EARLY PERFORMANCE OF FIRST GENERATION SEED ORCHARD STOCK AT OMATAROA FOREST

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ABSTRACT

Compartment 22, Omataroa Forest, consists of 14 ha of first-generation seed orchard stock and 63 ha of non-orchard stock. Both areas were planted in 1973.

Recent measurements showed that no increase in vigour was evident in seed orchard stock but a considerable reduction in leader malformation seems to have been achieved. Seed orchard stock also had more highly multinodal trees and a significant increase in the number of branches per tree. However, indicies of branch size and internode length were not different from those of non-orchard stock, and no statistically significant differerences were shown for bole straightness or for the frequency of stem cones.

A production thinning operation began in August 1983 to thin this compartment to 250 stems/ha and the volume extracted from seed orchard and non-orchard areas was compared. Seed orchard plots achieved a 16% increase in mean volume per piece extracted. This gain is probably due to reduced leader malformation in seed orchard stock, resulting in a higher conversion from standing volume to merchantable volume.

INTRODUCTION

Omataroa forest is located 7 km southwest of Whakatane on fertile yellow-brown pumice soils. In total, 6000 ha of radiata pine are established and managed as production forest by P. F. Olsen & Co. Ltd.

The first planting in Omataroa forest dates back to 1971 and the first seed orchard stock was established in 1973, with stock originating from 25 first-generation clones in Tasman's seed orchard. These clones are described by Gleed (1982) as being intensively selected by the New Zealand Forest Service in the 1950s from mainly unthinned 30- to 40-year-old stands in the

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North Island, and they are generally referred to as the "850" series. Selection aimed at achieving:

- — Superior stem straightness.
- — Small diameter branches.
- — Multinodal habit.
- — Low incidence of stem cones.
- — Superior diameter growth.

Sufficient improved stock was available to plant 14 ha of compartment 22. The remaining 63 ha of this compartment were planted in non-orchard stock the same year. This stock originated from "climbing select" seed (Matahina Forest) and both areas were planted at a stocking averaging 750 stems/ha. It is now policy to plant only seed orchard stock and this was achieved for the first time in 1983.

Stands planted up to 1974 have been managed as framing regimes with a production thinning between years 10 and 12 when topography permits. Compartment 22 was scheduled for production thinning in August 1983, thus providing an opportunity to compare seed orchard and adjacent non-orchard stands.

COMPARISON OF SEED ORCHARD AND NON-ORCHARD STOCK

The results of a similar comparison undertaken by Gleed (1982) in Tarawera forest were very encouraging. Tarawera forest is located 17 km west of Omataroa forest. Gleed compared 1972 planted Tasman seed orchard stock with non-orchard stock during an extraction thinning operation at age 9. Seed orchard stock achieved a 20% increase in piece size over non-orchard stock which he attributed to increased vigour and improved stem form. He also noted that improved stem form resulted in less wastage and lower work content to trim-up thinnings.

Assessment of seed orchard stock in compartment 22 was undertaken in 4 stages:

Stage 1: Comparison of growth and vigour.

Stage 2: Comparison of leader malformation, branching habit and bole straightness.

Stage 3: Comparison of branch index, number of branches, internode index and the number of stem cones.

Stage 4: Comparison of the volume extracted during production thinning.

These stages are discussed in detail in the following text.

COMPARISON OF GROWTH RATE AND VIGOUR

Prior to marking for production thinning, heights and diameters were measured on trees over 20 randomly placed 0.04 ha circular plots.

Measurement was undertaken on a total of 100 trees in the seed orchard area and 100 trees in the non-orchard area. Results are shown in Table 1.

TABLE 1: DIAMETER AND HEIGHT MEASUREMENTS

	Diam. at Breast Ht. (cm)		*Height (m)*	
	Mean of Plots	*Standard Deviation*	*Mean of Plots*	*Standard Deviation*
Seed orchard	28.4	2.0	19.7	1.2
Non-orchard	28.6	2.2	20.1	0.6

Differences between seed orchard and non-orchard stock are small and not statistically significant.

COMPARISON OF LEADER MALFORMATION, BRANCHING HABIT AND BOLE STRAIGHTNESS

Four 100 m long by 4 m wide transects were randomly placed over the seed orchard area and four were placed over the non-orchard area. All trees in these transects were visually rated on a one to nine scale for leader malformation, branching habit and bole straightness. This rating system is similar to that used by the Genetics and Tree Improvements Group (FRI, Rotorua).

In total, 122 trees were assessed in seed orchard stock transects and 116 trees in non-orchard transects. The results are graphed in Fig. 1.

A chi-squared contingency table was used in analysis and the results are discussed below.

Leader Malformation: Seed orchard stock had a lower incidence of double leaders, multiple tops, ramicorns and other leader defects. This improvement is significant at the 99% level.

Branching Habit: Seed orchard stock had more highly multinodal trees and fewer uninodal trees than non-orchard stock. This difference is significant at 99% level.

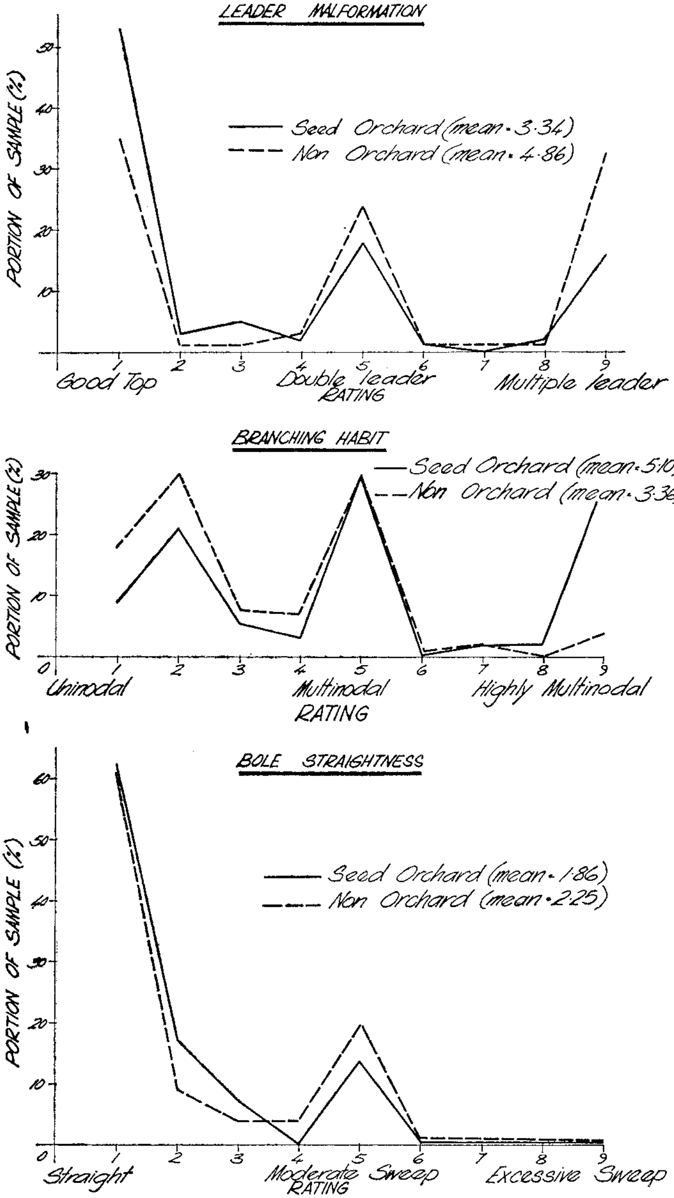

FIG. 1: *Comparison of seed orchard and non-orchard stock for ratings of stem characteristics.*

Bole Straightness: The overall incidence of stem sweep in compartment 22 is low, as indicated by the preponderance of trees scored as "straight" in Fig. 1. Seed orchard stock showed a slight improvement in bole straightness but the difference indicated was not statistically significant.

COMPARISON OF BRANCH INDEX, NUMBER OF BRANCHES, INTERNODE INDEX AND THE INCIDENCE OF STEM CONES

All data presented in this section are based on the measurement of 24 trees in the seed orchard area and 24 trees in the non-orchard area. Measurements were made only on non-malformed "crop" trees.

Branch index is defined as the mean of the diameters of the 4 largest branches, one from each quadrant, over a 5.5 m log length (Inglis and Cleland, 1982). This index measures the largest branches around a log since these are the branches having the biggest effect on sawn timber grades. Consequently branch index is directly related to unpruned log value.

In this exercise branch index was measured on first 5.5 m logs only as branches above this height were still actively growing. A stump height of 0.2 m at clearfelling was assumed. The mean branch indices derived are shown in Table 2.

TABLE 2: BRANCH INDEX MEASUREMENTS

	Branch Index (m) Mean of Plot	*Standard Deviation*
Seed orchard	5.15	1.14
Non-orchard	5.14	0.71

Only a small difference exists between plots means and this is not statistically significant.

The number of branches on the first 5.5 m log were also counted in conjunction with branch index measurements and the results are shown in Table 3.

On average, trees of seed orchard origin had a 41% increase in the number of branches occurring on the first log. This increase is significant at the 99% level.

Internode index over a log length is determined by summing all the internode lengths greater than 0.6 m (Whiteside, 1982).

TABLE 3: NUMBER OF BRANCHES

	No. of Branches	
	Mean of Plot	*Standard Deviation*
Seed orchard	58	9.05
non-orchard	41	11.02

This 0.6 m length is considered to be the minimum length of internode which can be utilised for short clear lengths. Because of the premium paid for clearcuttings grade timbers, internode index is closely related to the value of unpruned logs. In this study the lengths of internodes were measured over the first two 5.5 m logs on all 48 trees (0.2 m stump assumed). Internode index was then calculated for each log and the mean values for seed orchard and non-orchard stock are shown in Table 4.

TABLE 4: INTERNODE INDEXES

	Internode Index (m)			
	Log 1		*Log 2*	
	Mean of Plots	*Standard Deviation*	*Mean of Plots*	*Standard Deviation*
Seed orchard	1.82	0.61	2.39	1.11
Non-orchard	1.78	0.88	2.32	1.15

Although slight differences in internode index are apparent, they are not statistically significant. However, sample size is considered too small to detect small differences between seed orchard and non-orchard stock. The visual rating method discussed earlier was based on a larger sample and has indicated that seed orchard stock has significantly more multinodal trees, suggesting shorter internodes. This confirms results of a recent study in Kaingaroa State Forest where seed orchard stock showed a tendency towards more multinodal habit (M. Carson and C. S. Inglis, pers. comm.).

The incidence of stem cones was noted for the second 5.5 m log. No stem cones were evident on first logs. Table 5 shows the results.

TABLE 5: INCIDENCE OF STEM CONES

	No. of Stem Cones (mean of plots)
Seed orchard	1.79
Non-orchard	2.08

The difference between seed orchard and non-orchard stock is not statistically significant.

COMPARISON OF VOLUME EXTRACTED AT EXTRACTION THINNING

Operations began in August 1982 to production thin compartment 22 to a final crop stocking at 250 stems/ha.

In order to compare the volume extracted from seed orchard and non-orchard areas, fourteen 0.08 ha circular plots were placed over the compartment. Half of these plots were in the seed orchard area and half were in the non-orchard area. In each plot sufficient well formed final crop trees were selected to leave a stocking after thinning of 250 stems/ha. All additional stems were marked as culls to be removed at thinning. Cull trees were then felled, trimmed and extracted to the skids where they were cut to pulpwood specifications (random lengths between 9.2 m and 11.2 m, 100 mm minimum SED). Subsequently large end diameter underbark, small end diameter underbark and log length were measured so that volumes could be calculated using a three-dimensional volume function (Ellis, 1982). Plot results are summarised in Table 6.

To avoid any effect that differences in initial stocking may have had, plots in seed orchard stock were paired to plots of like stocking in non-orchard stock. Plots having equal number

TABLE 6: VOLUMES EXTRACTED

Plot No.	*No. of Culls*	*Mean Piece* (m^3)
Seed orchard:		
1	47	0.2428
2	30	0.2760
3	33	0.3191
4	42	0.3121
5	39	0.2508
6	31	0.3364
7	42	0.2848
Non-orchard:		
1	42	0.2786
2	39	0.2261
3	31	0.2503
4	46	0.2776
5	42	0.2857
6	30	0.2070
7	34	0.2441

of culls or differing by one tree were paired allowing 4 different combinations of the 14 plots. Analysis then used a paired *t*-test.

Analysis indicated that seed orchard stock had achieved a substantial increase in the volume extracted at production thinning. The average piece size increased to between 15.4 and 16.2% above non-orchard volumes depending on the combination of plot pairs. Corresponding *t* values ranged 1.8 to 2.2 while the critical value at the 95% level is 1.9.

CONCLUSIONS

The selection for a more multinodal branch habit of first-generation seed orchard parent trees has resulted in a shift to more multinodal branch habit in the seed orchard stock progeny of this study. Coupled with this has been an increase in the number of branches, but branch index does not seem to have been improved. Branch index provides a measure of the size of those branches having the biggest effect on log quality.

No apparent reduction in internode index was achieved despite the tendency to more multinodal habit but this may be attributed to a relatively small sample size. Also, no real improvements in bole straightness or reduction in stem cone frequency were realised in seed orchard stock in this study.

Although no increased vigour is evident in seed orchard stock at age 10, a 16% increase in the mean piece size extracted at production thinning has been achieved. This is probably a result of the significant reduction in leader malformation increasing the conversion from standing volume to merchantable volume.

In general, these results are very encouraging as improved stock has already demonstrated considerable gains in merchantable yield. As the crop matures further gains are expected.

In addition, progress achieved in the tree breeding programme since the introduction of first-generation improved stock suggests that even bigger gains from more recent breeds can be expected.

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