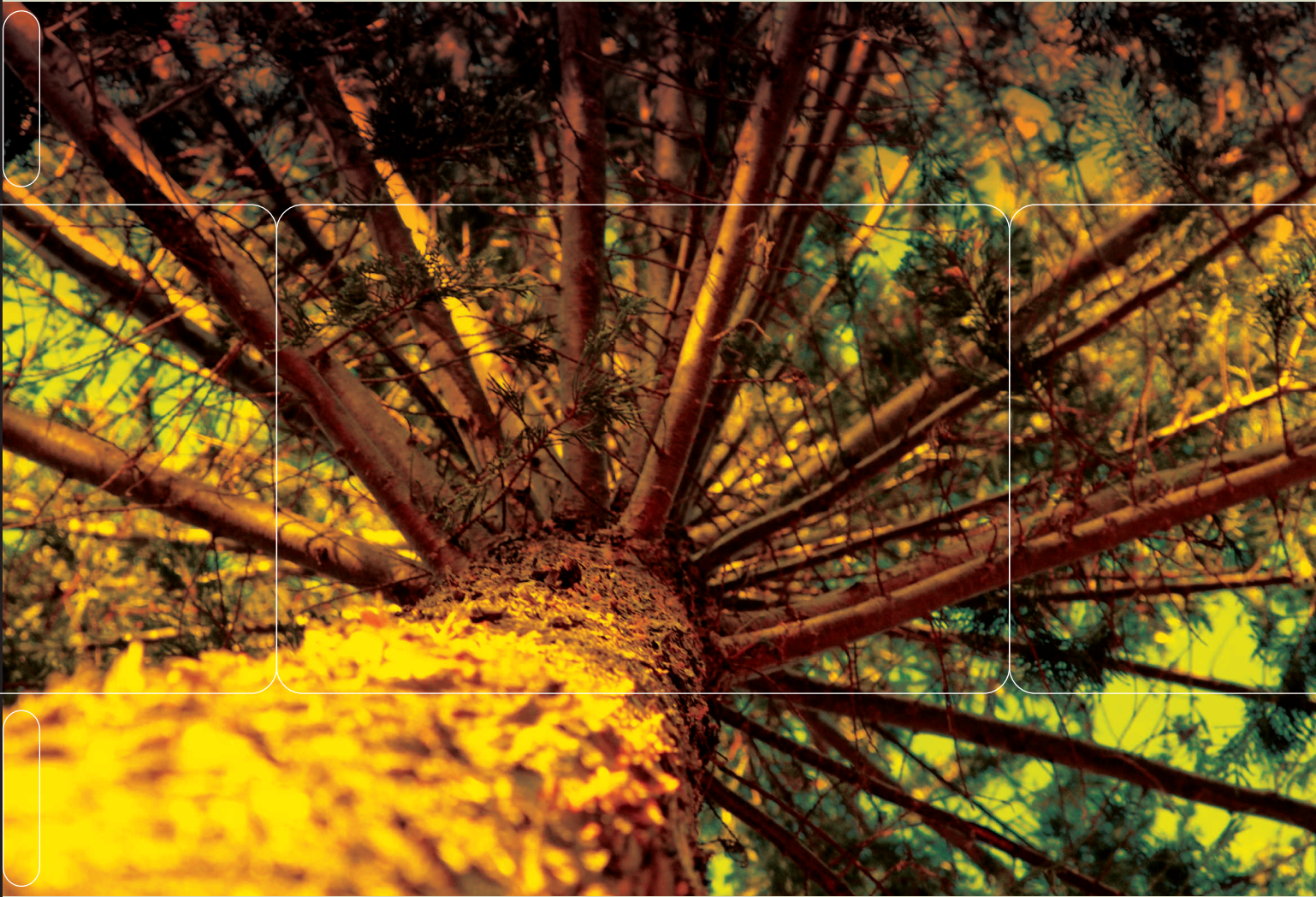


RADIATA PINE BRANCHING HABIT



RPBCTM
Radiata Pine Breeding Co Ltd
BREEDING QUALITY

- **Branching habit is variable in radiata pine. It has important effects on both branch size and on mean internode length (MIL), particularly in the first 3-11m of the tree bole**
- **MIL is strongly controlled by genetics and site**
- **Trees with a high MIL can produce high yields of valuable clear-cuttings timber grades**
- **Increase in internode length can be at the expense of control of branch size, such that it is generally impractical to grow stands simultaneously for structural and clear-cuttings objectives**
- **Trees with long internodes can be grown safely in areas without high exposure to wind, hail or snow, and/or where animals and/or disease do not cause serious damage to the tree's main leading stem**
- **The *GF Plus* scheme will replace the current branching habit trait with a direct measure of MIL within the next 2 to 3 years**

> **TREE BREEDING AND INTERNODE LENGTH**

Radiata pine tends to grow its branches in discrete 'clusters' up the stem, and there can be between 1 and 6 branch clusters formed in each year of height growth (Figure 1). The distance between branch clusters (the "internode length") varies in a corresponding manner, and can typically range between 0.13m and 2.40m, with an average mean internode length (MIL) of between 0.25m and 0.65m, depending on position in the tree, growing site and/or region, and genotype. Genetic differences in MIL have been selected for by the RPBC, and these are reflected in the "branching habit" trait currently identified in the *GF Plus* scheme. (See Information Bulletin No. 1, 'Rating the Genetic Quality of Radiata Pine'). Low values for branching habit indicate high MIL.

> **WHY IS INTERNODE LENGTH IMPORTANT?**

MIL is directly associated with the amount of unpruned clearwood, or "clear-cuttings", that can be cut from radiata pine sawlogs. Since knot-free timber usually commands a price premium (and if all other stand characteristics are held constant) increasing MIL will increase financial returns to growers and processors.

> **WHAT FACTORS AFFECT INTERNODE LENGTH?**

Within a tree, MIL tends to be longer with increased height growth, and reaches its longest between 3m and 11m height. This corresponds with the top half of the first 5.5m long sawlog, and the second log. MIL variation between forest stands is strongly affected by both genetics and site (Figure 2) although

the influencing site factors are not particularly well understood. MIL is shortest on sandy sites with low nitrogen nutrition, and also on high-fertility ex-pasture sites that tend to produce large branches, with whorls closer together. The genetic control of internode length is moderately strong and stable across sites. Seedlots can be selected for predictable MIL performance on specific sites. Conversely, tree spacing and stocking within a stand have negligible effects on MIL above initial stockings of about 600 stems/ha.



Figure 1: Differences in branch cluster frequency

INTERNODE INDEX BY BREED AND REGION

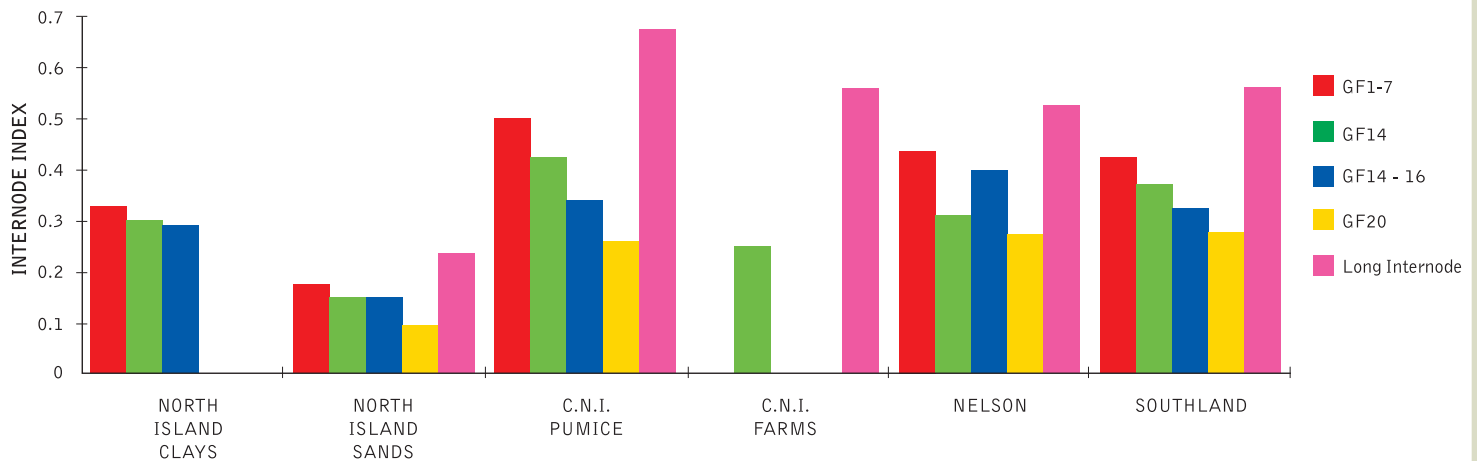


Figure 2: Internode Index by breed and region. Internode Index is the sum of length of internodes of 0.6m or longer, expressed as a fraction of log length
Source: Carson, S.D. 1996. Greater specialisation of improved seedlots: new developments for efficient selection of parent and evaluation of performance. NZ Forestry 41:12-17

> HOW DOES INTERNODE LENGTH INTERACT WITH OTHER TRAITS?

Internode length interacts directly with average branch size, and importantly with other log quality traits and growth rate. Trees with long internodes tend to have larger and more steeply angled branches, and multinodal trees have smaller branches. This means that, in general, it will be impractical to expect long-internode trees to produce high yields of structural timber grades, and conversely, for multinodal trees to produce high yields of clear-cuttings grades. The RPBC breeding programme initially selected for a ‘multinodal’ tree type (i.e. with more branch clusters and low MIL) because this trait was strongly correlated with the desirable traits of faster growth, straighter stems, smaller and more even branch size, and reduced malformation of the tree’s leading shoot. A smaller breeding population was formed to pursue ‘long-internode’ trees (with high MIL), and this has resulted in some 2nd generation parents with high values for MIL, plus gains in growth rate and log quality. Also, recent selections in the main RPBC breeding programme have not directly emphasised the multinodal tree type, with the result that reasonable MIL can be achieved for their progeny on most site types. However, there is a great deal of both research trial and observational evidence that trees with long internodes (say, MIL > 0.4m) can, on some sites, suffer serious damage from various environmental factors, including: hail, wind, snow, possums and fungal diseases. The long internode length trait is therefore best pursued on less exposed sites, with low levels of pest and disease hazard.

> HOW ARE TRAIT RATINGS DERIVED?

GF Plus branching habit ratings have previously been derived from RPBC progeny trials, using a subjective scoring method on trees aged 8-10 years (Figure 4). These ratings can be used as a guide to MIL performance. However, recent research has identified a laser method that can be used efficiently by tree breeders to directly assess MIL on the important, first two log height classes on standing trees in progeny trials (Figure 3). The laser is used to take a height measurement at the top and bottom of the internode and thus derive the internode length. The RPBC expects to develop **GF Plus** ratings for MIL to replace those for branching habit over the next 2-3 years.

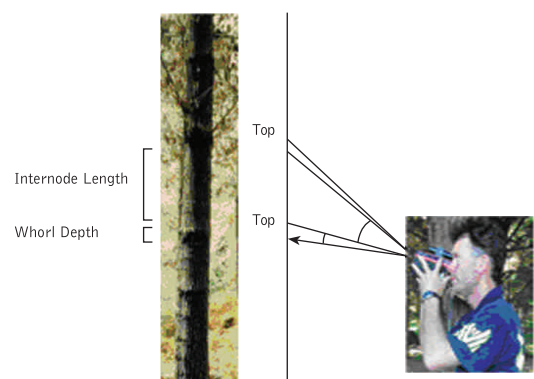
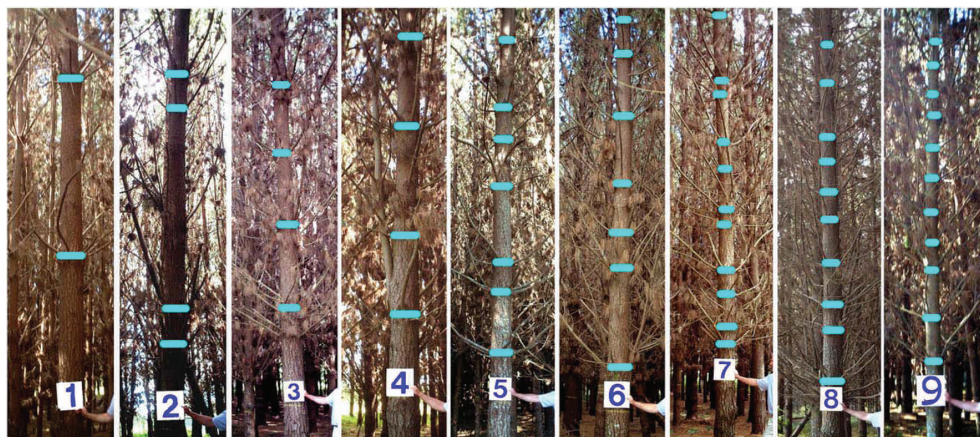


Figure 3: Measuring internode length by laser

> WHEN ARE GAINS IN INTERNODE LENGTH LIKELY TO APPEAR?

In side-by-side comparisons of different progenies and clonal varieties, differences in internode length usually begin to be visibly apparent by age 4-5 years, and become very evident at tree age between 6-10 years and older.

BRANCH FREQUENCY



1 = Uninodal - long internode 5 = Intermediate 9 = Highly multinodal

Figure 4: Branching habit scoring method

> **WHAT GENETIC GAINS CAN BE EXPECTED?**

Since the breeding population contains parents with a wide range of MIL, and as MIL is relatively highly heritable, the levels of differences in MIL among improved seedlots can be large enough to lead to dramatic differences in the clear-cuttings potential of forest stands. Stand average levels of MIL in second logs up the stem can differ substantially on some sites (Figure 2). The impact in terms of actual sawn timber outcomes can depend on a number of other factors – e.g. choice of sawing pattern – but one published study produced estimates of whole-tree percentages of clear-cuttings timber grades of 18% for an unimproved seedlot, compared to 8% for a multinodal seedlot, and 34% for a long internode seedlot.

> **CAN CLEAR- CUTTINGS TIMBER GRADES BE PREDICTED USING MODELS?**

Since branching habit/internode length in the most important first two sawlogs is essentially ‘fixed’ once the branches are formed, silvicultural models can be used with some confidence to predict final yields of clear-cuttings timber grades from stands aged 10–12 years and older.

> **HOW DOES INTERNODE LENGTH AFFECT VALUE?**

The choice of a seedlot representing a long internode versus a multinodal tree type will obviously have a substantial effect on resulting stand value. This will result not only from the direct impact of MIL on clear-cuttings grade potential but also from the associated reduction in structural grade potential. This reduction in

structural grade potential is as a consequence of the effects of larger branches and, on some sites, reduced overall timber yields due, in turn, to greater levels of damage by environmental factors. With other factors held constant, financial studies (such as the one mentioned above) have consistently shown that differences of estimated stand Present Net Worth can differ by up to \$400/ha between multinodal and long-internode seedlots, depending on the premium received for clear timber grades and if a 6–8% discount rate is used. However, a vertically-integrated forest company may extract substantially greater value from long-internode seedlots through taking the clear-cuttings products through to final products with a high added-value component. The RPBC breeding strategy makes provision for pursuing both structural and appearance objectives. Improved families and clonal varieties will be developed to provide growers with better opportunities to optimise value from a combination of yields from clear-cuttings and structural grade timber. It is important for the forest grower to consider that, when purchasing genetically improved planting stock, branching habit is just one of the traits described under the **GF Plus** scheme. Increased financial returns from improved MIL will be in combination with other traits, such as growth rate, stem straightness, wood density, wood stiffness, and disease resistance.

PLEASE NOTE

None of the NZ Forest Research Institute Ltd, RPBC or the seller of any plants or seed to which a GF Plus Seed Certificate may relate, will be liable to any person in contract, tort (including negligence) or otherwise for any loss or damage, including, without limitation, loss of profits or any other indirect or consequential loss arising directly or indirectly from the GF Plus trade mark, the GF Plus Seed Certificate or their use.

For more information
Freephone 0800 00 GFPLUS (0800 00 437587)



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