ASSESSMENT OF TREE QUALITY OF AGED CUTTINGS AND SEEDLINGS AT AGE 5 YEARS

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EXECUTIVE SUMMARY

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A second lift pruning assessment, including height, diameter at breast height (dbh), diameter-over-stubs (DOS), and branch diameter measurements was carried out on the Clearwood Trial, located near Te Puke, approximately five years after planting.

The three plant types compared were radiata pine seedlings and field-collected cuttings from 3 and 6-year-old parent trees. All plant types were of similar genetic origin (GF 21-22).

Results indicated that mean tree height was similar for all three stock types. The 6-year-old cuttings had a significantly smaller dbh compared to both the 3-year-old cuttings and seedlings. However, diameter increment following 1st lift pruning at age five years was similar for all stock types. A comparison of basal area per hectare, for the pruned crop, indicated a 20% increase for both the 3 and 6-year-old cuttings compared to the seedlings. The increase was a result of a higher number of cuttings pruned per hectare, due to their good form, compared to seedlings, and this in turn would improve crop selection at the time of thinning.

Mean branch diameter and DOS was smaller for the 6-year-old cuttings compared with the seedlings and 3-year-old cuttings. However, in contrast to the assessment carried out at the 1st lift pruning, branch number in the 2nd lift was similar for all stock types. Overall, up to a pruned height of 5-metres, branch basal area per hectare per metre pruned was 20% less for 3-year-old cuttings and 40% less for 6-year-old cuttings, compared with the seedlings. However, most of the reduction in branch basal area occurred in the 1st lift pruning (to a height of 3m) rather than in the second pruning lift applied to a height of 3-5m. The 6-year-old cuttings however, showed a reduced branch size up to a pruned height of 5m.

INTRODUCTION

Radiata pine seedlings and rooted cuttings taken from 3 and 6-year-old trees were established at initial stockings of 400 and 600 stems/ha on a farm site in the Bay of Plenty, in July 1994.

Earlier work with physiologically-aged cuttings had shown a considerable improvement in tree stability and straightness of the pruned butt log compared to the use of seedlings, particularly on farm sites (Menzies & Klomp, 1988; Klomp & Menzies, 1988; Menzies et al., 1991; Holden et al., 1995).

Whilst there is a significant improvement in the butt log straightness of aged cuttings grown on fertile sites, the quality of the unpruned upper logs may be similar to those of seedlings. Large branches can often degrade the upper logs, especially at final stockings less than 300 stems/ha.

To test any advantages of using physiologically-aged cuttings to improve upper log quality, a trial was established at the Clearwood property in the Bay of Plenty, comparing seedlings with aged cuttings (from parent trees 3 and 6-years-old) planted at 400 and 600 stems/ha.

Although the primary objective of this trial was to obtain upper log branching information, the opportunity was taken to obtain growth and branching data, following pruning. In March 1998, following the 1st lift pruning, the trial was assessed and the results were presented to the Forest & Farm Plantation Management Cooperative (Report No. 51).

Subsequently, the results of a 2nd lift pruning assessment carried out in September 1999 were summarised and are presented in this report.

MATERIALS AND METHODS

Planting Stock

Cuttings were collected from Kaingaroa Forest in June 1993. The 3-year-old cuttings were collected from a routine planting established in 1991 and the 6-year-old cuttings were collected from a field trial established in 1987. Seed from the same seedlot as the 6-year-old cuttings was subsequently sown in the ***Forest Research*** nursery to produce the seedling controls for the trial. A description of the planting stock is shown in Table 1.

Table 1: Planting stock

Stock type	Origin
Seedlings	1/0 Control pollinated, Seedlot No. 6/3/86/054, GF21
3-year cuttings	Cuttings from 3-year-old trees, GF22
6-year cuttings	Cuttings from 6-year-old trees, Seedlot No. 6/3/86/054, GF21

Trial site
The trial is located at Mystery Valley in the Bay of Plenty. The property is owned by the Clearwood Forest Partnership, a joint venture initiated in 1992. The trial was established on fertile pasture and the topography is flat to moderately undulating. The altitude is 180m a.s.l with an annual rainfall of 1200-1300mm. The soil is derived from Kaharoa ash and described as yellow-brown pumice on yellow-brown loam.

Trial design
The trial was established as a randomised block design containing five replications per tree stock type, at initial stockings of 400 stems/ha and 600 stems/ha. Each plot measures 50m x 50m including a two-row buffer around each measurement plot. Plant espacement is 5m x 5m (400 stems/ha) and 4.1 x 4.1 (600 stems/ha). Due to insufficient plant material being available, the 6-year-old cuttings were established at 600 stems/ha only. The total of 25 plots occupies an area of 6.25 hectares.

Measurements
Following medium pruning (to approx. 5m), two replicates of each of the three stock types in the 600 stems/ha stocking were randomly selected for assessment. This assessment included height and diameter at breast height (dbh), diameter-over-stubs (DOS), pruned height, branch and whorl frequency for each plot tree. Assessment results are based on the measurement of approximately 100 trees per stock type.

RESULTS AND DISCUSSION

Survival
Survival, five years after planting, was above 90% for all stock types (Table 2). Early seedling losses were generally the result of topple, while the cutting losses were caused by mortality and animal browsing.

Table 2: Survival at age 5 years

	Initial Stocking (sph)	Stocking @ age 5 years (sph)
Seedlings	600	567
3-year Cuttings	600	572
6-year Cuttings	600	553

Growth
Mean height for all three stock types was 9.0m – 9.3m, five years after planting, which was not significantly different. The 6-year-old cuttings had a slightly but significantly smaller diameter compared to both seedlings and 3-year-old cuttings, five years after planting. However, mean dbh increment from age 3.5 (1st lift prune) to age five years (2nd lift) was not significantly different between the three stock types (Table 3).

Seedlings and 3-year-old cuttings had a similar diameter-over-stubs (DOS) at the 2nd pruning lift, while the 6-year-old cuttings had a significantly smaller DOS. However, the difference in DOS between stock types was much reduced at the 2nd lift compared with the 1st lift (Table 3).

Table 3: Dbh and DOS at age 5 years

	Dbh (cm)	Dbh Incr. (cm)	1st lift DOS (cm)	2nd lift DOS (cm)
Seedlings	19.3a	6.41	20.4c	19.9b
3-year Cuttings	18.7a	6.36	18.2b	19.9b
6-year Cuttings	17.2b	6.37	15.5a	18.7a
Significance	**	ns	**	**

For each variable, the values indicated with the same letter are not significantly different
** indicates significant differences at the P=0.001 level
ns indicates that differences are not significant at the P=0.05 level

Pruning intensity

Both 1st and 2nd pruning lifts were carried out by a private contractor, with the instruction that all prunable trees should to be pruned, regardless of stocking. Unpruned trees had poor form, multiple leaders, blown tops or had toppled. Pruning details for the two lifts are shown in Table 4.

Table 4: Comparison of the Pruned Element

	Pruned Height 1st lift (m)	No. Pruned (Sph)	Pruned Height 2nd lift (m)	No. Pruned (Sph)
Seedlings	2.5	427	4.7	338
3-year Cuttings	2.4	502	5.2	450
6-year Cuttings	2.3	520	4.8	478

Mean pruned height at each pruning lift was similar for all stock types, although the 3-year-old cuttings were pruned slightly higher than the other stock types, at the 2nd pruning lift. The cuttings had a significantly higher number of trees pruned at the 1st and 2nd lifts, compared with the seedlings. Approximately 60% of the seedlings were second-lift pruned, compared with 80% of 3-year-old cuttings and 86% of the 6-year-old cuttings.

Mean basal area/ha for the pruned and unpruned elements is shown in Figure 1. The seedlings had a similar basal area (BA) compared to the 3-year-old cuttings, and both were significantly larger than the 6-year-old cuttings. Comparison of the BA for the pruned element indicated significantly greater BA for 3-year-old cuttings (11.7m^2/ha) and 6-year-old cuttings (11.0m^2/ha) compared with the seedlings (9.1m^2/ha).

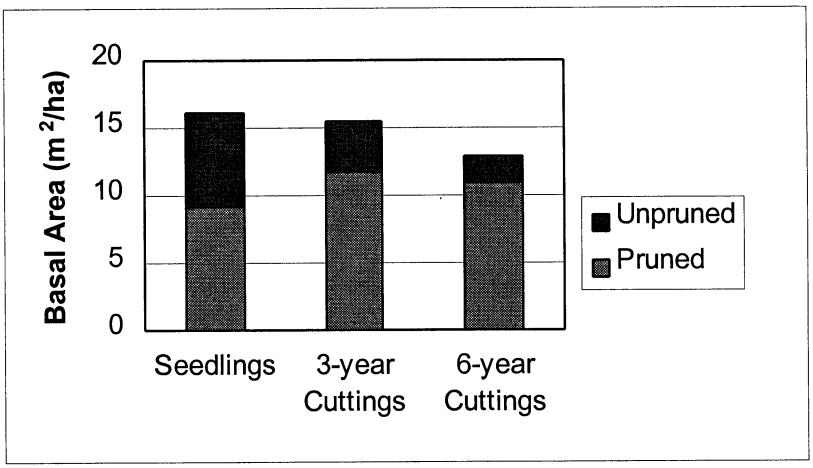

Fig. 1: Comparison of basal area/ha for pruned and unpruned trees

Branching

Pruned whorl frequency at 2nd lift pruning is shown in Table 5. The mean number of whorls / tree pruned at the 2nd lift was similar for all stock types. For both pruning lifts, the 6-year-old cuttings had significantly fewer whorls pruned compared with the other stock types. However, larger differences in pruned whorl number were evident in the 1st lift compared with the 2nd lift.

Table 5: Comparison of Pruned Whorls

	Mean No. pruned whorls/tree 2nd lift	Mean No. pruned whorls/m 2nd lift	Total whorls 1st & 2nd lifts
Seedlings	3.6	0.6	9.3b
3-year Cuttings	3.7	0.8	9.0b
6-year Cuttings	3.9	0.6	7.7a
Significance	ns	ns	**

For each variable, the values indicated with the same letter are not significantly different
** indicates significant differences at the P=0.001 level
ns indicates that differences are not significant at the P=0.05 level

A comparison of pruned branch size and branch frequency is shown in Table 6. The mean branch diameter at 2nd lift pruning was similar for seedlings and 3-year-old cuttings, although the 6-year-old cuttings had a significantly smaller branch diameter. Mean number of branches per tree was similar for all stock types. However, results indicated that 6-year-old cuttings had significantly less total diameter of branches compared with the other stock types. From these results, it is evident that differences in branch and whorl characteristics between cuttings and seedlings, that were apparent at 1st lift pruning, have diminished as pruned height increases.

Table 6: Comparison of Branch Characteristics

	2nd Lift			1st + 2nd Lifts	
	Mean branch diameter (mm)	**Mean Branch No./tree**	**Total Branch diameter/tree (cm)**	**Mean Branch No.**	**Mean branch diameter /tree (cm)**
Seedlings	31.0b	22	65 b	53c	168c
3-year Cuttings	32.0b	21	65 b	48b	144b
6-year Cuttings	27.8a	21	58a	39a	106a
Significance	**	ns	**	**	**

For each variable, the values indicated with the same letter are not significantly different
** indicates significant differences at the P=0.001 level
ns indicates that differences are not significant at the P=0.05 level

A comparison of total pruned branch basal area per ha for both the 1st and 2nd pruning lifts is shown in Figure 2. Results indicate that, up to a pruned height of five metres, the 3-year-old cuttings had approximately 20% less basal area of pruned branches, while the 6-year-old cuttings had a 40 % smaller basal area of pruned branches, compared to the seedlings.

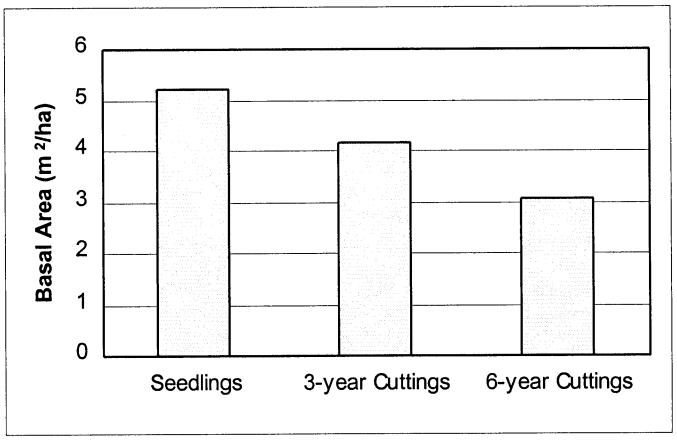

Fig. 2: Comparison of branch basal area /ha per metre pruned up to 5m.

CONCLUSIONS

- Survival, at age five years, was > 90% and similar for all stock types.
- Height growth was similar for all stock types. Diameter was similar for seedlings and 3-year-old cuttings. Although the 6-year-old cuttings showed a diameter loss compared to the other stock types, the diameter increment was similar for all stock types since 1st pruning lift.
- Seedlings had a larger DOS compared with the 3-year-old and 6-year-old cuttings in the 1st lift. However, this difference has been reduced in the second lift, so that only the DOS of the 6-year-old cuttings remains significantly smaller than that of the other stock types.

- Pruned height was similar for all stock types. Due to leader and stem defects, generally caused by early toppling, only 60% of the seedling trees planted had a 2nd lift prune, compared to over 80% of the cutting trees planted.

- The higher number of cuttings pruned compared with seedlings resulted in a 20% higher basal area per hectare for the cuttings. This would improve crop selection, at first thinning, for the cuttings compared with the seedlings.

- Mean branch diameter, pruned in the 2nd lift, was significantly smaller for 6-year-old cuttings compared to the seedlings and 3-year-old cuttings. However, branch frequency for the 2nd lift was similar for all stock types.

- Branch basal area per hectare per metre pruned was 20% less for 3-year cuttings and 40% less for 6-year-old cuttings, compared with the seedlings. However, most of the reduction in branch BA occurred in the 1st lift pruning (up to 3m) rather than the 3-5m stem section.

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