We need a new approach to plantation silviculture in New Zealand

Euan Mason[1]

Plantation silviculture is a marvelous tradition in New Zealand, and, like many well-established traditions, our silvicultural strategies warrant some oblique scrutiny.

Our silviculture is remarkable for its intensity and the extent to which investments such as site preparation, weed control, breeding and pruning are made in individual crop trees. High investment per tree has promoted open spacing, where low numbers of crop trees are given plenty of space so that investment returns can be recovered before compounding costs overwhelm value growth.

There are some downsides to widely spaced crops, however. Lower stockings mean greater branch growth, more wind damage, plenty of tree sway, and rapid diameter growth, particularly when stems are small. We obtain higher microfibril angles and therefore lower stiffness in large sections of corewood. These contribute to a mini crisis in wood quality, as users of our plantation wood confront the sagging realities of using wood from young, widely spaced crops for structural purposes.

The industry's response has been swift. We are faced with more stress grading and the potential demise of visual grading, and tree breeders are now charged with breeding out wood characteristics that partly result from harvesting of widely spaced, young trees.

Yes, it's timely to have a fresh look at our silviculture. Suppose, for example, we could increase profits by producing higher quality wood at lower cost? This may be possible with some radically new approaches, but they need some investigation before we could recommend them. Let's walk through some new findings and some old ideas.

Recent work by Mike Watt, a postgraduate student at the School of Forestry, has indicated that at a small scale, microfibril angle (and therefore wood stiffness) is affected by radial stem growth rate and possibly tree sway. Corewood is apparently promoted by rapid radial growth that is typical near the pith and possibly by swaying of small sections at the tops of stems. I can't suppress a small satisfaction at this finding, because I've long thought that the misnomer, "Juvenile" wood led people to ask the wrong kinds of questions about corewood.

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It's pretty clear that toppling of juvenile trees is still producing a wall of buttsweep and compression wood across New Zealand. What is also clear from limited studies here and more comprehensive ones overseas is that trees grown from seed *in situ* generally don't suffer from juvenile instability.

It's hardly news that pruning is expensive partly because several lifts are required to retain small defect cores throughout the length of a buttlog. In fact, for any given DOS and spacing, more lifts are needed on fertile sites than on infertile ones. Pruning cost is also related to branch size, and large branches are a common feature of fertile sites with low stockings.

So where is all this leading? Imagine a regime that involves much higher initial stocking or perhaps more initial competition from an overstorey, and much greater use of spacing to control growth and value of the crop, particularly during the first third of the rotation. We'd have smaller branches, lower radial growth rate, smaller microfibril angles (and therefore stiffer wood), less tree sway, and less taper. We might wait until a height of 10 m and prune to 6 m in one hit. Maybe two lifts would be required on very fertile sites. The cost of pruning would be lower, with fewer visits to the stand and smaller branches.

But wait, you interject, what about the high cost of establishing many more, highly bred trees per hectare, and what about the greater cost of thinning? Fair questions, to be sure. I'll get to those good points in a minute.

Imagine a stand of trees without toppling, where new breeds are not required for high quality log and wood production. Imagine one with much lower establishment cost than you are used to. Imagine a naturally regenerated stand of radiata pine. Natural regeneration may:

- Cost less to establish.
- Provide very high initial stockings.
- Reduce radial growth rates near the core and therefore increase wood stiffness.
- Reduce tree sway.
- Eliminate the problem of juvenile instability and associated compression wood.
- Reduce taper.
- Reduce branch size.
- Lower the cost of pruning.
- Provide higher selection ratios.
- Eliminate the need to purchase new breeds.
- Result in less costly, higher quality crops.
- Increase profits.
- Be more environmentally acceptable to the public.

A quick, "back of the EXCEL envelope" comparison of NPV versus rotation age assuming *no* improvement

in wood quality looks favourable (Fig. 1). For this analysis I assumed that

- Site index was 32.
- A direct sawlog regime was employed in the "Usual" treatment.
- Site preparation costs were identical for both regimes.
- The natural regeneration regime resulted in prolific regeneration requiring a thinning at age 1, costing $400/ha.
- Only one pruning lift to 6 m at age 8 achieved the same products in the naturally regenerated stand as did 3 pruning lifts in the "Usual" regime.
- Stocking was equivalent in the two regimes after age 8.
- The naturally regenerated stand was consistently 1.5 years behind the "Usual" stand.
- The interest rate was 7%.

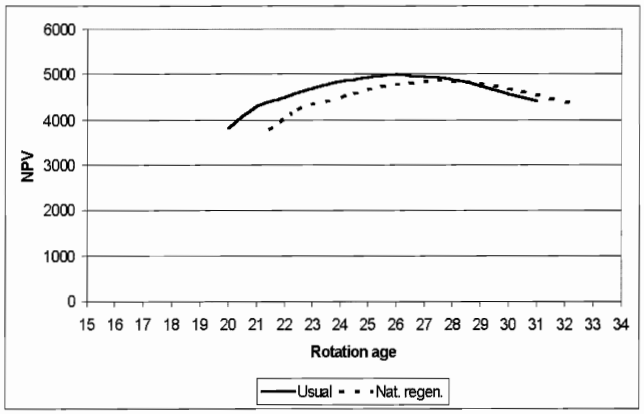

Fig. 1 – Rough "back of the envelope" Net Present Value (NPV) comparison between a conventional direct sawlog regime ("Usual") and one involving natural regeneration and higher stockings prior to pruning. Revenues at harvest are assumed to be equivalent at times of equivalent yields.

A naturally regenerated stand, however, may yield higher quality, more valuable logs. Assuming a 10% improvement in revenue at harvest, the comparison may look more like Fig. 2.

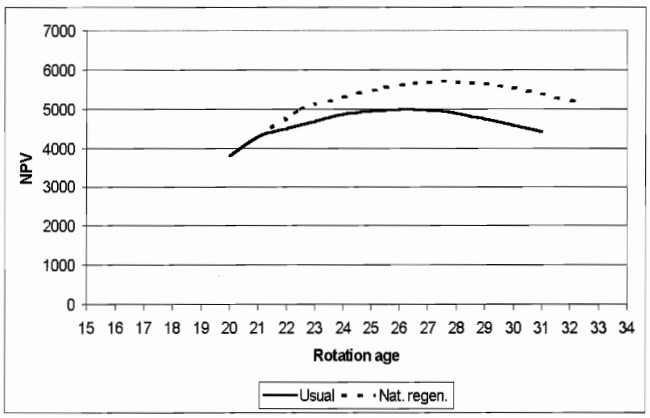

Fig. 2 – Net present values of a conventional direct sawlog regime ("Usual") and one involving natural regeneration and higher stockings early in the rotation, assuming that revenues were 10% higher from the naturally regenerated regime.

Your reply is rapid: Come on Mason, stick your neck out, you wuss! What's this "may" business? It's the natural caution of a researcher. This kind of regime is way beyond the range of existing models that were built to represent crops with low stockings.

To change the "may" to either a "will" or a "will not", we need new experiments and new models. We need to understand enough to predict where and how to engage in natural regeneration with a high degree of confidence. We need more studies of conditions that promote germination in field sites, reduce impacts of seed predation, and balance initial growth with wood quality. We need to confirm and refine the findings that, at a micro level (no pun intended), stiffness of corewood may be related to radial growth rate and tree sway.

And, yes, thinning costs might be higher. But how much higher, and how would returns from a naturally regenerated, highly stocked stand with one pruning lift, no corewood problems and very straight stems really compare with those from a planted, widely spaced, highly bred crop with three pruning lifts, plenty of toppling and a low selection ratio?

These questions and concerns require a new research programme. The goal is to find innovative, environmentally friendly ways to increase profits from plantations.

Calendar

The following conferences, expos, courses and other events will be of interest to readers. Details are brief, so please contact the organisers for more information.

24-30 March 2003
International Expert Meeting on Planted Forests
Role of Planted Forests in Sustainable Forest Management
Contact: Don Wijewardana, Ministry of Agriculture and Forestry, P O Box 2526, Wellington, Tel: 04 4989870, fax: 04 4989891, email: don.wijewardana@maf.govt.nz. Website: www.maf.govt.nz/mafnet/unff-planted-forestry-meeting/

27 April-1 May 2003
ANZIF Australian and New Zealand Institute of Forestry Conference, Queenstown

21-28 September 2003
XII World Forestry Conference
Forests, Source of Life
Quebec, Canada
www.wfc2003.org

8-13 August 2005
XXII IUFRO World Congress, Brisbane
www.iufro2005.com