EFFECT OF HEAVY THINNING ON WOOD DENSITY IN RADIATA PINE

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It has been shown that wood density of radiata pine (*Pinus radiata* D. Don) grown in unthinned stands decreases as radial growth rate increases (Harris, 1965). Consequently, it might be expected that wood density will decrease with any increase in growth rate after a heavy thinning.

This study investigates wood density in one of the first stands to be thinned to an intensity similar to that currently proposed for radiata pine, short rotation, sawlog regimes on high quality sites (Fenton and Sutton, 1968; Fenton *et al.,* 1972).

Stand history

Compartment 110 at Ngaumu Forest received the following conventional treatment: In 1956, radiata pine was planted at 2.6 × 2 m spacing. Blanking was done in 1957 and 1958. At age 7 yr and approximate height 8.5 m, the stand was selectively low pruned (one in four) to 2.6 m. At age 11 yr and approximate height 13.5 m, 250-350 stems/ha were high pruned to 6 m and the stand was marked for thinning to waste leaving 550 stems/ha.

Confusion over the marking resulted in about 3 ha of the stand being thinned not as marked, but down to the high pruned stocking. The timing of both the pruning and thinning was late by current standards but the severity of thinning is comparable with that proposed for short rotation regimes. In the heavily thinned area, two permanent 0.1 ha plots (at stockings of about 285 stems/ha) were established several months after thinning. Growth data for the mean of the two plots are given in Table 1. No plots were established in the conventionally (moderately) treated area of the stand.

TABLE 1—Growth of heavily thinned stand

Approx. age (yr)	Mean tree ht. (m)	Mean d.b.h. (mm)
11	14.3	190
13	18.1	260
14	20.0	290
16	22.5	315

Site index (Lewis, 1954): 30 m approx.

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In 1971, a part of the heavily thinned area was experimentally thinned to lower stockings and a representative sample of the stems removed was used for wood density analysis. The other sample was selected from the conventionally thinned stand.

Sampling pattern

Cross-sectional discs were cut from breast height (b.h.) and from the top of the first and second logs (6.7 m and 13.5 m) from each of 25 trees removed from the heavily thinned stand at the time of its second thinning. Because no trees were felled in the area of conventional thinning, this area was sampled with increment borers: two 5-mm cores were extracted at b.h. from each of 25 trees and, in addition, a 10-mm core was taken from every third tree at b.h.

Wood density was first measured on wood samples containing only the five outermost growth layers. Samples for density measurement were cut as radial strips of wood from b.h. discs from the heavily thinned stand, whereas the 5-mm cores were used for the moderately thinned stand. No significant differences in wood density were apparent between trees from the heavily thinned (379 kg/m^3 basic density) and from the moderately thinned stands (376 kg/m^3).

By using the results of these preliminary measurements, trees were selected for detailed examination, in a beta-ray densitometer, of wood density variation. In the heavily thinned area, two trees were selected to represent extremes of wood density and four to represent mean density values. The trees were also selected to be representative of the diameter range examined and to have mean diameter within 10 mm of the mean for all trees. In the moderately thinned area, the same selection criteria were applied to the 10-mm increment cores to bring the average density of those examined with the densitometer into line with the average for all trees examined.

Strips of wood, 4 mm in tangential thickness, were then prepared from selected trees for examination in the densitometer (Harris, 1969), using either the 10-mm increment cores or a radial strip cut from cross sectional discs.

Densitometric results

Radial increments (ring widths in mm) determined by measurement of samples used in the densitometer are presented in Figure 1A. Moderately thinned trees show a gradual increase in radial increment for the 3 years after thinning, whereas trees from the heavy thinning show a rapid increase in the first year and a steady decrease thereafter until ring widths over the last year's growth are similar to those in the moderate thinning. The two upper levels sampled in the heavily thinned trees show similar evidence of response to thinning.

The densitometer records have been summarised to provide data on density variations within annual growth layers in addition to radial trends of mean density variation (Fig. 1B). The upper line (maximum (latewood) density in each annual growth layer) and the lower line (minimum (earlywood) density) indicate the extreme limits of wood density between which the line of mean density shows a characteristic increase, over the region of corewood, from the pith outwards.

Density values vary from year to year for each of these parameters, and trend lines have been drawn in as smoothed curves ignoring yearly fluctuations. For example, all parameters in all samples decrease in value over the past one or two years' growth

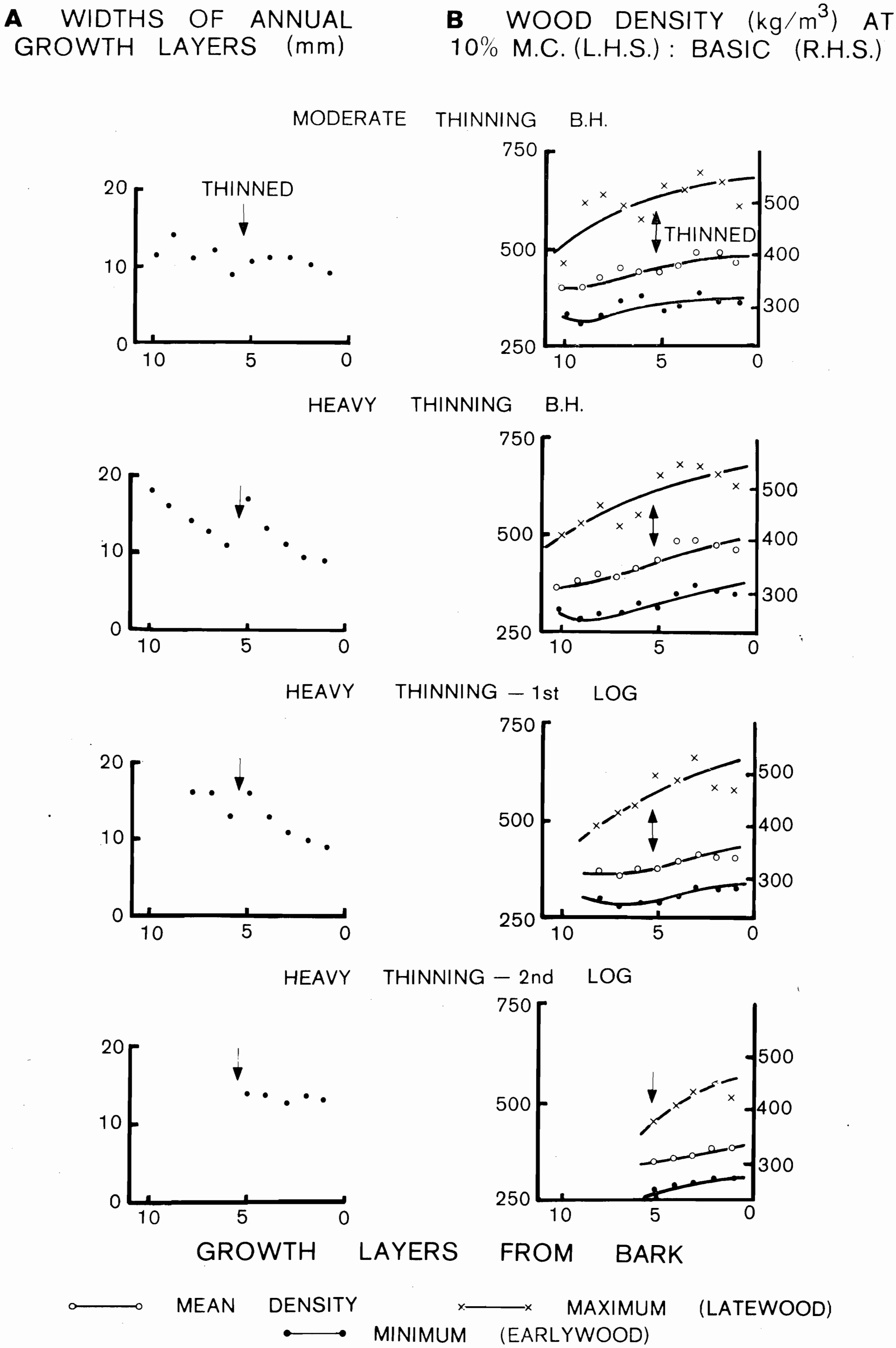

FIG. 1—Effect of thinning in radiata pine

A. Width of annual growth layers (mm) at b.h. in moderately thinned trees, and at three levels in heavily thinned trees.

B. Radial patterns of wood density for the same specimens used in A.

(rings 1 and 2 from the bark), but there are no indications that this is associated with the thinning. Short-term variations of this nature are frequently encountered (Harris, 1969 pp. 424-8); this decrease in density is probably due to some unrecorded climatic effect which will be placed in proper perspective by later growth.

The important feature of these results is that, despite the rapid increase in radial growth among heavily thinned trees, there is no evidence of any corresponding change in mean wood density. Past experience with the densitometer has proved it to be an instrument well adapted to detecting wood density variations, but there is nothing in Figure 1B to suggest that wood density in the heavily thinned stand is in any way different from that in the moderate thinning.

These results are in keeping with previous observations (J.M. Harris—unpublished data) that wood density does not respond to increased growth rates following thinning, in the way that would be predicted from studies of unthinned stands. A paper in course of preparation offers evidence that, after thinning, complex changes in the environment (amongst which the effects of wind-sway and root graft must be included) can induce growth responses not encountered in wood from unthinned trees.

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