ESTIMATION OF CLEAR WOOD PROPERTIES BY NEAR INFRARED SPECTROSCOPY

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Rapid cost-effective methods of measuring wood quality are extremely important to tree improvement programs where it is necessary to test large numbers of trees. Non-destructive sampling of a forest can be achieved by using increment cores generally removed at breast height. At CSIRO Forestry and Forest Products methods for the rapid, non-destructive measurement of wood properties and wood chemistry based on increment core samples have been developed.

In this paper the application of near infrared (NIR) spectroscopy to the prediction of a range solid wood properties, including density, longitudinal modulus of elasticity (E_L) and microfibril angle (MFA), is described. Experiments conducted on individual species (*Eucalyptus delegatensis* and *Pinus radiata*), the two species combined and a number of mixed species from several genera are reported.

NIR spectra were obtained from the radial/longitudinal face of each sample and used to develop calibrations for the measured physical properties. When the individual species were used the relationships between laboratory determined data and NIR fitted data were good in all cases. Coefficients of determination (R^2) ranging from 0.77 for MFA to 0.93 for stick density were obtained for *E. delegatensis* and R^2 ranging from 0.68 for MFA to 0.94 for strip density were obtained for *P. radiata.*

The calibration statistics for the combined *E. delegatensis* and *P. radiata* samples were similar to those found for the individual species. As these results indicated that it might be possible to produce general calibrations based on samples from a number of species of a single genus or samples from a number of different genera, a wide range of species was subsequently tested. Good relationships were obtained for both density and E_L. These calibrations had R^2 that were slightly lower than those determined using individual species and standard errors that were higher. The mixed species calibrations, when applied to the *E. delegatensis* and *P. radiata* sample sets, provided good estimates of density (stick and strip) and E_L. The results demonstrated that a mixed species calibration, that encompasses wide variation in terms of, wood anatomy, chemistry and physical properties, could be used to rank trees.

Experiments reported in this paper demonstrate that solid wood properties can be estimated by NIR spectroscopy. The method offers a rapid and non-destructive alternative to traditional methods of analysis and is applicable to large-scale non-destructive forest resource assessment, and to tree breeding and silvicultural programs.