalent to that occupied by one stem in the plot with the widest spacing and then selecting the largest stem within each area. These trees were then permanently marked for remeasurement. The trees were selected in this way because these are the ones that will probably form a large proportion of the final crop. However, since there were only 12 trees in the plot with the widest spacing, no choice of trees for measurement was possible; genetic variation in the planting stock could therefore affect the measurement results considerably.

To determine differences in height and diameter growth, branching characteristics and stand health, the following data were recorded: total height, diameter at breast height over bark, stem height to the base of the crown (taken as the first green branch over 2.5 cm diameter), and a survival count over the whole sub-plot.

RESULTS

Mean values for total height and for diameter at breast height were calculated from the data and are presented in Table 1.

TABLE 1

Mean total height and mean diameter at breast height for karri planted at various spacings

Spacing (m)	Height (m)	Diameter (cm)
1.22	9.06	9.22
1.83	9.17	10.43
2.74	8.19	9.95
3.66	7.72	8.97
4.57	7.55	10.57
6.09	7.31	10.12

Both sets of data were subjected to an analysis of variance, which showed no significant differences between treatments. However, the height measurements indicate a definite trend towards taller trees in the closer spacings.

Mean values of stem height to the base of the crown, which can be used as a measure of form and therefore future suitability for sawlog use, were calculated and analysed using Duncan's (1955) multiple range test and are shown in Table 2.

Trees in the 4.57 m and 6.09 m spacings have significantly lower crowns than those in any other treatment. Trees in the 3.66 m spacing have significantly lower crowns than those in the 1.22 m and 1.83 m spacings, and trees in the 1.22 m spacing have significantly higher crowns than those in any other. These differences may be due to the higher crown density in the closer spacings which obstructs light from the lower branches.

TABLE 2

Mean heights to base of crown in karri planted at various spacings

Spacing (m)	1.22	1.83	2.74	3.66	4.57	6.09
Height to crown base (m)	3.35	2.38	2.18	1.77	1.04	1.18

Differences between means connected by a line are not significant (0.05 level of significance)

TABLE 3

Stand health of karri planted at various spacings

Spacing (m)	Initial stocking (stems per ha)	Stem survival* (per cent)	Suppressed stems** (per cent)	Present stocking (vigorous stems per ha)
1.22	6727	90.8	25.1	4575
1.83	2990	90.7	16.6	2262
2.74	1329	96.5	17.0	1064
3.66	747	94.0	0	702
4.57	478	98.7	0	472
6.09	269	87.5	0	235

*stem survival expressed as a percentage of initial stocking
**suppressed stems expressed as a percentage of surviving stems.

A factor that further affects the success of an artificial regeneration programme and which consequently affects the cost-efficiency of the operation is the plant survival percentage. As Table 3 shows, heavy stem mortality occurs in the closer spacings during the early years of stand development. The suppressed stems noted in Table 3 are those that were considered likely to die before the first commercial thinning, which will take place when the stands are 30 years old (Bradshaw, Forests Department of Western Australia, personal communication); they were defined as sub-dominant stems with crowns of relatively low leaf area that are uneconomical in relation to site qualities.

DISCUSSION

No firm conclusions can yet be drawn concerning the future karri planting regime because the trials have not been established for long enough. Nevertheless, two points that may have an important bearing on future decisions emerge from the results.

Firstly, plant spacing in the trial has had no significant influence on the diameter and the height growth of final crop trees in their early stages (Table 1).

Secondly, there are significant differences between the branching trends under various spacings, the closer spacings showing far less tendency towards persistent low branching (Table 2). This is of importance because stem branching considerably affects the future sawlog value of a stand.

Since the trial area is sited on abandoned farmland, it does not contain the normal proportion of scrub species (notably Acacia species) common to young karri regeneration areas. Consequently it is likely that the more widely spaced stems are more open than they would be under normal regeneration conditions.

The optimum stocking at age 30 years is 675 stems per hectare; it is planned to thin this to 125 stems per hectare to form the basis of the final sawlog resource (Bradshaw, personal communication). Table 3 indicates that whilst all the trial plots are stocked sufficiently for sawlog production, neither of the two widest spacings is stocked heavily enough to provide a full chipwood yield at this thinning; however, even though further investigation of growth patterns is needed before results may be considered conclusive, it appears that the 3.66 m spacing will provide a stocking approximately that required at age 30 for optimum chipwood yield.

CONCLUSIONS

Although few immediate conclusions can be drawn from this trial, continued monitoring of the plots should assist in the planning of alternative management strategies for karri regenerative procedures.

The only advantages of close spacing that are evident at present are the reduction of low branching and a possible increase in height growth. However, plant survival rates are excellent under the current planting regime, which prescribes wider spacing and which leads to less costly establishment and maintenance. Therefore, unless the advantages of closer spacing are considered more important, it may be better to retain the current regime, especially since under natural conditions the competition from the forest understorey may offset the disadvantage of heavy branching in the wider spacings.

REFERENCE

Duncan, D.B. (1955). Multiple range and multiple *F* tests. Biometrics 11, 1-42.