Technical brief: genetic gain continues to improve in the national *P. radiata* breeding program

26 March 2025

Tree Breeding Australia Limited (TBA) has recently completed a new genetic analysis (run) for the national *Pinus radiata* tree improvement program using TREEPLAN. Each run builds on previous analyses by including new measurement data gathered for new and existing trees in genetic trials across Australasia. The evaluation allows us to identify new selections and improve the accuracy of prediction for use in breeding and deployment.

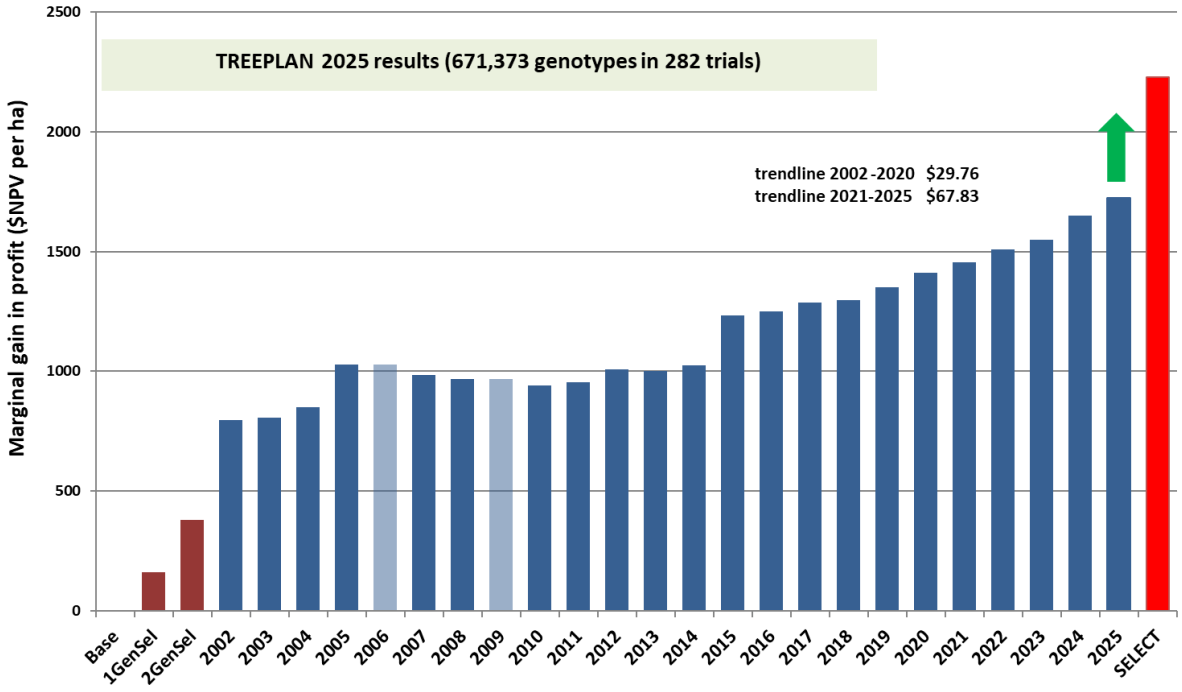
Genetic values for clearfall harvest age characteristics of growth (MAI), form (SWEEP and BRANCH size) and wood properties (STIFFNESS) are produced for each genotype. Economic indices (based on various production systems and end-use processing) are used to quantify the net present value (NPV) of each tree against all other tested trees. Growers can then objectively compare the genetic and economic worth of trees (and seedlots) depending upon their particular production and processing objectives.

For example:	The value of gain in:			
	MAI growth (MAI m^3/ha/yr)	plus	**STIFFNESS** (GPa)	plus
	reduced **BRANCH size** (cm)	plus	reduced **SWEEP** (mm/m)	**equals**
	$NPV marginal increase in net present value by using seed or plants from this tree relative to a base line group of early generation selections			

The integrated approach provides efficiencies as the national DATAPLAN database allows TREEPLAN to use all historical and new information (including genomic data) in a single industry wide multivariate genetic analysis enabling objective comparisons to be made.

TREEPLAN statistics for this run	**Trials**	**Genotypes**	**Measured traits**
Total number included:	282	671,373	35
Number of objective traits: 4 (with MAI on a regional basis, STIFFNESS, BRANCH size and SWEEP)			
	Trials	**Individual genotypes**	**Measurements**
Size of *P. radiata* database:	509	1,263,166	19.8 million

TBA is the national body which manages the Australian tree improvement programs for radiata pine (*P. radiata*) and blue gum (*E. globulus*). TBA is a not-for-profit cooperative and our members collectively contribute resources for efficiencies in maximising the genetic quality and value of the plantation resource.



This graph shows the average marginal improvement in net present value $ of the best 5% of genotypes identified for **breeding purposes** with each annual analysis. For comparative purposes, each group of genotypes identified previously is now described in terms of its updated NPV value in the 2025 TREEPLAN analysis. This allows for an objective comparison of genetic material over time. The SELECT result is more indicative of the gain which could be achieved in a new deployment orchard based on an average Australian index.

The results indicate a high and competitive return (10-14%) on investment through membership fees can be achieved.

Technical brief: genetic gain continues to improve in the national P. radiata breeding program *(continued)*

Table 1 below shows the average performance of each generation for each trait as well as the average trait values of the best 5% of trees (33,568 genotypes) selected for a single trait. For example, the best 5% of trees selected for MAI (volume) alone would have an average predicted increase in volume production of 3.96 m³/ha/yr (18% more than base productivity) but only deliver a marginal improvement in economic value (profit) of $1096 due to trade-offs in other correlated traits. The very best trees for growth have MAI breeding values up to 36% better than the baseline (set of early generation selections) genotypes. The SELECT orchard result is indicative of the gain which could be achieved in a new orchard based on an average Australian index.

Table 1: Marginal gain (or loss) in selecting various groups of genotypes based on generation, the national multi-trait index or independent traits.

	INDEX	MAI (volume)		STIFFNESS		BRANCH SIZE		SWEEP	
Base productivity and units*	*NPV $/ha*	*22.6 m^3 /ha/yr*		*11.3 Gpa*		*5.5 cm* (lower is better)		*10.5 mm/m* (lower is better)	
Baseline genotypes	0	0		0		0		0	
Overal mean (671,373 trees)	429	0.95	4%	0.08	1%	-0.32	-6%	-0.50	-5%
1G Selections (1137 trees)**	230	0.49	2%	-0.07	1%	-0.42	-8%	-0.24	-2%
2G Selections (855 trees)**	445	0.84	4%	0.00	0%	-0.50	9%	-0.77	-7%
Top 5% for **INDEX NPV$**	1722	2.37	11%	1.26	11%	-0.95	-17%	-1.27	-12%
Top 5% for **MAI**	1096	3.96	18%	-0.29	-3%	-0.48	-9%	-1.30	-12%
Top 5% for **STIFFNESS**	1367	0.41	2%	1.78	16%	-0.75	-14%	-0.29	-3%
Top 5% for **BRANCH**	1191	1.31	6%	0.53	5%	-1.38	-25%	-1.41	-13%
Top 5% for **SWEEP**	915	2.19	10%	-0.27	-2%	-0.83	-15%	-2.58	-25%
SELECT Orchard	2228	1.85	8%	2.34	21%	-0.99	-18%	-1.32	-13%

** Base Productivity is an average commercial performance indicator used in developing TREEPLAN Genetic Values for Pinus radiata.*

^ 1G and 2G trees were selected using breeding values reported in STBA TR92-02 and TR92-04.

Deployment gains are more targeted

The following graph is indicative of the additional marginal improvement in NPV$ available when deploying TBA genetic material. National and regional orchards (DEPLOY – orange) are compared with the average NPV$ of the generations and the best 5% of genotypes identified for breeding purposes (BREED - blue). The breeding program must retain diversity and targets national objectives, whereas seed producers and forest growers can increase selection intensity and focus more on regional performance. For example, despite the national breeding program delivering a marginal improvement of NPV $1722, a new orchard for the Green Triangle Region (DEPLOY Int. GTR) could deliver a marginal gain of NPV $2639 using an 8% discount rate. Individual results will vary depending upon the production model assumed by growers.