THE RELATIONSHIP BETWEEN RING WIDTH AND WOOD CHARACTERISTICS IN DOUBLE-STEMMED TREES OF RADIATA PINE

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ABSTRACT

Wood specimens were taken at breast height from trees of radiata pine (**Pinus radiata** D. Don) which forked near ground level. From three trees on each of three sites specimens from major and minor stems were compared ring for ring. The specimens were examined for average tracheid length, spiral grain, maximum, minimum and average density, and latewood ratio. Overall no differences were demonstrated between major and minor stems for these characteristics.

INTRODUCTION

The relationships between growth rate and such wood characteristics as average tracheid length, spiral grain, latewood percentage and basic density have been the subject of much controversy. Both positive and negative correlations have been reported between growth rate and these characteristics (*see,* for example, reviews by Dinwoodie 1961, Goggans 1961 and Nicholls 1963).

In a previous study (Nicholls and Fielding 1965) the between-tree effects of growth rate were investigated using clonal material to eliminate genetic variation. Wood characteristics were not affected significantly by environmental variation between trees as expressed by differing radial growth rates.

The within-tree relationship between wood characteristics and ring width, as a measure of rate of growth, may be investigated by comparing characteristics along radii of different length in a transverse stem section. The range of variations in ring width, however, is normally small unless the stem is markedly eccentric, and such eccentricity is commonly associated with the presence of reaction wood which has characteristics different from those of normal wood (Dadswell and Wardrop 1949).

Material which can offset these limitations is provided by forked trees. Reaction wood is avoidable if specimens are taken above the distortion associated with the fork, and pairs of stems can be found which exhibit large diameter growth differentials.

The present study is based on such pairs of stems and the relationship between ring width and wood characteristics was investigated by comparing material from the major and minor stems at the same ring number from the pith.

MATERIALS AND METHODS

Suitable trees were sampled at three localities in the Australian Capital Territory. Site elevation varied between 640 and 790 m and tree spacing from 2.4 to 2.7 m. The trees studied forked between ground level and 0.5 m. Further details are set out in Table 1.

TABLE 1—Details of double-stemmed radiata pine trees from three localities in the Australian Capital Territory

Locality	Mean annual rainfall (mm)	Tree no.	Stem height (m) Major	Stem height (m) Minor	Diam. DHOB (cm) Major	Diam. DHOB (cm) Minor	No. of complete rings in specimens
Vanities Crossing	750	D1	16.5	15.0	12.8	9.8	9
Plantation Compartment		D2	15.5	14.5	12.2	10.1	9
192		D3	16.8	15.5*	10.6	9.0	9
Kowen Plantation	675	DLK3	18.0	13.7	19.5	10.2	13
Compartment 60		DLK4	14.5*	11.9	16.1	12.3	13
		DLK5	13.9	10.2*	14.3	9.7	13
Blue Range	1090	DLB2	12.3	11.2	13.1	8.9	9
Plantation Compartments		DLB4	14.0	12.9	16.7	9.5	9
231 and 232		DLB5	13.6	9.7	14.7	7.9	9

* This stem forks again above the sampling position.

Wood specimens were collected at about breast height; individual sampling heights were adjusted to avoid branch whorls. Specimens extended from bark to bark and included the pith, and measured 25 mm × 25 mm in section. The orientation of the specimens relative to true north was recorded. The vertical axis of the stem at the point of sampling was marked on the ends of each specimen prior to extraction as a datum for grain angle determinations.

Growth ring boundaries were determined for all specimens using both visual examination and the densitometric charts described below. Three trees having matching ring counts in samples from both stems were selected from each locality; discontinuous growth rings (Harris 1952; Larson 1956) necessitated the rejection of other trees.

Determinations of spiral grain angle, average tracheid length X-ray densitometric data were carried out according to techniques described elsewhere (Nicholls 1971, Nicholls and Brown 1971). These authors defined latewood ratio as the proportion of latewood in a growth ring, assuming a linear change from earlywood to latewood and an earlywood/latewood boundary at the mid-density point. The specimens for densitometric determinations were treated with methanol to remove resinous material. Determinations were carried out on individual growth rings along both radii of the diametrical pieces. Tracheid lengths were measured on selected growth rings, viz. 2, 4, 7, 10 and 14 for the trees from Kowen and rings 2, 4, 7 and 10 for the Blue Range material. This feature was not investigated for the trees from Vanities Crossing which exhibited the least growth difference between stem pairs.

Data for each characteristic at each locality were grouped on the basis of ring number from the pith and means were calculated for the major and minor stems. The means for the three trees from Vanities Crossing are shown in Fig. 1, those from Kowen in Fig. 2, and those for Blue Range in Fig. 3.

RESULTS AND DISCUSSION

Ring width differences between major and minor stems were most marked in the material from Blue Range (Fig. 3) and least in that from Vanities Crossing (Fig. 1).

There were no consistent or noteworthy differences between major and minor stems for spiral grain angle, maximum, minimum and average density, or latewood ratio (Figs. 1-3). That is, by inspection, there is no relationship between ring width and these characteristics.

At Kowen a slower radial growth rate is associated with the production of longer tracheids (Fig. 2); such a finding would support conclusions of Bannan (1954, 1957) regarding the frequency of cambial division and its effect on tracheid length. However, analysis of variance showed that the average difference in tracheid length between the major and minor stems was not significant compared with the variation in this difference from tree to tree; the effect varied with ring number and was significant in rings 7 and 10.

In view of work by Liese and Dadswell (1959) which showed that consistently shorter fibres were formed on the "sun" side than on the "shaded" side of the tree, explanations for the differences in tracheid length for the Kowen trees were sought in terms of the orientation of specimens, and the cardinal relationship of the two stems in each pair. No obvious pattern in relation to tracheid length was found.

As compression wood tracheids are shorter than normal tracheids (Dadswell and Wardrop 1949) the presence of compression wood in the major stems might also have accounted for the differences in tracheid length for the Kowen trees. However, compression wood is usually denser than normal wood (Dadswell and Wardrop 1949) and an inspection of Fig. 2 shows only minor differences in the means for average density.

There is no difference in average tracheid lengths associated with the major and minor stems from the Blue Range plantation despite large differences in ring widths (Fig. 3). Therefore the doubtful nature of the Kowen evidence for an association of growth rate and tracheid length is further weakened by the Blue Range results.

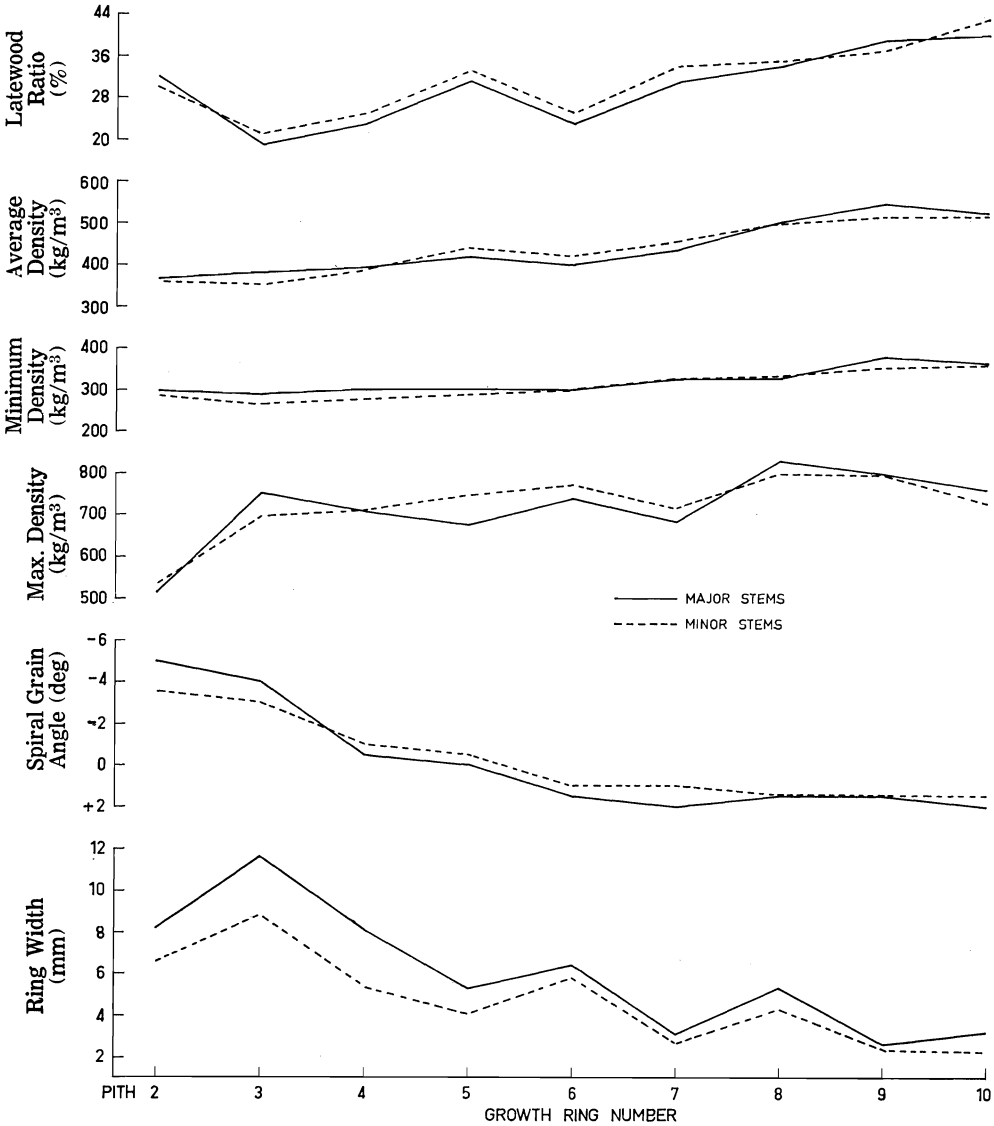

FIG. 1—The variation through successive growth rings from the pith of the mean of ring width, spiral grain angle, maximum, minimum and average density and latewood ratio for breast high specimens from the major and minor stems of three double-stemmed trees from Vanities Crossing plantation, A.C.T.

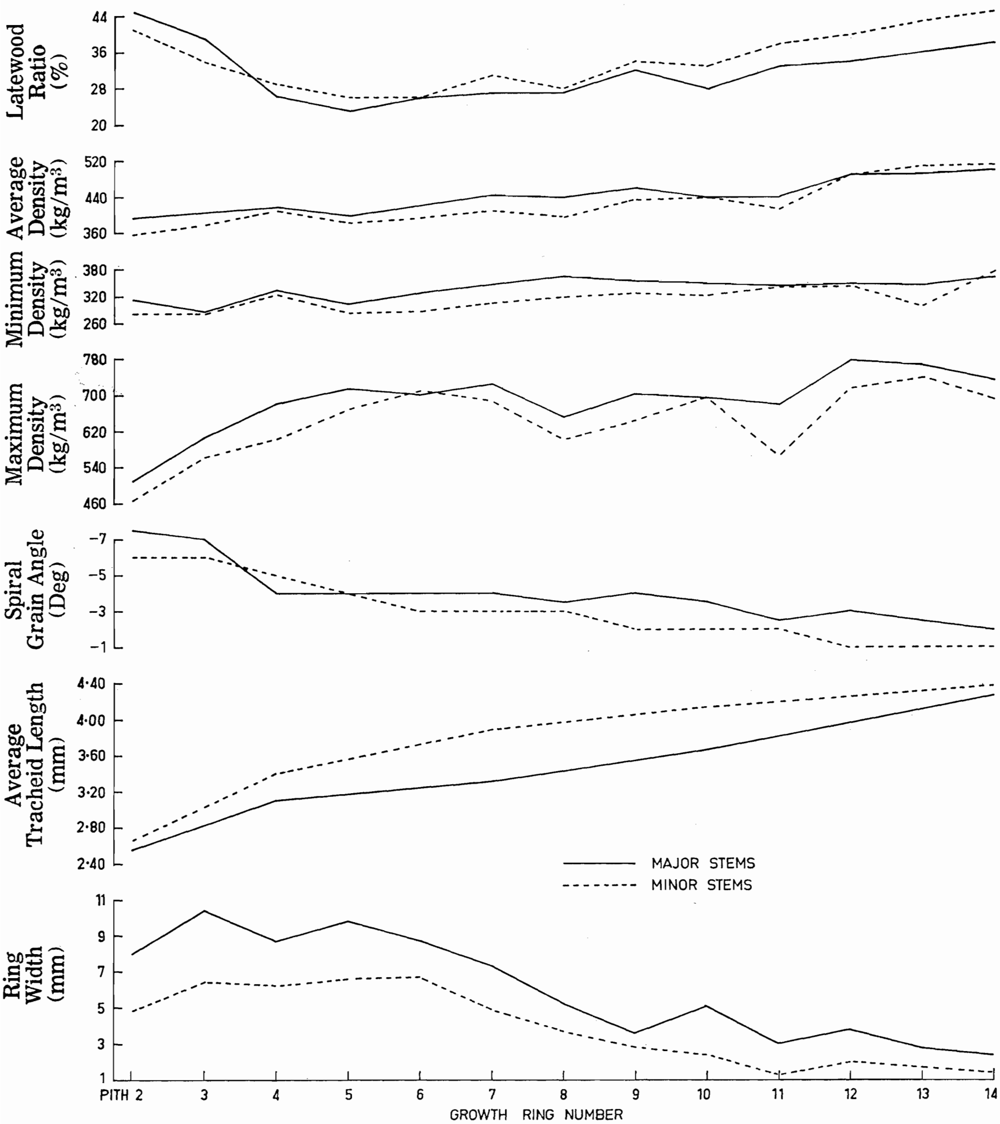

FIG. 2—The variation through successive growth rings from the pith of the mean of ring width, average tracheid length, spiral grain angle, maximum, minimum and average density and latewood ratio for breast high specimens from the major and minor stems of three double-stemmed trees from Kowen plantation, A.C.T.

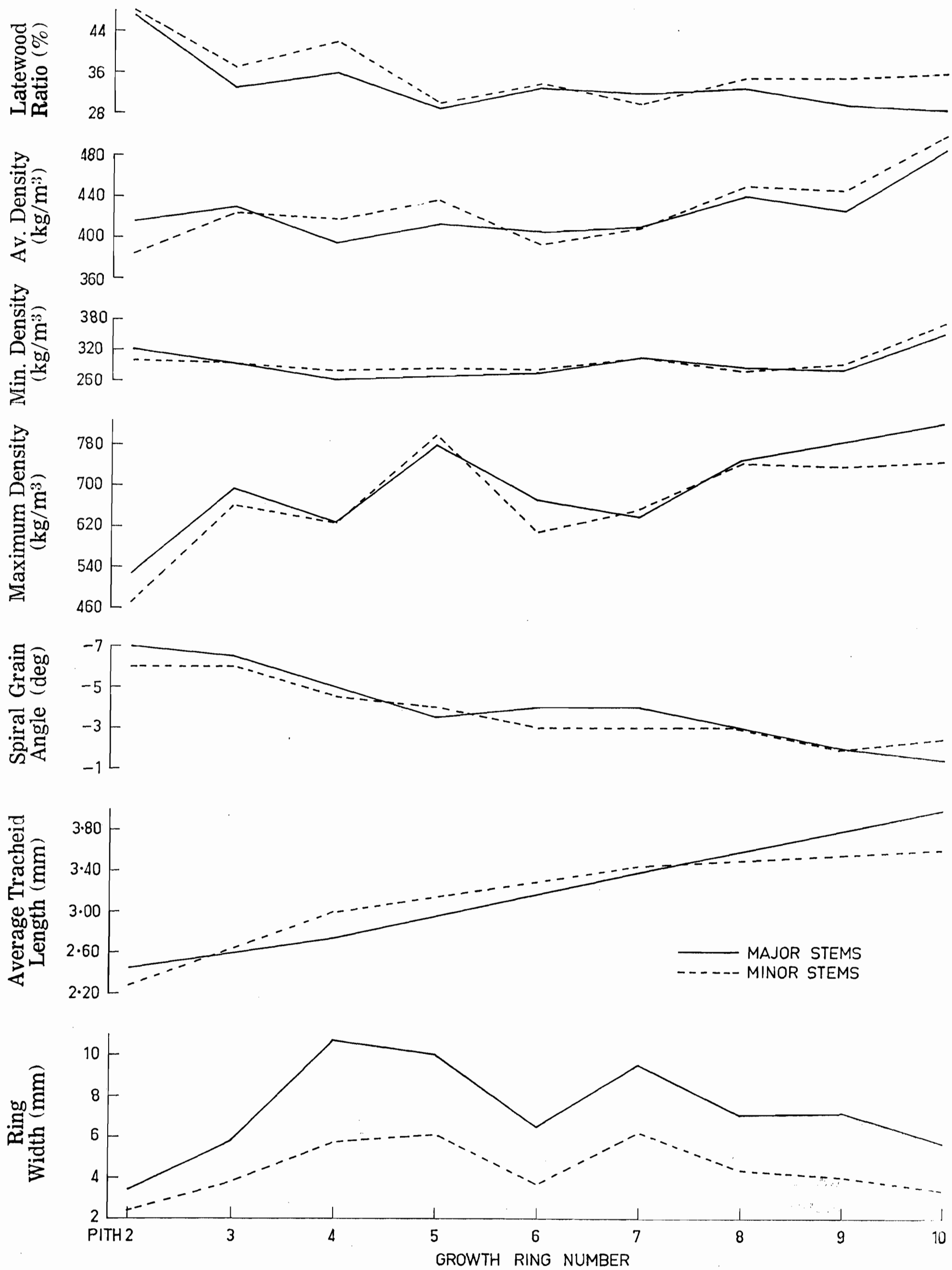

FIG. 3—The variation through successive growth rings from the pith of the mean of ring width, average tracheid length, spiral grain angle, maximum, minimum and average density and latewood ratio for breast high specimens from the major and minor stems of three double-stemmed trees from Blue Range plantation, A.C.T.

CONCLUSIONS

The results indicate that wood characteristics of *P. radiata* are not related to ring width in itself. Although this finding should be viewed against the limited range of environments and stand conditions sampled, the major and minor stems of the forked trees studied do provide paired material with appreciably differing ring widths but which is genetically identical, and shares a common root system and has similar aerial environments, thus largely eliminating most sources of variation which might confound the association of wood properties with ring width *per se.*

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