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Salt-tolerant Hybrid Eucalypts

**A report for the RIRDC/Land & Water Australia/FWPRDC/MDBC Joint Venture
Agroforestry Program**

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Executive summary

What this report is about

This report is about selecting eucalypt hybrid material that can be grown for pulp production on saline lands. The report describes the production, morphology, selection and seedling growth of *E. globulus* x *camaldulensis* hybrids. It also describes the field performance of *E. globulus* x *camaldulensis* seedlings and clones, *E. camaldulensis* seedlings and clones, and *E. globulus* seedlings in trials on saline and non-saline sites. Preliminary assessment of 5-6 year old trees for fibre and sawlog properties was also undertaken.

Who is the report targeted at?

This report is for farm advisors, industry investors and researchers looking for appropriate genetic material to grow on saline and non-saline lands. The hybrids reported here have the potential for commercial returns while achieving land rehabilitation.

Background

There is increasing recognition that rising salinity is one of the biggest threats to productivity of agricultural land, and to infrastructure in both rural and urban areas. Existing and predicted damage to remnant native vegetation and wetlands is also significant. Tree planting has an important role for salinity control in both recharge and discharge areas.

This project initially concentrated on trees suitable for discharge areas, where both salt and waterlogging tolerance is important, and water uptake by the trees is predicted to slow or halt the rise in water table. Several species of trees and shrubs are suitable for planting on saline land, but at the time this project started, the species available for saline land produced materials such as fence posts, honey, firewood or provided shelter. None was appropriate for pulp production.

Aim

Our aim was to produce salt tolerant trees with high quality pulp, and for this purpose we developed hybrids between *Eucalyptus camaldulensis* x *E. globulus*. As the project progressed it became clear that 1) some highly productive hybrids were also suitable for plantations in non-saline areas, and 2) hybrids in both saline and non-saline areas could provide sawlogs. Therefore, preliminary assessment of fibre and sawlog wood properties was also undertaken.

Methods

The parents were selected for either their salt tolerance or pulp quality and yield. *E. camaldulensis* and *E. globulus* are not closely related but are placed in different sections of the sub genus *Symphomyrtus* of the genus *Eucalyptus*. As is usual with wide crosses in eucalypts, the progenies included large proportions of abnormal plants that died. Despite this there were some hybrids that showed excellent growth and form. It was clear that there was a wide range of compatibility between the parents, and that an initial survey of the compatibility (in terms of numbers of seeds per capsule, germination and proportion of abnormal plants) would be valuable before investing a large amount of time in extensive crossing. The superior clones from the present work are concentrated in five cross combinations.

The inheritance of morphological traits from the *E. globulus* parent made it easy to confirm that seedlings from crosses using *E. camaldulensis* as a female parent were in fact hybrid. The variation of mature leaf shape and size of the parent species and the hybrids made it impossible to distinguish the hybrid from the parents on the basis of leaf morphology, but the flowers and fruits of the hybrids were intermediate in shape and size.

Field trials were set up in 1995 at Mount Barker, Beverley and Pinjarra in Western Australia, and in 1997 in Narrikup and Boyup Brook, Western Australia; Coleambally, NSW and Cressy, Tasmania. All sites were saline except for Pinjarra and Coleambally. Trees were assessed for survival, height, diameter and form.

A small sample of 5-6 year old trees was harvested and assessed for pulp yield, active alkali, basic density, milling and sawlog properties.

Results/Key findings

The hybrid families showed a level of tolerance to saline waterlogging intermediate between the parents in the glasshouse. In the field selected hybrids showed better survival than *E. globulus* on both saline and non saline sites. The best hybrids on all sites were equal to the surviving *E. globulus* in height, but for all hybrids combined, there was only a significant difference in the reduction in height due to soil salinity at the Mt Barker site (which was the most saline). On sites that were less suitable for *E. globulus*, several hybrids were significantly better than *E. globulus*. Further monitoring of growth and survival as the trees increase in biomass is necessary to determine the degree of superiority of the hybrids over *E. globulus* and to define areas in which it would be preferable to plant hybrids rather than *E. globulus*.

The clones giving the most vigorous growth were the same regardless of whether the site was saline or not, and over a rainfall range from 432–948mm. This may indicate that the selection has been for general vigour rather than for salt tolerance per se.

Although the hybrids were originally selected for growth in saline areas, they have potential for growth elsewhere. The hybrids grew well at Cressy, an area too cold for *E. globulus*, and at Coleambally and Beverley, which are too hot and dry for *E. globulus*. Use of hybrids could extend the regions that produce pulp wood further into drier regions than can be planted with *E. globulus*.

Timber from the hybrids was found to have potential for value-added purposes. Wood from 5-year-old trees had medium density and shrinkage greater than that of mature *E. camaldulensis* but less than that of 17–23 year old *E. globulus*.

Further crossing to extend the genetic base of the hybrids is desirable. The hybrids are reproductively fertile so backcrossing with *E. globulus* to improve wood properties is also possible.

Implications for stakeholders

These early results suggest that selected eucalypt hybrids can have superior salt tolerance and vigour to the parent stock. Farmers and industry investors can plant these hybrids for commercial products and rehabilitation of saline agricultural land. Small numbers of clones are already commercially available. Growth data should be collected from plantings on a wider range of sites, to evaluate climatic tolerance of the selected clones.

For researchers, this study provides clones suitable for testing on a range of sites to evaluate climatic tolerance and growth. Further crossing to broaden the genetic base is also recommended.

Recommendations for further research

1. Additional crosses should be undertaken to broaden the genetic base of the hybrids. Only crosses that give high numbers of seeds and a high proportion of normal progeny should be included in further screening trials and field trials. Crosses should also include backcrosses to *E. globulus* to improve the wood quality.

2. Plants from these new crosses should be grown to sufficient size for cuttings to be taken before a salt screening process that kills non-tolerant genotypes is imposed, as these may well have potential for use in non saline areas.

3. Further research to improve the efficiency of the micropropagation process should be undertaken.

An IVS (in vitro soil) process that improves rooting and acclimatisation of plants of woody Australian species grown in vitro has been developed by the Department of Agriculture WA (Newell et al. 2002).

This should be tested using the hybrid lines.

4. Further field trials are needed to test:

- lines held in vitro that have not been included in any trials
- growth in areas too dry or too cold for *E. globulus* (both saline and non saline)
- growth in further sites in the Murray-Darling Basin using both non-saline and saline water for irrigation over the first few years
- water use patterns of the hybrids and selection of those with highest water use for planting in discharge areas.

5. Continued monitoring of existing trials is necessary to determine whether the trees, particularly the hybrids and *E. globulus* will continue to survive and grow to harvestable size.

6. Once trees in the Coleambally, Narrikup and Mount Barker sites reach appropriate size, further tests of pulp and timber properties should be done.

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