Using a portable near infrared spectrometer in Eucalyptus breeding trials

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Introduction

Tree breeders are frequently interested in obtaining phenotypic data on standing trees in the forest or breeding trial, and near-infrared (NIR) spectroscopy has been identified as a means to provide rapid pheno-typing for several key traits.[1,2] There is also interest in using rapid tools such as NIR spectroscopy to identify species,[3,4] provenance and more recently hybridisation. The availability of portable NIR devices allows this to be undertaken more readily in the field.

Materials and methods

A progeny trial of *Eucalyptus cloeziana* was measured at approximately 9 months old by obtaining NIR spectra of juvenile and mature leaves using a portable NIR instrument. The trial was situated in southeast Queensland, Australia (26° 19′ S 152° 42′ E, altitude 87 m asl, mean rainfall (1889–2007) 1230 mm). Trees were arranged in 4-tree, line plots in six replicates. Four-month old seedlings were selected from a hybridisation trial of *E. camaldulensis* and *E. urophylla* at the ITC R&D Centre in Hyderabad, India (18° N 78° E, altitude 545 m asl). In both instances, spectra were acquired on the underside of two juvenile and two mature leaves for each tree and then averaged. Spectra were acquired using a Polychromix Phazir (Polychromix Inc., Boston, MA, USA, www.polychromix.com), model 1018 between 950 nm and 1800 nm at 8 nm resolution. All data analysis was performed using *The Unscrambler* v 9.8 (Camo A/S, Norway, www.camo.com). Qualitative assessment was performed using PCA.

Results and discussion

Qualitative principal component analysis of the leaf spectra shows segregation of *E. cloeziana* trees according to their original provenance (Figure 1), based empirically on the altitude of the original seed source (PC2).

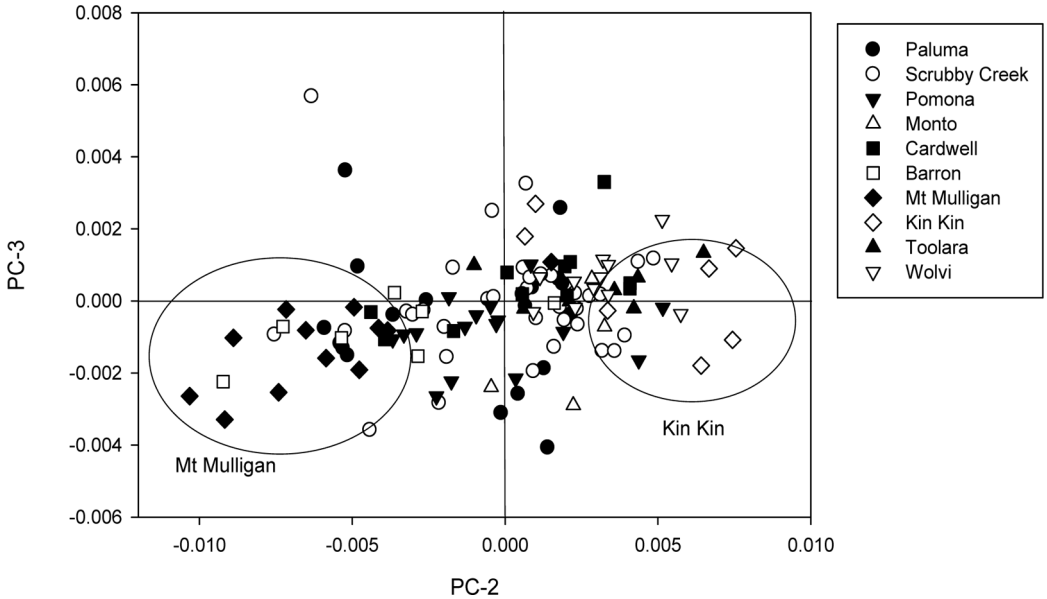

Figure 1. PCA scores plot showing segregation of provenance of the original seed source for nine-month old trees of *E. cloeziana* in a provenance trial.

The difference in altitude ranges from 700 m asl (Mt Mulligan, filled diamond, ◆) to 71 m asl (Kin Kin, open diamond, ◇). The loadings plot of the first two principal components (not shown) shows the two primary absorbance bands as being 1346 nm and 1455 nm with assignments for these being given in Table 1.

When the NIR spectra were regressed against the latitude and altitude in a PLS-2 regression (not shown), there was a moderate correlation with the altitude of the original provenance (R^2 0.54). However there was a gap in the range of altitude which may have biased the result, but nonetheless provides an interesting observation that is worthy of further study.

The qualitative discrimination between *E. camaldulensis, E. urophylla* and *E. camaldulensis* × *urophylla* hybrids is shown in Figure 2.

This shows that there is discrimination between the hybrids and parents but that there is considerable spread in the hybrid progeny. The loadings plot (not shown) is similar to that for the *E. cloeziana*, but also includes a band at 1165 nm (Table 1).

Table 1. Assignment of NIR absorption bands.[5]

Wavelength (nm)	Assignment
1165	CH str. (2nd OT), HC=CH, lignin
1346	2XCH str. + CH def., cellulose
1455	OH str. (1st OT), CH str. CH def., lignin

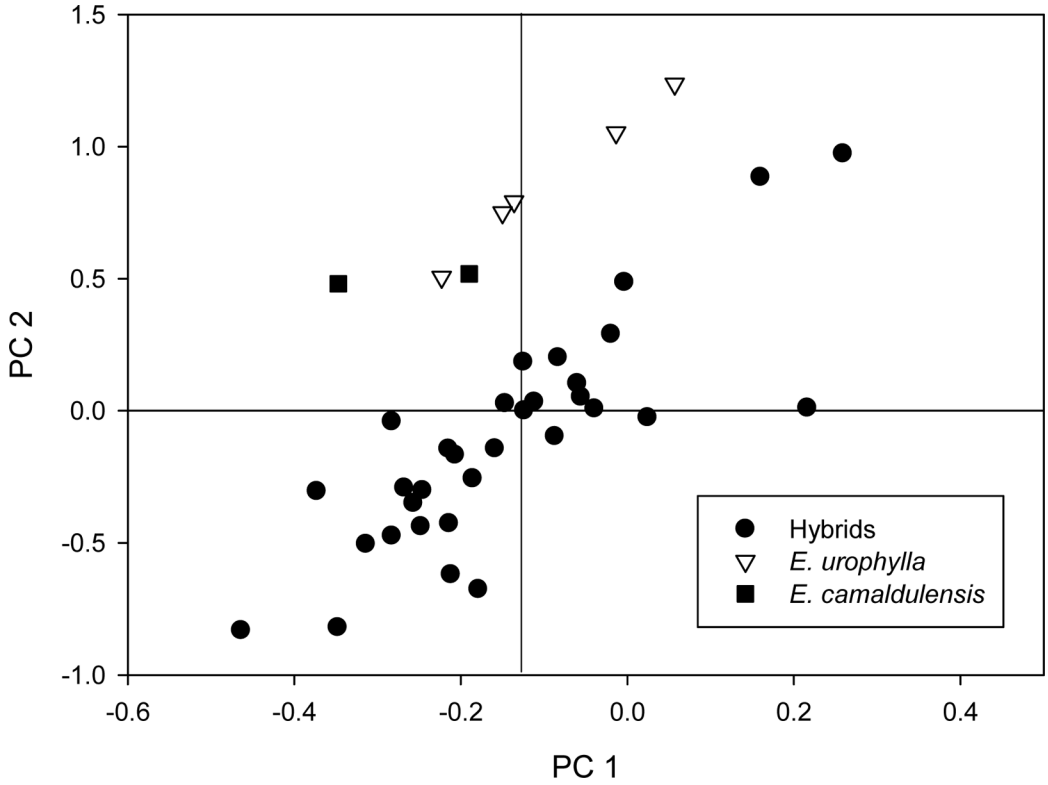

Figure 2. PCA scores plot showing segregation of *E. camaldulensis* and *E. urophylla* parents and *E. camaldulensis* x *urophylla* hybrids based on NIR spectra obtained from leaves of seedlings.

Conclusion

Near infrared spectra obtained from leaves of trees may be used to provide qualitative information about the genetic background of trees and may play a larger role in the rapid phenotyping of genetic material to aid selection of elite germplasm.

References

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