

The science of growing better trees

by Andrew Jacobs

Tasmania's biggest private plantation forest manager, Forico, is undertaking ground-breaking scientific research to enable it to grow trees that are more productive in terms of volume, yield and density. The trees will grow faster, providing both commercial and environmental benefits, including carbon storage.

While the research program does not involve genetically modified organisms (GMOs), it does mean tapping into the molecular structure and genomics of trees and using that data to breed eucalypts that grow faster and deliver the best possible economic return.

The Forico research is focused on *Eucalyptus nitens* (Shining Gum) which is the company's major production species across its 90,000 plus hectares of plantation estate. The other major production species are *Pinus radiata* (Radiata Pine) and *Eucalyptus globulus* (Tasmanian Blue Gum).

The purpose of this science-based selective breeding program is to ensure the genetics of seedlings are best positioned to deliver trees which:

- Enable an increase in the volume of trees grown on the Forico estate;
- Provide greater density in the timber by lowering water content; and
- Deliver a higher yield of cellulose fibre for kraft wood pulp production.

In other words, we are endeavouring to increase the commercial value of each tree by utilising seedlings which have the best, scientifically-proven genetics to deliver that objective.

This is a significant advancement on historic selective tree breeding programs which, at their most fundamental, involved gathering seeds from trees which demonstrated superior qualities. This involved growing and measuring thousands of trees in trials to identify elite tree families.

One of the science-based methods Forico is now using to gather data for the breeding program is through genetic marker assisted selection (MAS).

This is a collaborative industry partnership program with Forest and Wood Products Australia and led by specialist research firm Gondwana Genomics. The objective is to develop a key test of DNA marker technology to accelerate plantation tree improvement.

The MAS system has shown that elite tree families, as well as the best individuals within those families, can now be identified by a simple DNA test. That test involves screening trees with thousands of targeted DNA markers that occur in genes which control key commercial traits, such as wood density, growth and pulp yield. Once ideal families and individuals are identified and selected, the plants are grafted and put in a seed orchard where they are nurtured under strict supervision.

Selectively breeding plantations resulting from MAS allows Forico to speed-up generational intervals in the breeding cycle. For example, it normally takes around 6-7 years for a young tree to naturally produce seed from which the next generation can be propagated. By using MAS techniques new seedlings can be screened immediately after germination to confirm the desired genetics are apparent and elite seedlings can be targeted for seed orchard production.

In addition, it usually takes 15 years to grow a plantation tree and to complete the production cycle from cultivation to harvest. If that cycle can be achieved in less time due to faster growth rates, there are significant commercial benefits to be gained. There are also environmental benefits as

new generations of young trees absorb CO₂ from the atmosphere more quickly and a percentage of harvested trees lock-up carbon in wood products.

The molecular data gathered for the breeding program will also gather valuable data that could allow Forico to adapt much faster to the emerging effects of climate change.

Forico's breeding program currently only involves collecting and analysing data from *Eucalyptus nitens*. In a major industry collaborative project, Tree Breeding Australia provides *Pinus radiata* and *Eucalyptus globulus* germplasm to Forico for use in its seed orchards.

Like any other farmer, Forico aims to improve the quality of its product. However, our research also holds important implications for other tree farmers across the globe at a time when there is an increased understanding of the importance of well-managed, sustainable forestry in protecting the environment.

Andrew Jacobs is Chief Technical Officer at Forico. He has worked in molecular biology and plant breeding in Australia and New Zealand for over 20 years.