



R & D

TREEPLAN® targets profitability of tree breeding programs

BY PETER CUNNINGHAM



Skogforsk researchers met with STBA in Umea, Sweden in August 2006. (L to R) Dr Bengt Andersson, Johan Kroon, Dr Tony McRae (STBA), Dr Torgny Persson, Dr Ola Rosvall, Dr Greg Dutkowski (PlantPlan Genetics), Dr Lars-Goran Stener, Mats Berlin, Dr Bo Karlsson, Dr Tore Ericsson, Dr Gunnar Janson and Johan Westin.

Following up on expressions of interest and some specific invitations from European tree breeders, Dr Tony McRae of STBA and Dr Greg Dutkowski of PLANTPLAN Genetics have just returned from a trip to Sweden, Spain, Portugal and France. They had been asked to demonstrate the applications of TREEPLAN®. TREEPLAN® is an integrated web-based data management and breeding software package, which has more than doubled the rate of genetic gain in the Australian national breeding programs for radiata pine and blue gum.

The response of European breeders and companies was positive. Many expressed interest in adopting the innovative technology, most notably Sweden's Skogforsk. Skogforsk is Sweden's national Forest Research Institute and a world leader in forestry and forest genetics. Impressed by the utility and formidable analytical capabilities of the TREEPLAN® system, Skogforsk wants to use TREEPLAN® to analyse their tree improvement data.

Skogforsk is keen to apply the TREEPLAN® technology to their national breeding programs for Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*).

The STBA's success is derived from its drive to fulfil its responsibilities as Australia's only national tree breeding organisation. Established as a national cooperative in 1983, the STBA undertakes tree improvement on behalf of its members on a not-for-profit basis. The STBA manages the national tree improvement programs for radiata pine and blue gum, and is responsible for breeding improved trees, i.e. trees that produce higher quality timber at lower cost for greater profits for commercial growers.

In order to produce superior genotypes (trees), the STBA has, and continues to, set up trials in plantations across temperate Australia, measuring commercially important traits of individual trees throughout their lifespan. The ensuing data is compiled and organised into a national database for each species. Because of environmental influences, genetically superior or elite trees are not always obvious, and performance data must be analysed across environments to identify them. The selected elite trees are used to establish clonal seed orchards. The performance data, gathered by the STBA, also serves to guide deployment decisions by member companies to maximise production.

Innovative in its approach, the STBA has been at the forefront in the adoption of progressive rolling front tree improvement strategies and the use of economically defined breeding objectives. In 2005, it established a National Genetic Resource Centre for plantation forestry at Mount Gambier, supported by the Federal and South Australian government. Planted with grafted selections of high performance trees, this facility is expected to improve breeding efficiency and further consolidate their national breeding effort.

AN INDUSTRIAL STRENGTH SYSTEM

Before TREEPLAN®, the STBA's geneticists were swamped by the volume of collected data. The STBA recognised they needed a software system with 'industrial strength'. Combining the talents of the STBA's team of operational breeders and geneticists with research scientists of the Animal Genetics and Breeding Unit (AGBU) based at the University of New England, the TREEPLAN® system was developed.

Simply explained, TREEPLAN® uses best practise genetic and statistical models, utilising all pedigree and performance data in national analyses. It is fully integrated with national databases managing pedigree



(L to R) Dr Greg Dutkowski (PlantPlan Genetics) and Dr Gustavo Lopez (ENCE) inspecting *E. globulus* plants at Huelva, Spain.

relationships, individual measurement data on trees and other trial information. The size of the STBA database is substantial, containing data for some 928 genetic trials. The database for *Pinus radiata* and *Eucalyptus globulus* is building and includes performance data for 331,674 trees (175 trials) and 291,693 trees (130 trials) respectively.

TREEPLAN® uses the best methodology of any breeding program available. Retrospective analyses with radiata pine have proven that other commonly used methods are only about 30% efficient when compared to TREEPLAN®. This is in part due to TREEPLAN®'s integration of all data and pedigree relationships into its genetic analyses, which recent studies in a number of species have shown greatly improves selection efficiency.

The STBA does not imagine TREEPLAN® as a static concept, rather as a dynamic system that must constantly improve. The breeders are relentlessly advancing its capacities to meet the demands of forestry.



(L to R) Dr Bengt Andersson (Skogforsk Program Manager) and Dr Greg Dutkowski (PlantPlan Genetics) inspecting Scots pine at Umea in Sweden.

The TREEPLAN® system is inherently flexible, providing a systematic framework allowing incorporation of all genetic material and information relating to a species. New research results are, and will continue to be, assimilated into the software's models.



R & D

RESEARCH UNDERWAY

Research is now underway to better accommodate risk traits, such as drought, pine aphid, pine pitch canker, spring needle cast, drought, high fertility and *Dothistroma* needle blight, in TREEPLAN®. Early results from the FWPRDC funded Juvenile Wood Initiative have already been utilised in the national TREEPLAN® runs.

While practising traditional breeding, the STBA is also aware of the benefits of molecular genetics. As part of a \$1.4 million research initiative by the STBA, FWPRDC and AGBU, TREEPLAN® is being enhanced by the incorporation of advanced modelling of genetic and environmental effects, also integrating genetic information at the DNA level.

One major advance made in the national radiata pine program is the recent adoption of selection indices based on economic data. Using industry data from STBA member companies (forestry growers, saw millers and integrated enterprises), the STBA, in partnership with FWPRDC and CSIRO, have developed bio-economic models to identify the relative importance of different tree traits influencing enterprise profit. This is the first time that such a rigorous economic study has been done in radiata pine. Each company can now choose its own set of economic weights to rank its genetic material for deployment purposes. This means the most suitable/profitable trees for a particular end purpose or growing environment can be selected, and growers can customise their trees.

Study results show that genetically improved pine trees can deliver an extra \$4,500 net present value per hectare over the rotation, compared with earlier generation selections.

Industry can access elite STBA genetic material from Association members and/or SeedEnergy Pty Ltd. While members can deploy the material freely, non-members must pay a royalty for using the genetically improved material. Non-members wishing to access TREEPLAN®, can do so by an independent company set up by the STBA. PLANTPLAN Genetics Pty Ltd provides genetic evaluation services for companies to analyse their own databases and maximise the returns from their genetic resources. Non-members are welcome to join the Association.

Though the STBA has been encouraged by the interest shown by European tree breeders, the company remains committed to the Australian forestry industry. The STBA believes their combination of elite genetic material with proven performance under Australian conditions, TREEPLAN® generated genetic values, and their use of robust economic indices, makes investment in the national breeding programs a sound financial investment.

**Peter Cunningham, Business Manager,
Southern Tree Breeding Association**