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GROWTH STRESS EVALUATION OF REGROWTH JARRAH

K.J. White

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Weir Road Harvey WA 6220 (097) 29 1913
50 Hayman Road Como WA 6152 (097) 367 0333

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SUMMARY

The relationship between growth stresses in regrowth jarrah (*Eucalyptus marginata* Donn ex Sm.) sawlogs and spring and bow deflection in sawn timber products was evaluated, using stress measuring equipment developed by CSIRO.

The trial involved growth stress measurements in standing trees in a growth plot at Karnet, in the high rainfall zone of the northern jarrah forest. Fifty trees had growth stresses assessed, and half of these were randomly selected for felling and milling at the Department of Conservation and Land Management's Wood Utilisation Research Centre sawmill at Harvey. Only truly backsawn or quartersawn boards were assessed.

A statistical relationship was established between:

(i) bow and spring, and growth stresses
(ii) bow and spring, and mean annual increment
(iii) growth stresses and mean annual increment.

However, the scatter of data was so great that reliable predictions could not be made.

INTRODUCTION

Early research in Australia on growth stresses in eucalypts includes that by Jacobs (1945) and Boyd (1950 a, b, c). Quantitative assessments included those by Nicholson (1971; 1973), Nicholson and Ditchburne (1973), and Nicholson *et al.* (1972; 1973; 1975), while Chafe (1979) discussed variations in longitudinal growth stresses, basic density and modulus of elasticity. Kubler (1987) gave an excellent overall review of growth stresses in trees and their related wood properties.

Stress assessment equipment had been developed by CSIRO for use with ash-type eucalypts in Victoria and Tasmania (Nicholson 1971). The CSIRO equipment measures strains (i.e. the changes in longitudinal dimension caused by growth stresses) to give an estimate of stresses.

Regrowth jarrah (*Eucalyptus marginata* Donn ex Sm.), which will provide an increasing proportion of the State's sawlog production, can exhibit the effects of growth stages when milled directly after felling. The present study was to assess growth stresses in regrowth jarrah and to determine whether these stresses were likely to be a significant problem in milling operations as indicated by bow and spring in the sawn timber. The relationship between mean annual increment (MAI) and bow and spring, and MAI and growth stresses, was also assessed.

METHODS

A jarrah stand at Karnet, in the high rainfall zone of the northern jarrah forest south of Perth, was sampled for this growth stress study. The actual rainfall at Karnet is about 1300 mm/year. This site was selected because the history of both tree growth and fire conditions was known for the past decade (Davison and Tay 1988, 1989).

In the present study 50 of the 86 trees in the plot were selected randomly for growth stress assessment. Twenty-five of these trees were subsequently selected for harvesting and milling.

Each tree had a 100 mm x 200 mm section at breast height cleared of growing bark to allow removal of a sapwood sample for assessment. The method for using the CSIRO stress assessment equipment is given in Appendix 1.

After the trees were sampled within the plot and growth stresses assessed, the 25 trees selected for milling were felled and transported to the Wood Utilisation Research Centre at Harvey. At the mill the logs were sawn fresh into backsawn or quartersawn boards for bow and spring assessment.

The initial breakdown of mill logs to cants and flitches was undertaken on a Forester 150 horizontal bandsaw, followed by resawing on a Jonsereds two-person vertical bandsaw. Whenever possible 30 mm thick boards were cut to give an adequate sample size. After each log was milled, backsawn boards were assessed for bow, and quartersawn boards for spring.

The bow and spring data (mm/m) were used to assess any relationship between stress value (mm/m) in the log and deflection values in the sawn boards. The MAI, expressed as mean annual increase in circumference over bark (mm/year), was related to the other three variables. The data were analysed by analysis of variance and regression techniques.

RESULTS AND DISCUSSION

The mean values and standard deviation for the variables assessed were (Table 1):

Table 1
Means and standard deviations for growth stresses and mean annual increment (MAI) of regrowth jarrah trees sampled, and bow and spring in sawn timber

Variable	Units	Mean	S.D.
Growth stress	(µm/m)	2950	2390
MAI (Circumference)	(mm/yr)	9.5	5.2
Bow	(mm/m)	4.5	3.3
Spring	(mm/m)	1.7	1.6

The small mean values and the large standard deviations indicate the considerable variation in these properties. As explained in the Introduction, growth stress is estimated from accurate measurement of the strain in the tree or log.

Kubler (1987) summarised data for the peripheral longitudinal growth strains for a range of species, including several eucalypts. He did not include tree size. In comparison with the mean value of 2950 µm/m for jarrah reported in the present study, the following results for ash-type eucalypts were given:

E. delegatensis (syn. *E. gigantea*)	770 µm/m	(Jacobs 1945)
E. obliqua	730 µm/m	(Nicholson and Ditchburne1973)
E. obliqua	810 µm/m	(Nicholson 1973)
E. regnans	>810 µm/m	(Boyd 1950a)
E. regnans	760 µm/m	(Nicholson 1973).

The analysis of variance indicated that there were significant relationships between the variables, with spring/MAI and growth stress/MAI having the greatest significance (Table 2). The other variables showed poorer correlations.

Table 2
Relationship between growth stresses and mean annual increment (MAI) of regrowth jarrah trees, and bow and spring in sawn timber.

Dependent variable	Independent variable	F-value	Significance
Bow	MAI	3.7	0.062
Spring	MAI	12.5	0.001
Bow	Growth stress	4.1	0.051
Spring	Growth stress	5.7	0.022
Growth stress	MAI	11.1	0.002

The relevant regression equations were subsequently derived using the basic data (Table 3).

Table 3
Regression equations relating growth stresses and mean annual increment of regrowth jarrah trees, and bow and spring in sawn timber

Stresses	=	-906 - 216 MAI	(r^2 = 21.7%)
Bow	=	6.24 - 0.184 MAI	(r^2 = 8.5%)
Spring	=	0.261 + 0.154 MAI	(r^2 = 23.8 %)
Bow	=	5.72 + 413 Stresses	(r^2 = 9.2%)
Spring	=	1.02 - 240 Stresses	(r^2 = 12.4 %)

Despite the significance of the F values (Table 1), the coefficients of determination (Table 2) indicate that although growth stresses and MAI could be used to predict bow and spring, the scatter of points is so great that the predictions are not worthwhile. Similarly, the relationship between growth stresses and MAI is not good enough to justify predicting growth stresses from MAI.

A strong relationship between growth stresses and growth rates would assist in planning future utilisation, because silvicultural schedules could be used to manage stands to minimise the effects of stresses in the individual trees.

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Appendix 1
Stress assessment of regrowth eucalypts using CSIRO's techniques

1. Ensure that the logs for stress assessment have sufficient length to allow location of the test area at three times the log diameter from each end.

2. Ensure that the logs are supported for their full length and are not bridging.

3. Test an uneven number of points around the log circumference, with a minimum of 3.

4. Ensure that live cambium is removed before stress points are applied.

5. Place a single drop of 'Superglue' under the required points, and press firmly for 30 seconds.

6. Number each specimen, and mark its location to ensure that each specimen is taken using the same orientation.

7. Chisel the specimen at each end.

8. Reset the specimen in the stress correction jig, and remeasure, by setting to the original value using light tension only and then allowing two to three minutes before taking a reading.

9. Clean the equipment by soaking the points overnight to remove 'Superglue' and then clean them with acetate.

10. Spray 'Proof-cote' from a pressure pack can onto the wounds to protect growing trees which have had specimens removed.