FOREST & FARM PLANTATION MANAGEMENT COOPERATIVE

AN ASSESSMENT OF STAND AND TREE QUALITY AT LOW PRUNING COMPARING AGED CUTTINGS WITH SEEDLINGS

D.G. Holden; B.K. Klomp; C.L. Sundgren

Report No. 55 **November 1998**

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EXECUTIVE SUMMARY

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A first lift pruning assessment, including height, Dbh, DOS, branch and branch whorl measurements and incidence of toppling was carried out on the Clearwood trial, near Te Puke, approximately 4 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. However, the 6-year cuttings however, had a significantly smaller Dbh compared to both the 3-year cuttings and seedlings. A comparison of basal area per hectare, for the pruned crop, indicated no significant difference between stock types as a result of the higher number of cuttings pruned, as a consequence of their good form, compared with seedlings.

Branch and branch whorl frequency and size, in the low pruning zone (0-2.5m), decreased with an increase in physiological age of the planting stock. Likewise, mean diameter over stubs (DOS) and mean diameter of all whorls was significantly reduced with an increase in physiological age.

The incidence of toppling was significantly higher among seedlings than either type of cuttings. Many of the trees left unpruned were as a result of severe (>30°) topple.

The superior quality and reduction of defect core size of the cuttings was evident compared with the seedlings.

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; Anon, 1991; Holden et al., 1995).

Whilst there is a significant improvement in the quality of the pruned butt log 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 to below framing grade, especially at stockings lower than 300 stems/ha.

To test the possible 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. Details are contained in Coop. Report No. 5.

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-olds were collected from a field trial established in 1987. Seed from the same seedlot as the 6-year cuttings was subsequently sown in the ***Forest Research*** nursery to produce the seedlings 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, flat to moderately undulating, at an altitude of 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 5 replications per tree stock type, at initial stockings of 400 stems/ha and 600 stems/ha. Each plot measures 50m x 50m including a 2-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 cuttings were established at 600 stems/ha only. The totals of 25 plots occupy an area of 6.25 hectares.

Measurements

After the low pruning operation, all plot trees were measured for height and diameter at breast height, in March 1998. In addition, two replicates of each of the three stock types in the 600 stems/ha stocking were post-prune assessed. This assessment included pruning and toppling status, pruning height, height and frequency of branch whorls, branch frequency and stem and leader malformation for each plot tree. The results of the post-prune assessment on approximately 100 trees per stock type form the basis of this report.

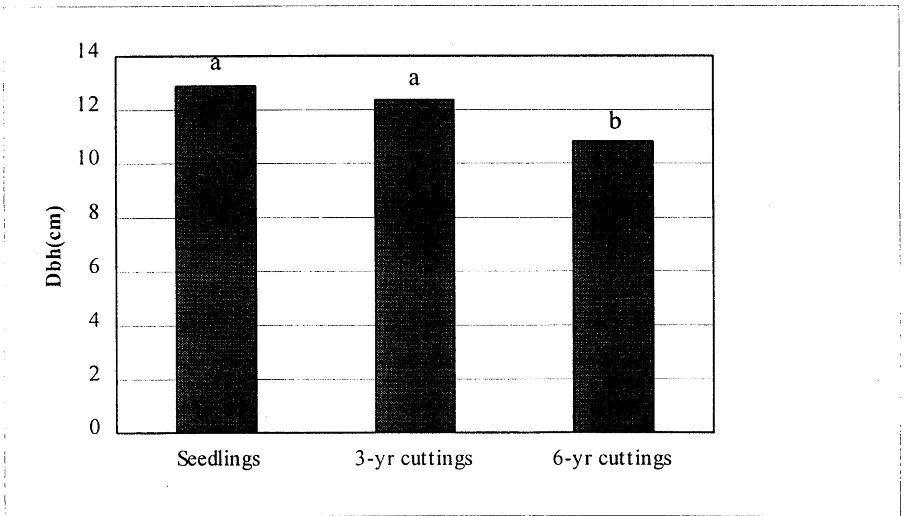
RESULTS AND DISCUSSION

Survival

Good survival was evident for all three stock types, ranging from 93-98%. Growth comparisons of the tree stock types at time of first lift pruning, approximately 3.5 years after planting, are as follows:

Mean height and diameter

Mean height for both cutting types and seedlings was 6.4 m and 6.5 m respectively, which were not significantly different (P=0.05). However, the 6-year cuttings had significantly smaller diameter compared to both seedlings and 3-year cuttings (Figure 1).



Bars indicated with the same letter are not significantly different (LSD test, P=0.05)

Figure 1: Mean diameter (Dbh) at age 3.5 years.

Pruning intensity and its effects

The pruning operation was carried out by private contractor with the understanding that all trees were to be pruned, regardless of stocking (i.e. survival). This was largely achieved, although a few of the trees were left unpruned due to multi-leadering or broken tops. However, the main reason for trees being unpruned was due to severe topple. Most toppled trees which had a lean of greater than 30 degrees from the vertical were not pruned.
Pruning details are shown in Table 2.

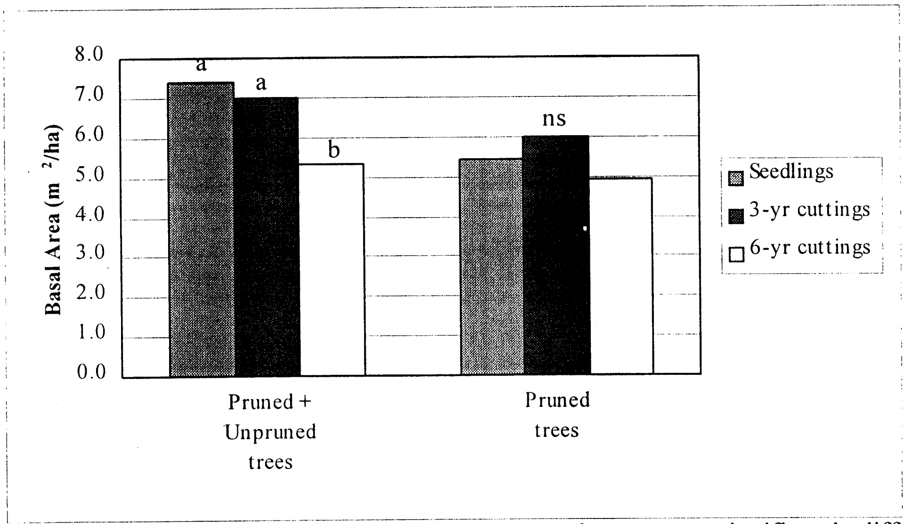
Table 2: Comparison of the pruned element

	Mean Pruned ht (m)	Green crown removed (%)	Pruned trees (%)
Seedlings	2.5	38	75 b
3-year cuttings	2.4	37	87 a
6-year cuttings	2.4	37	93 a
	n.s.	n.s	**

Values indicated with the same letter are not significantly different (LSD test, P=0.05)

The percentage of green crown removal was based on pruned stem length and not the amount of biomass removed or remaining. In reality, the remaining green crown on the older cuttings appeared less in volume, different in shape and more permeable.

A significantly higher number of 3-year and 6-year cuttings were pruned compared to the seedlings, which only had 75% of existing trees pruned (P=0.05). Subsequently, this will have a significant effect on the value of the final crop. In terms of total basal area, the seedlings and younger cuttings had 25% greater basal area/ha compared with the 6-year cuttings (Figure 2). However, a comparison of basal area for the pruned element shows that the difference between stock types was far less, and although not significant, the 3-year cuttings had the greatest basal area(6.0m^2/ha) compared with the seedlings (5.5m^2/ha) and older cuttings (5.0m^2/ha).



For each variable the values indicated with the same letter are not significantly different (LSD test, P=0.05)

Figure. 2: Comparison of basal area/ha for all trees and pruned crop.

Branching

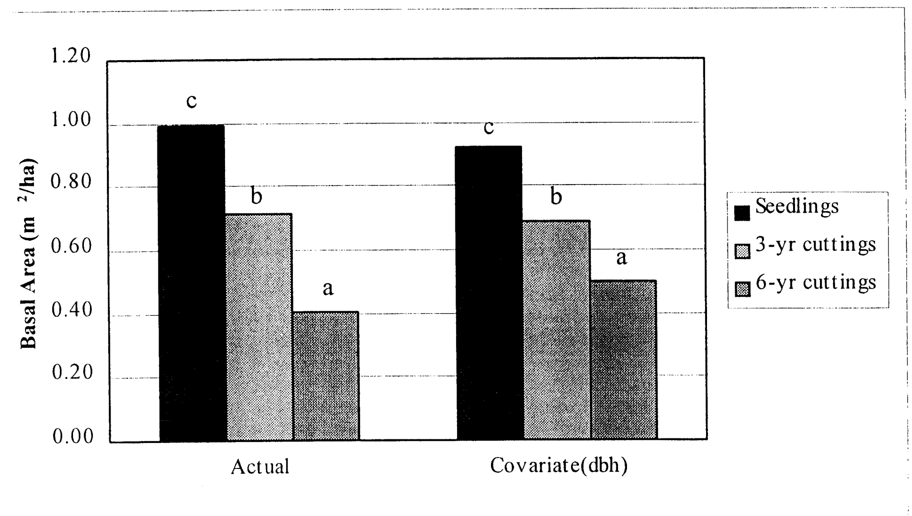
Whorl and branch frequency, and branch size within the low pruning zone is shown in Table 3.

Table 3: Comparison of whorl and branch characteristics

	Mean No. pruned whorls/tree	Mean No. pruned whorls/m	Mean No. branches/m	Mean branch BA (cm²)
Seedlings	5.7 c	2.3 b	14.6 c	7.4 b
Cuttings (3-year)	5.3 b	2.2 b	12.4 b	6.6 b
Cuttings (6-year)	3.8 a	1.6 a	8.3 a	5.3 a
Significance	**	**	**	**

For each variable the values indicated with the same letter are not significantly different (LSD test, P=0.05)

Branch and branch whorl frequency and size, in the low pruning zone, decreased with an increase in physiological age of the stock type (Table 3). The seedlings and 3-year cuttings had significantly more whorls pruned (2.2-2.3/metre) compared with the 6-year cuttings (1.6/metre) Also, the mean number of branches per metre of pruned stem was significantly higher in seedlings (~15) compared with 3-year cuttings (~12) and 6-year cuttings (~8). The mean branch size was also significantly smaller in the 6-year cuttings compared with seedlings and 3-year cuttings. From these data, the total pruned branch basal area was calculated and the results show that the 3-year cuttings have approximately 30% less basal area of pruned branches compared with the seedlings, while the 6-year cuttings have a 30 % smaller basal area of pruned branches compared to 3-year cuttings (Figure 3). Furthermore, this trend was consistent following a covariate analysis, using Dbh as the covariate. This concurs with earlier study published by Klomp & Hong, 1985. Although pruning time was not recorded, the data indicated that there would be a significant cost-saving in the pruning of both types of cuttings compared with the seedlings, at least on a 1st lift pruning operation, assuming they were scheduled for pruning at the same time.



For each series, bars are significantly different (LSD test, P=0.05)

Figure. 3: Comparison of total pruned branch basal area per hectare.

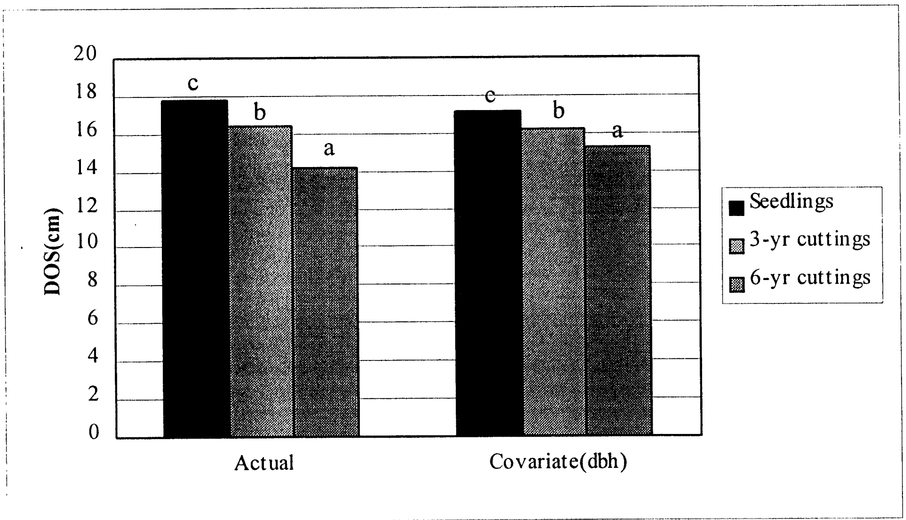
Diameter over stubs

All whorls within the pruning zone(0-2.5m) were measured for diameter. The mean diameter of all pruned whorls and a comparison of DOS is shown in Table 4 and Figure 4.

Table 4: Mean diameter of pruned whorls

	Dbh(cm)	DOS(cm)	Mean whorl diameter(cm)
Seedlings	12.9a	20.4c	17.8 c
3-year cuttings	12.4a	18.2b	16.4 b
6-year cuttings	10.8b	15.5a	14.2 a
Significance	**	**	**

For each variable, values indicated with the same letter are not significantly different (LSD test, P=0.05)



For each series, bars with different letters are significantly different (LSD test, P=0.05)

Figure 4: Comparison of mean DOS

Mean whorl diameter and DOS were significantly smaller for both cutting types compared with seedlings. A covariate analysis of DOS using Dbh as the covariate indicated that the seedling DOS was significantly greater than either the 3-year cutting or 6-year cutting DOS. Clearly, physiological age had a significant influence on decreasing DOS relative to Dbh at 1st lift pruning. However, DOS measurements will be required throughout the pruning phase to indicate whether this trend continues in subsequent pruning lifts. Similar results were reported by Klomp & Hong, 1985, and Holden, Klomp & Hong, 1993.

The incidence of tree toppling.

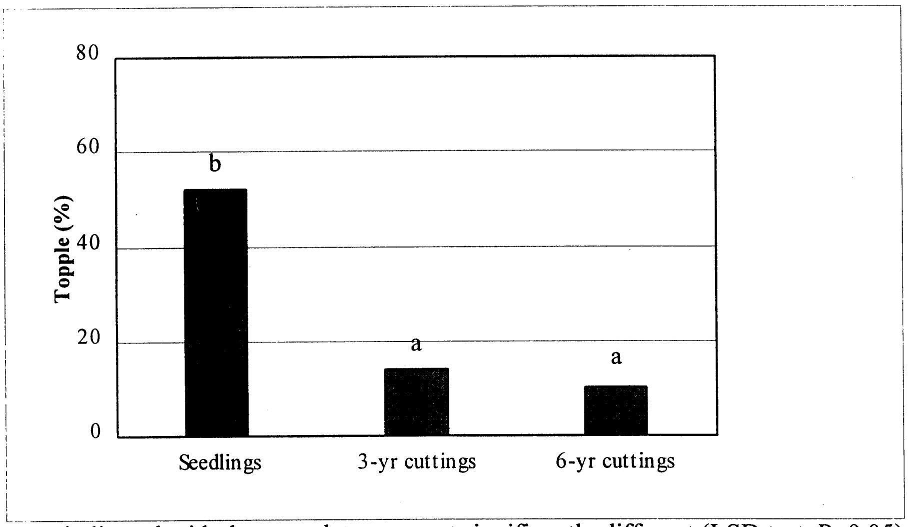
A tree was classified as having toppled if the base of the stem had a deviation from an upright position of more than 15 degrees. Much of the toppling occurred in the second and third year following planting and consequently trees that had toppled early were in the process of correction and showed varying degrees of butt sweep.

The percentage of toppled trees is shown in Table 5. Although moderately-toppled trees will generally produce an acceptable crop tree with some degree of sweep in the pruned log, those severely toppled will often suffer windthrow later or be significantly down-graded as a saw log. The overall percentage of toppled trees is shown in Figure 5.

Table 5: Percentage of moderately and severely toppled trees.

	% moderate topple(15°-22°)	% severe topple(>22°)
Seedlings	40 c	14 b
3-year cuttings	13 b	4 a
6-year cuttings	3 a	2 a
Significance	**	**

For each parameter, the values indicated with the same letter are not significantly different (LSD test, P=0.05)



Bars indicated with the same letter are not significantly different (LSD test, P=0.05)

Figure 5: Comparison of trees toppled > 15 degrees.

Although most of the topple was assessed as moderate, the seedlings (55%) had significantly more topple overall, than either the 3-year cuttings(15%) or 6-year cuttings(6%).

The superior resistance of the cuttings to toppling is obvious and will have a lasting effect on the selected, pruned crop, through to rotation end. The immediate effect has been a reduction in the potential crop within the seedlings. A more permanent effect will be the significantly higher proportion of seedlings with minor or medium sweep that will have to be included in the pruned crop. This in turn will be detrimental to log quality and value outturn at maturity.

CONCLUSIONS

The Clearwood trial has confirmed results from earlier studies on the merits of growing physiologically-aged cuttings rather than seedlings on fertile farm sites. In general, growth rate was comparable with other trials established on fertile farm sites, 3.5 years after planting. Height growth was similar for seedlings and cuttings, although diameter growth was significantly reduced for 6-year cuttings compared with the 3-year cuttings and seedlings.

Although initial survival was high (>90%) for all stock types, a significantly lower number of seedling trees were first lift pruned compared with the cuttings (Appendix I). Around 10% of the cuttings were unpruned due to leader or stem defects, while 25% of the seedlings were unpruned and most of these were unpruned due to severe toppling. A basal area comparison within the pruned crop indicated that, despite the smaller Dbh of the cuttings, there was no significant difference in basal area per hectare between seedlings and cuttings.

Branch and whorl frequency and size were reduced with an increase in physiological age of the planting stock type. The 3-year cuttings had around 20% less basal area in pruned branches, for the same pruned height, compared with seedlings, while the 6-year cuttings had an almost 50% reduction in pruned branch basal area. This trend was still significant after taking the Dbh difference between stock types into account. Furthermore, due to their lower frequency of branches and smaller branch size of the cuttings, their relative pruning cost would be cheaper than the seedlings at least on a per tree basis.

Mean whorl diameter and DOS was reduced for both cutting types compared with seedlings, and assuming that pruning is scheduled at the same time for the subsequent lifts, this will result in a significantly smaller defect core for both types of cuttings, compared with seedlings.

However, the most striking benefit of both types of cuttings was their wind firmness and subsequent improved straightness. Around 50% of the seedlings had toppled to some extent, compared with only 10 % of the cuttings and the resulting sweep of the pruned log could have a significant effect on the quality and value of the crop.

Further assessments following subsequent pruning lifts should be carried out to provide growth and quality data.

ACKNOWLEDGEMENTS

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Appendix I A comparison of the three stock types after first lift pruning.

Seedlings

3-year-cuttings

6-year-cuttings

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3-year-cuttings

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