

Quality assurance of radiata pine pedigree, for more productive Aussie forests

Decades worth of data underpins a tool developed to help Australian growers select radiata pine trees based on attributes associated with their pedigree that make them suitable for the conditions in their plantation.

As the tool continues to become more sophisticated, the data itself is set to undergo a thorough reliability check. The work will help ensure grower decisions are made based on the most accurate information, which will prove vital for the current and future success of Australian forestry.

The goal is to enable the industry to maximise genetic gains by helping to accurately determine which trees are best suited for growing under different conditions. This will ultimately increase the profitability of plantations, while also promoting ongoing improvements to the Australian radiata pine resource.

Since the early 1980s, Tree Breeding Australia (TBA) has managed our national tree breeding improvement programs, collecting and analysing data, and supplying genetic evaluation services, tools and systems to the forestry industry.

While the genotype (or genetic make-up) of a tree is inherited from its parents, its phenotype (or observable characteristics) can be influenced by external environmental factors.

To support smart grower decision making, TBA uses TREEPLAN — a leading analytical system for genetic evaluation. This software has been built and enhanced by TBA over many years.

Until now, the tool has been used to combine tree pedigree and phenotypic data collected in-field to generate breeding values that can be used by growers during tree selection.

These values demonstrate the potential economic merits of trees for different production environments and processing outcomes. They enable the ranking of trees in different regions based on their predicted performance for traits such as growth rate, tree form (including branching and stem straightness), wood properties and health attributes.

By combining this information with genomic data, the tool can now be used to generate 'single-step' genetic evaluations, offering a single set of objectively comparable breeding values. These values have the potential to strengthen the accuracy of predictions and improve the process by which growers select suitable trees.

In fact, recent studies conducted by TBA and industry collaborators demonstrated that when genomic data is added to the analysis, not only is the accuracy of prediction improved, but genetic gain could increase by as much as 10 to 15 per cent.

However, historical data errors around pedigree are expected to have accumulated over the past several decades. These sorts of errors may be the result of the exchange of genetic material between contributing breeding programs, and basic human error in operational breeding activities.

A recent analysis of the national radiata pine tree improvement program database — which currently contains more than a million genotypes from 17,126 different families — indicated the error rate may be higher than expected. These errors can be problematic for single-step evaluation accuracy, resulting in misalignment of genotype and phenotype, reducing the genetic gains associated with traits of commercial importance.

To rectify this, TBA is undertaking a quality assurance strategy comprising extensive sampling, DNA analysis and diagnostics. The work will investigate the degree and scale of errors in the pedigree data, allowing for correction.

“The statistical methodology that TREEPLAN has used over the last two decades is inherently robust to a certain amount of error,” said TBA General Manager Dr Tony McRae.

“However, if errors are detected in pedigree data, they can now be rectified using genomic data. This new capability will provide an immediate lift in realised genetic gain.”

Using genetics to grow better trees can mean more wood is produced from the same unit area, and with the same input of resources.

“Based on the results of recent studies, we expect that by using genotype data to refine pedigree data before it is combined with phenotypic data, we will not only see improved accuracies and boosted genetic gain in the long-term, but also an immediate, one-off boost of between 10 and 15 per cent,” said McRae.

The national radiata pine tree improvement program is ongoing, meaning TBA is capturing new data on a daily basis. However, it is anticipated that any errors in recent and future data should be minimal, thanks to the effectiveness of electronic data capture and improved breeding methods.

The methodology developed through this project is anticipated to have application across other plantation species in Australia for pedigree recovery and quality control.

This FWPA-supported project is one element in a series of planned research projects that aim to double the rate of genetic gain in pine breeding within Australia.