

Economic and genetic gain continue to improve over time for *P. radiata*

25 August 2017

The Southern Tree Breeding Association Inc. (STBA) 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 from new and existing trees in genetic trials across Australia. 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 tree. 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 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 m³/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 from this tree relative to revised base line trees

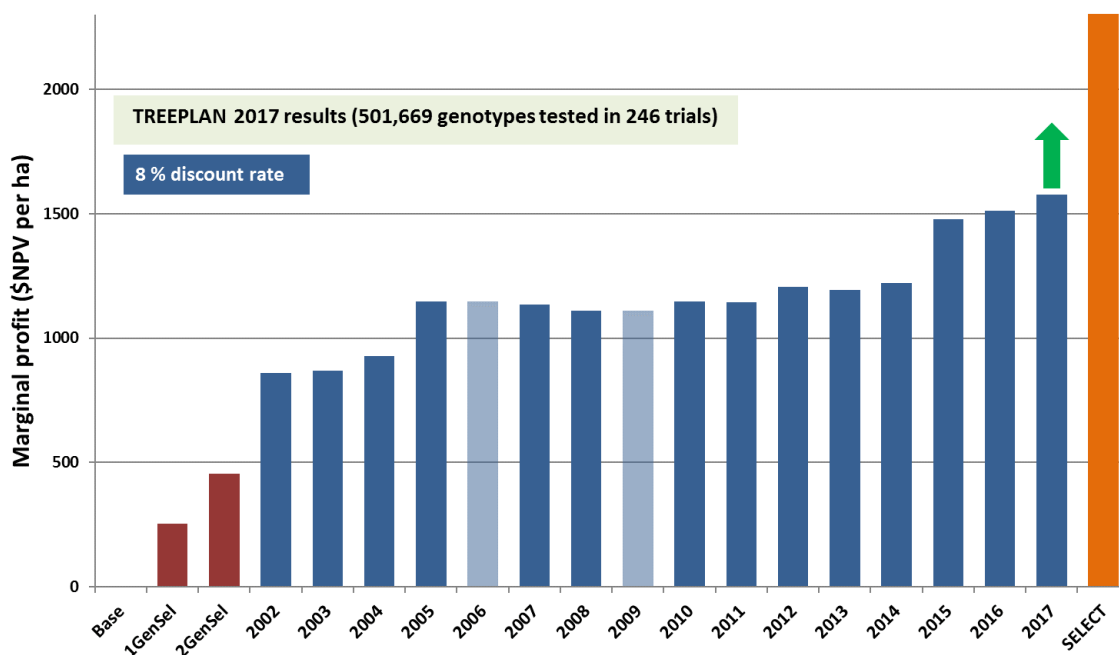
The integrated approach provides efficiencies as the national database allows TREEPLAN to use all historical and new information in a single industry wide multivariate genetic analysis. Growers can compare genetic potential on an “apples vs apples” basis to optimise selection of material for plantation establishment.

| TREEPLAN statistics for this run | Trials | Genotypes | Measured traits |
|--|--------|----------------------|-----------------|
| Total number included: | 246 | 501,669 | 34 |
| Number of objective traits: 4 (with MAI on a regional basis, STIFFNESS, BRANCH size and SWEEP) | | | |
| | Trials | Individual genotypes | Measurements |
| Size of <i>P. radiata</i> database: | 445 | 905,602 | 16.4 million |
| Total DATAPLAN database size | 2616 | 5 m genotypes | 110 million |

The STBA (established in 1983) is the national body which manages the Australian tree improvement programs for Radiata pine (*P. radiata*) and Blue gum (*E. globulus*). STBA is a not-for-profit cooperative and our members collectively contribute resources to maximise the genetic quality and value of the plantation resource.

TREEPLAN software has been jointly developed for use in the forest industry by STBA, PlantPlan Genetics and AGBU (a joint institute of the University of New England and Industry and Investment NSW).

Improvement in marginal profit (\$NPV) for a vertically integrated industry



This graph shows the average marginal improvement in net present value \$ of the best 5% of genotypes identified 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 2017 TREEPLAN analysis. This allows for an objective comparison of genetic material over time. The SELECT result is indicative of the gain which could be achieved in a new orchard for deployment based on an average Australian index.

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

Economic and genetic gain continue to improve over time for *P. radiata* (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 (25,084 genotypes) selected for a single trait. For example, the best 5% of trees for MAI (volume) alone would have an average predicted increase in volume production of 3.26 m³/ha/yr (14% more than base productivity) but only deliver a marginal improvement in economic value (profit) of \$830 due to trade offs in other correlated traits. The SELECT orchard result is indicative of the gain which could be achieved in a new orchard based on an average Australian index.

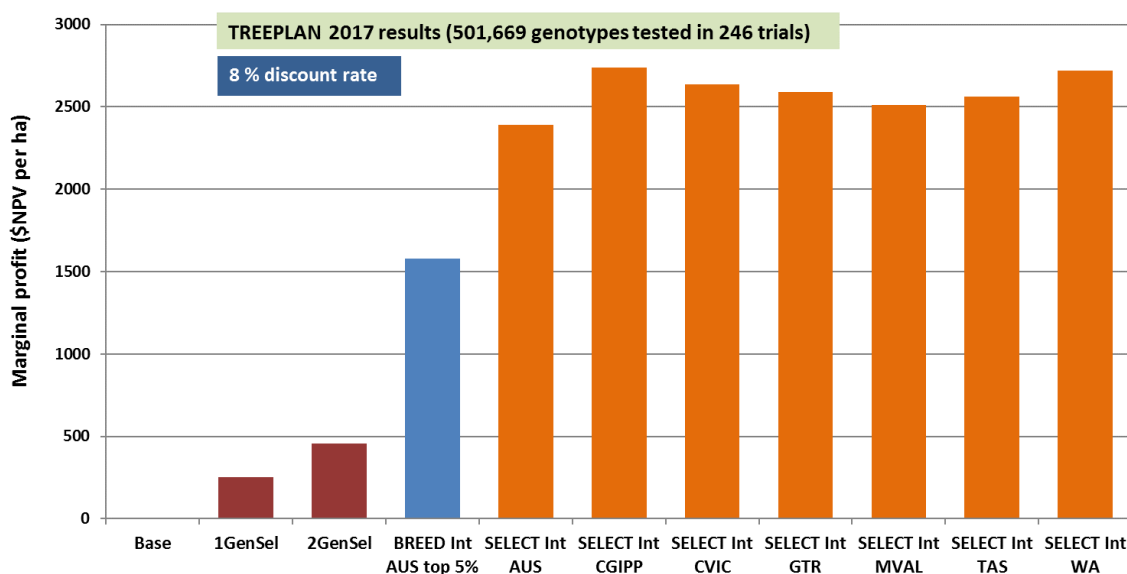
Table 1: Marginal gain (or loss) in selecting various groups of genotypes based on generation, the national multi-trait index or independent traits.

| | INDEX | MAI (volume) | | STIFFNESS | | BRANCH SIZE | | SWEEP | |
|---|------------------|---------------------------------|-----|-----------------|-------|---|-------|--|-------|
| <i>Base productivity* and units</i> | <i>NPV \$/ha</i> | <i>22.6 m³/ha/yr</i> | | <i>11.3 GPa</i> | | <i>5.5 cm</i> <i>(lower is better)</i> | | <i>10.5 mm/m</i> <i>(lower is better)</i> | |
| Baseline genotypes | 0 | 0 | - | 0 | - | 0 | - | 0 | - |
| Overall mean (501,669 trees) | 313 | 0.67 | 3% | 0.04 | 0% | -0.21 | -4% | -0.31 | -3% |
| 1G Selections (1137 trees) [^] | 254 | 0.56 | 2% | -0.02 | -0.2% | -0.24 | -4.4% | -0.25 | -2.4% |
| 2G Selections (855 trees) [^] | 456 | 0.93 | 4% | 0.02 | 0.1% | -0.32 | -5.9% | -0.76 | -7.2% |
| Top 5% for NPV\$ | 1577 | 1.78 | 8% | 1.27 | 11% | -0.77 | -14% | -0.87 | -8% |
| Top 5% for MAI | 830 | 3.26 | 14% | -0.43 | -3.8% | -0.33 | -6% | -1.09 | -10% |
| Top 5% for STIFFNESS | 1218 | 0.24 | 1% | 1.69 | 15% | -0.48 | -9% | -0.06 | -1% |
| Top 5% for BRANCH | 993 | 1.21 | 5% | 0.17 | 1% | -1.13 | -21% | -1.25 | -12% |
| Top 5% for SWEEP | 619 | 1.56 | 7% | -0.50 | -4% | -0.63 | -12% | -2.34 | -22% |
| SELECT Orchard | 2392 | 1.43 | 6% | 2.64 | 23% | -0.98 | -18% | -1.27 | -12% |

* 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 STBA genetic material. National and regional orchards (SELECT – 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 \$1577, a new orchard for the Green Triangle Region (SELECT Int. GTR) could deliver a marginal gain of NPV \$2592. The marginal gains are shown using an 8% discount rate. Individual results will vary depending upon the production model assumed by growers.



For more information see the STBA web site (www.stba.com.au) or contact the General Manager, Dr Tony McRae (tmcrae@stba.com.au) or Business Manager, Peter Cunningham (pcunningham@stba.com.au).