Genetics, tree improvement and PSPs

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For a moderately fast growing, intensively managed exotic planted species such as radiata pine in New Zealand, genetics and tree improvement is an important subject. Picking the wrong variety or provenance will severely reduce profitability – there are still a few foresters who can remember the Ponderosa stands on the Low Level Road at Kaingaroa that were planted with stock originating from an unsuitable provenance. At the same time improved tree stocks offer much benefit, as can be seen on the back page by the comparison between a current stand with the old-crop radiata on the frost flats of the Central North Island.

This issue covers the theme of genetics and tree improvement, illustrating the great potential for the future. John Butcher, as CEO of the Radiata Pine Breeding Cooperative, opens with a description of different approaches to increase financial returns from tree breeding, where the priorities for research are to speed up the breeding and deployment cycle while pursuing gains in target traits. Mike Carson et al describe the deployment of varietal forestry, with impressive improvements in volume productivity, wood quality and reduced risk of disease. Heidi Dungey et al explain quantitative genetics and propose a future of the integration of quantitative and molecular genetics that, in combination through genomic selection, will deliver gain faster and across multiple traits. They describe Scion's breeding programmes for species besides radiata.

There are two papers on New Zealand forestry entering the genomics era. The paper by Phillip Wilcox and Lucy Macdonald presents an 'every-person's guide' to the concepts of genome sequencing. It describes current progress in researching the genome sequence of radiata pine. That by Yongjun Li et al comments on the forestry applications of genomic technologies. Rowland Burdon and Heidi Dungey discuss the need for tree genetic resources for forest biosecurity and to conserve and actively manage wide genetic diversity. John Hay provides a Last Word on tree breeding in New Zealand, concluding that the forest industry must grapple with the new technologies to keep competitive.

There are two other papers of note. Modifying conventional even-aged clear-felling silvicultural systems by Perry et al provides an economic analysis of a variant of the single-tree selection system, target diameter harvesting. At Woodside Forest in Canterbury, harvesting in the same stand has taken place every two years, extending the rotation length and maintaining tree cover, so far by 10 years. There have been few practical examples of alternative silvicultural systems with commercial objectives in New Zealand (the former Selwyn Plantation Board's Douglas-fir compartment managed under the Femelschlag system being a notable example).

A paper on tree counts from airborne LiDAR by Dave Pont et al presents two semi-automated image processing methods to identify tree locations that can consistently provide results with known error limits. The work is based on research that began in the late 1990s, failed, was restarted a decade later, and in the second attempt, took far longer than was originally envisaged. The colourful Gant charts and target dates beloved of project managers are not necessarily of benefit in original research.

The claims of the gain due to tree breeding are supported by long-term trials that integrate genetics, silviculture and site with the measurements of permanent sample plots (PSPs) over many years to estimate per hectare volumes and other stand parameters. These trials dispel the notion that the new breeds have improvements early in the rotation but these gains fade away later. The PSP measurement programme not only establishes contrasts between one treatment and another, but is essential to construct growth and yield models that are able to predict the consequences of tree breeding and are relevant to the forest now and in the future.

There is a gap developing in the establishment programme of new PSPs, with a short-sighted view that PSPs with silvicultural treatments different to current practice are no longer needed. Nowhere is this more apparent than in the small-scale and farm forests. Genetic improvement affects basal area growth differently to its effects on height, possibly changing stand mortality and carrying capacity, so that the form of the growth functions for the newer varieties are likely to be different than in the past. The 300 Index model for radiata pine, first described in the Journal 10 years ago, is the fifth generation of radiata growth models (earlier models were constructed in the 1950s, 60s, 70s and 80s). Will there be sufficient new growth measurements over a wide enough domain to construct an improved sixth generation model?

Current PSPs provide evidence for forest management decisions, to underpin the long-term harvest plan and in valuing the forest business. Managers need growth data not only to monitor the forests and verify their forecasts, but also to assure the forest owners that their decisions, including that of utilising improved more expensive tree stock, are the best possible over other alternatives.

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