

**ESTABLISHMENT REPORT FOR THE 1994
SPECIAL-PURPOSE BREED TRIALS**

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REPORT NO. 106

September 2001

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: This is an unpublished report and must not be cited as a literature reference.

***Forest Research* / INDUSTRY RESEARCH COOPERATIVE**

EXECUTIVE SUMMARY

This report describes the basic field procedures which are being used for all special-purpose breed trials (similar to the silviculture/breed trials), and examines the actual pruning, thinning, and establishment of permanent sample plots (PSP) in the three trial sites planted in 1994.

The Stand Growth Modelling Cooperative supports a series of genetic gain trials for the purpose of quantifying genetic gain in growth for Radiata pine in New Zealand (Carson et al. 1994, 1997, 1999). This project coordinates the efforts of tree breeders and forest mensurationists, in order to ensure that the information required to meet genetic gain objectives is obtained in an efficient and productive manner (SGMC Report Nos 24, 24a, 40, 70 and 100). In 1999, there was agreement between the Stand Growth Modelling Cooperative and the Radiata Pine Breeding Cooperative (now Radiata Pine Breeding Company, RPBC) to jointly support a further series of trials to compare the performance of special-purpose breeds across regions. The trials described in this document were designed in 1991 (FR Workplan 2295) and planted in 1994 (FR Workplan 3211).

Plot establishment and silvicultural treatment has been completed according to plan in most cases. PSPs are measured annually starting from the first winter after plot establishment. Each trial, once established, is measured during the same winter month each year for 4 years following plot establishment, then every two years following. Growth data from these trials at the first winter measurement is presented in the document. There has been no statistical analysis yet, and any trends in data may not persist over time.

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INTRODUCTION

Trials were planted in 1992 (Hayes, 2001a) and 1994 to evaluate special-purpose breeds. These trials, when combined, represent four growth regions and seven different forest sites. These series of trials were designed to compare the performance of special-purpose seedlots of radiata pine, test their response to differing final crop stocking and thinning strategies, and to compare their performance across regions. The original design was similar to the silviculture/breed trials to quantify genetic gain in growth. Large plot trials were established to test seedlots of the highly multinodal, long internode, high and low wood density breeds on contrasting sites.

The Stand Growth Modelling Cooperative (SGMC) and the Radiata Pine Breeding Company (RPBC) jointly support this work which will extend knowledge gained from the genetic gain and silviculture/breed trials (Hayes, 2001b). Data collected from these and other trials in the series will give a better understanding of the growth and performance of the improved breeds so that growth models can be developed or modified to reflect growth increase due to genetic improvement.

PSP establishment, thinning and pruning of the 1994 plantings of the special-purpose breed series is fully documented in this report. The basic field procedures for pruning, thinning and establishment of PSPs in these trials are also documented.

TRIAL LOCATIONS

Trials were planted at three sites in 1994, in three growth regions (Table 1). The sites were chosen from three regions in New Zealand, Southland, Central Pumice Plateau and Northland:

- The Northland site was to be fertile, with high density and multinodal branch habit.
- The Southland site would be fertile, but prone to low density and long internodes.
- The Central site would be fertile, but intermediate for density and nodality.

TABLE 1. Trial sites planted in 1994 as part of the Special Purpose Breed trial series.

Trial No.	Forest Name	Forest Owner	Growth Region	Site Category	Current Site index
FR 215/1	Kaingaroa	Fletcher Challenge Forests	Central North Island	High SI	33.2
FR 215/2	Rakautao	Carter Holt Harvey Forests	Auckland Clays	High BA	36.1
FR 215/3	Tokoiti	City Forests	Southland	High BA	31.2

EXPERIMENTAL DESIGN

Re-design of treatments

The original experimental design (Table 2) in the 1994 trials included three treatments, 2 pruned and 1 unpruned at two initial and three final stockings, with two replications for each seedlot/silviculture treatment. In July 1999 a joint sub-committee of the SGM C and RPBC agreed upon the final trial design where by there was a consolidation of treatments to provide better on-site replication. An unthinned / unpruned treatment will be allocated to the 500sph planted plots to reflect current practices (particularly of Carter Holt Harvey Forests) and the remaining plots planted at 1000sph will all be pruned for access only and thinned to 400sph. This design (Table 3) is the same at all sites.

TABLE 2. Original core experimental design for the 1994 Special-purpose breed trials.

Trt	Pruning	Thinning at age 8			
		Initial Planting	Final Crop Stocking	Initial Spacing	Plot area (ha)
1	✓	500	200	5 x 4	0.050
2	✓	1000	400	5 x 2	0.049
3	x	1000	1000	5 x 2	0.049

The new design doubles the replications to four for each seedlot in treatment 2. Treatment 1 remains with two replications only.

TABLE 3. Revised core experimental design for the 1994 Special-purpose breed trials.

Trt	Pruning	Thinning at age 8			
		Initial Planting	Final Crop Stocking	Initial Spacing	Plot area (ha)
1	x	500	500	5 x 4	0.050
2	✓	1000	400	5 x 2	0.049

Plot establishment

Trial plantings took place in June/July 1994 and plot establishment was initially planned for a MCH of 6m. Due to lack of agreement for funding until July 1999 the plot establishment was delayed and MCH was somewhat larger in all trials at the time of plot establishment (Table 4).

TABLE 4. Planting and PSP establishment dates

Trial No.	Location	Date of PSP Establish	Age (yrs) at PSP Establish	MCH (m) After thinning	Range of MCH
FR 215/1	Kaingaroa	Nov 1999	5.6	7.8	6.1 – 9.3
FR 215/2	Rakautao	Sept 2000	6.2	11.9	10.6 – 12.9
FR 215/3	Tokoiti	Nov 2000	6.6	7.9	6.4 – 9.3

Planting stock

There are six seedlots (GF7, 14, 18, 25, 30 and GF15 (LI27)) which are planted at all sites. The special-purpose breeds seedlots were produced in the *Forest Research* nursery in 1991 by control pollination using pollen mixes. A description of the seedlots planted is given in Table 5. In the 1994 trial plantings, there are 2 buffer rows around each PSP plot in treatment 1 and one buffer row around the treatment 2 plots.

TABLE 5. Seedlots used in the 1994 special-purpose breed trials.

Stock	Seedlot Number / Breeding series #	Seedlot Rating	Breed	Description
Seedlings	88/102	GF7	Climbing select	Kaingaroa & Rotoehu climbing select
Seedlings	3/3/87	GF14	'850' orchard	OP mix of Gwavas '850' series
Seedlings	'875' x '268' mix	GF18	High density	CP mix of 6 clones
Seedlings	'875' x '268' mix	GF25	Highly multinodal	CP mix of 5 clones
Seedlings	'850' x '268' mix	GF30*	Low density	CP mix of one '268' clone x 850.55
Seedlings	'870' mix	GF15(LI27)	Uninodal	CP mix of 3 clones

* Only a small number of parents have contributed to the seedlot mix, thus less confidence should be placed on the GF rating

A full description of the parental composition of the seedlot crosses is given in Appendix 3.

BASIC FIELD PROCEDURES

This section outlines the field procedures used for pruning, PSP establishment, and thinning of the silviculture/breed trials. Departures from these procedures are detailed in the individual trial sections.

First, all numbered pegs in the trials were located (see trial maps), released and repainted where necessary. A check was also done to ensure that the plot location map is correct.

The field work then proceeded as follows.

1) Pruning and marking for thinning

- a) **Forest Research** field staff met with the pruning gang and explained the pruning specifications to be used. Trees, including those in buffer rows, were access pruned only to 2m (Table 6).
- b) Trees were marked for thinning in all treatment 2 plots. Crop tree selection criteria were based on size, form and spacing, in that order, with an emphasis of 50:40:10. Buffer rows were also thinned to the prescribed stocking.
- c) Trees marked for thinning were not pruned. All the remaining trees in treatment 2 were pruned. **Forest Research** field staff supervised the pruners. Periodic height and pruned height measurements were taken to ensure that the pruning requirements were being met.

TABLE 6. Results of the pruning operation for each site

Trial No.	Forest Name	Mean crown length (m)	Mean prune height (m)	Average DOS (cm)	Average DOS HT (m)	Max Branch diameter (cm)
FR 215/1	Kaingaroa	6.0	2.1	20.4	0.6	3.4
FR 215/2	Rakautao	9.4	2.4	26.9	1.1	4.2
FR 215/3	Tokoiti	6.0	2.1	24.4	0.6	3.9

2) PSP Establishment

The original planted plots are rectangular with pegs at each corner. The permanent sample plots are also rectangular and are located within the original plot with a buffer zone of at least one row of trees on each side of the plot, Appendix 1, shows an example of a plot with 5x4m spacing (500stems/ha). The buffer in Treatment 1 plots was increased so that the inner PSP had a smaller number of trees (25) reducing remeasurement time and costs, but not compromising the data analysis. Table 7 shows the generic plot establishment specifications for all trials.

TABLE 7. PSP establishment specifications

Trt	Plot Area	Row x tree spacing	No. trees planted	Initial no. trees buffer : plot	Final no. trees buffer : plot	Thinning ratio	Pruning	No. PSPs*
1	0.050	5 x 4	81	56 25	56 25	1 : 1	Unpruned	12
2	0.049	5 x 2	81	32 49	13 20	2.5 : 1	2m	24

* this number differs at some sites

Each plot is numbered consecutively within each trial with unique plot numbers (Appendix 2). A subplot number specifies the replication and treatment number. Seedlot number and GF rating were specified as PSP database variables 'Seedlot' and 'Improvement rating' (Dunlop, 1995). Husky Hunter 16 data loggers were used by field staff to record all measurements. Establishment followed a standard procedure (Ellis & Hayes, 1997):

- The width of the buffer zone was determined (Table 8 shows the number of buffer rows for each treatment) and pegs were placed in the four corners of the permanent sample plot (Appendix 1).
- The north-west corner peg was labelled with the plot identification and seedlot GF rating.
- The diameter of all trees within the plot was measured and recorded before thinning. A diameter band was painted with spray paint at the appropriate level. A numbered aluminium (or plastic) tag was stapled above the diameter band onto all crop trees (i.e. those not marked for thinning). Trees were numbered consecutively from the north-west corner, up and down the planted rows. Dead trees and those to be felled were included in the numbering but did not get tagged.
- The total number of tagged trees was counted to make sure that the correct stocking would remain after thinning. If necessary, extra trees were pruned (in treatment 2) and/or marked for culling to correct the number of final crop trees. The trees, which were recorded as being alive on the Husky Hunter 16, were also counted to make sure they corresponded with the required number of live trees remaining after thinning.
- Twelve height trees were selected from the crop element. Four of these were the tallest trees within each 0.01 ha quadrant (used to calculate predominant mean height, PMH). The predominant height trees were found by dividing the plot into quadrants with an 11.3m radius and measuring the tallest tree within each quadrant (Appendix 1). The remaining eight trees were selected to cover the range of diameters present in the plot and were referred to as sample height trees. Trees with dead or broken tops or unusually large diameters were not included as sample height trees. Each height tree, whether predominant or sample, was measured for total height, pruned height, DOS, DOS height and maximum branch diameter (pruning measurements taken only if applicable). These measurements were recorded along with the tree diameter.

3) Thinning

Thinning was carried out by forestry contractors.

- a) All unpruned trees and/or trees marked for culling were felled (no thinning in treatment 1 plots).
- b) Buffer trees were felled into the plots wherever possible to ensure subsequent easy location of boundaries and access to plots.
- c) All naturally regenerated stems in all plots were also felled.

TABLE 8. Width of buffer zone for PSPs

Trt	Planted plot area	PSP plot area	No. rows planted	No. rows in PSP	No. rows in buffer
1	0.162	0.050	9 x 9	5 x 5	2 x 2
2	0.081	0.049	9 x 9	7 x 7	1 x 1

INDIVIDUAL TRIAL DESIGNS AND PSP ESTABLISHMENT REPORTS

FR 215/1, KAINGAROA FOREST, Central North Island

This trial was planted in June 1994 with a randomised complete block design containing 24 rectangular 45 x 18m plots and 12 rectangular 45 x 36m plots (a total of 36 plots). The trial occupies 3.88 hectares.

Pruning, PSP establishment and thinning was carried out (as per the basic field procedures) during November 1999 (age 5.6 years). A total of 36 plots were established. The trial MCH at plot establishment, after thinning, was 7.8m with a range of 6.1m – 9.3m.

Trial Design

This trial was re-designed before plot establishment (see section on 'experimental design' page 2). It now consists of two silvicultural treatments, six different seedlots (all seedlings), with two replications for treatment 1 and four replications for treatment 2 (Table 9).

TABLE 9. Trial design for FR 215/1 Kaingaroa Forest

Silviculture					Planting stock					
Trt	Pruning	Stocking (stems/ha)		Thinning	Seedlings					
	Access only	Initial	Final	Ratio	GF7 (88/102)	GF14 (3/3/87)	GF18 (875'/268')	GF25 (875'/268')	GF30* (850'x'268')	GF15 (LI27) (870' mix)
1	Unpruned	500	500	1:1	••	••	••	••	••	••
2	2m	1000	400	2.5:1	••••	••••	••••	••••	••••	••••

Each • represents one PSP with a buffer which receives the same treatment as the inner PSP.

* only a small number of parents have contributed, thus less confidence should be placed on the GF rating

Pruning

Pruning of the 24 plots was carried out by Fletcher Challenge Forests contractors (a total of 8 mandays help). Selection for thinning was carried out by **Forest Research** staff at the same time, and only selected crop trees (including the buffer) were pruned. The average crown remaining of the pruned plots was 6.0 m (mean pruned height was 2.1m). Pruned heights and DOS measurements (DOS, DOS height and maximum branch diameter) of the selected height trees were measured at the time of plot establishment.

PSP Establishment

Thirty-six permanent sample plots were established by six **Forest Research** field crew beginning on 8 November 1999 (19 mandays). Table 7 shows the plot establishment requirements for each of the treatments (nos. 1 & 2). Trees in this trial were not planted very straight across the rows, so there were initial problems working out which trees were the plot trees. All trees are now identified correctly.

Measurements were taken and recorded as described in the section on 'Basic field procedures'.

Thinning

Fletcher Challenge Forest contractors carried out thinning on 22 November 1999, two weeks after plot establishment (a total of 2 mandays). Twenty-four of the 36 plots were thinned, as scheduled, from 1000 to 400sph. The thinned plots were regen treated (all regenerated trees were thinned out) at the same time as the prescribed thinning. The regen trees in the unthinned plots were not removed until April 2001.

Trial Layout and Site Information

All of the thirty-six plots in the new trial design were established as PSPs at this site (see map, Figure 1). The original planting peg numbers are shown at the plot corners. A full description of each treatment and seedlot is given in Tables 3, 5 & 7 and Appendix 3.

It was noted in 1994, that some damage had been sustained in the trial, possible because of unseasonal frosts. Most plots suffered some mortality, although all the thinned plots are at the prescribed stocking of 400sph. Seven of the twelve unthinned plots have suffered more than 25% mortality. The trees that remain in the trial are of reasonable size, form and health.

Although there were no regeneration problems anticipated at the time of planting, the trial did require treatment by age 5 at the time of plot establishment. The thinned plots were treated at the time of plot establishment in 1999, the unthinned plots were treated after plot measurement in 2001.

The following site information was recorded at the time of planting:

Altitude:	400m
Soil Type:	Scoria (Tarawera Ash)
Site Preparation:	Cutover, no preparation
Weeds:	Nil
Regeneration:	None
Slope:	0 - 6°
Aspect:	Various (generally south or north-west)
Previous land use:	Radiata pine plantation
Site:	Volcanic, high site index

The trial has easy access, but there are some broadleaf shrubs that may hinder measurements in the future.

Plot Data

GTI form assessments were carried out on all plots at the time of plot establishment; 25 trees in the treatment 1 plots and 49 trees in treatment 2. A full Cooperative report will be completed.

A summary (Table 10a) at the time of the first winter measurement in April 2000 (age 6.0 years), shows data (mean diameter, mean height, basal area, volume and prune height/crown height) sorted by treatment and seedlot. Note, prune data was recorded at the time of plot establishment at age 5.6 years. Means by replication are shown in Table 10b. No statistical analysis has yet been carried out and any trends in data may not persist over time.

The average DOS at this site is 20.4cm and the average maximum branch diameter is 3.4cm.

The following trends were noted:

- The average maximum branch diameter is largest in the long internode seedlot (3.6cm) and smallest in the GF18 seedlot (3.0cm).
- In the unpruned plots crown height has not risen significantly; mean crown height at age 7 is still 0.7m.
- The GF30 seedlot is performing the best for both diameter and height growth on average, in both the thinned and unthinned treatments. Growth is inconsistent within plot replication though.
- The GF25 seedlot is performing the worst for diameter growth on average in the thinned treatment.
- One plot in GF14 seedlot is performing very well in the thinned treatment, which has lifted the average diameter growth.
- In contrast, the one GF14 plot in the unthinned treatment is performing the worst on the site – mortality may be contributing factor.

- FIGURE 1. Map showing plot locations, FR 215/1

FR 215/1

Kaingaroa Forest

Compartment 1284

Planted 1994

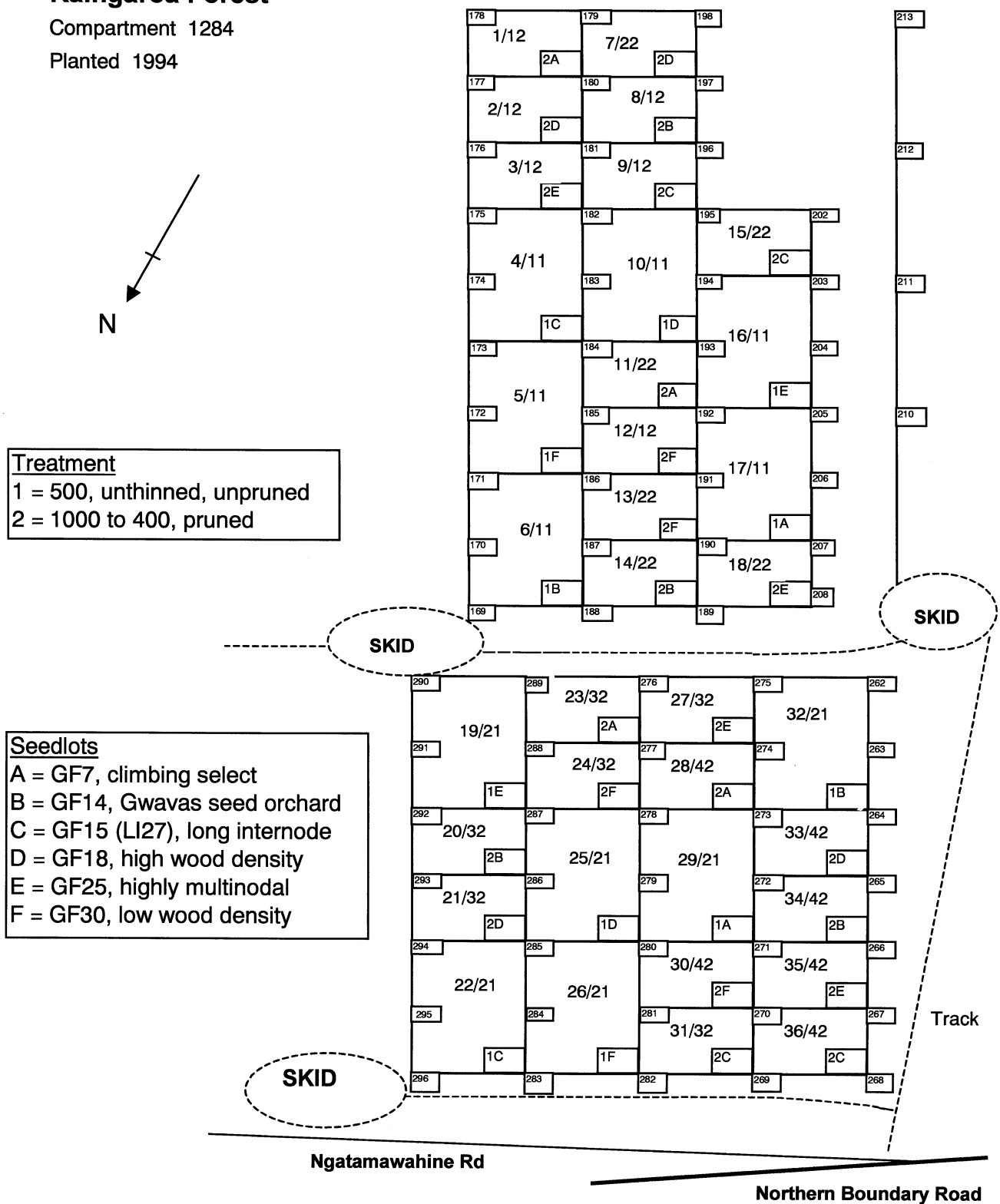


TABLE 10a. FR 215/1: Trial data at the first winter remeasurement (6.0 years)

Trt	Seedlot	GF rating	SPH estab	SPH live	Mn DBH	Mn HT	Basal Area	Volume	Mn CRHT	Mn PRHT	DOS	DOS HT	Max Branch
1	88/102	7	500	500	16.0	8.7	10.1	35.1	0.2				
1	88/102	7	500	460	14.6	7.6	7.7	24.7	0.4				
1	3/03/87	14	500	440	15.7	8.7	8.5	30.0	0.2				
1	3/03/87	14	500	320	14.0	7.3	4.9	15.8	0.2				
1	'870'mix(LI)	15	500	360	16.5	8.9	7.7	27.0	0.2				
1	'870'mix(LI)	15	500	340	15.8	8.0	6.6	22.1	0.5				
1	'268'/875' mix	18	500	300	17.4	8.7	7.1	24.4	0.2				
1	'268'/875' mix	18	500	420	15.4	8.1	7.9	26.5	0.6				
1	'268'/875' mix	25	500	340	17.0	8.3	7.7	25.4	0.2				
1	'268'/875' mix	25	500	360	16.7	8.7	7.9	27.2	0.2				
1	'850'x'268'	30	500	480	18.8	9.6	13.3	48.8	0.2				
1	'850'x'268'	30	500	360	15.1	8.3	6.5	22.2	0.3				
2	88/102	7	1000	408	15.4	9.4	7.6	29.1	2.3	2.1	19.4	0.6	3.3
2	88/102	7	1000	408	17.1	9.7	9.4	35.9	2.3	2.2	21.6	0.5	3.4
2	88/102	7	1000	408	15.5	8.5	7.7	26.7	2.0	2.1	19.3	0.6	3.7
2	88/102	7	1000	408	15.0	8.4	7.2	25.2	2.0	2.0	19.1	0.8	3.3
2	3/03/87	14	1000	408	18.3	9.8	10.7	40.3	2.3	2.2	22.7	0.6	3.4
2	3/03/87	14	1000	388	16.9	9.0	8.7	30.9	2.3	2.3	21.3	0.4	3.7
2	3/03/87	14	1000	408	16.0	9.0	8.2	30.1	1.9	1.9	20.5	0.6	3.3
2	3/03/87	14	1000	408	15.6	8.6	7.8	27.9	2.1	2.0	18.9	0.5	2.9
2	'870'mix(LI)	15	1000	408	16.8	9.8	9.1	35.2	2.0	2.0	22.2	0.6	4.3
2	'870'mix(LI)	15	1000	408	16.0	9.0	8.2	29.5	2.2	2.1	21.2	0.5	4.1
2	'870'mix(LI)	15	1000	408	16.7	9.1	9.0	32.9	2.1	2.0	19.8	0.7	3.3
2	'870'mix(LI)	15	1000	408	15.8	9.1	8.1	29.8	2.2	2.1	18.5	0.5	2.7
2	'268'/875' mix	18	1000	388	16.6	10.0	8.4	33.8	2.1	2.1	20.3	0.6	2.7
2	'268'/875' mix	18	1000	408	16.6	10.2	8.9	36.5	2.1	2.0	20.4	0.4	3.2
2	'268'/875' mix	18	1000	408	16.6	8.9	8.9	31.8	1.9	1.9	19.2	0.8	2.8
2	'268'/875' mix	18	1000	408	15.9	9.0	8.1	29.7	1.9	2.0	20.2	0.5	3.3
2	'268'/875' mix	25	1000	408	16.4	9.3	8.7	32.1	2.1	2.1	21.7	0.5	3.8
2	'268'/875' mix	25	1000	408	15.7	8.2	7.9	26.4	2.4	2.4	19.9	0.5	3.1
2	'268'/875' mix	25	1000	388	14.9	7.7	6.8	22.1	1.9	1.9	19.8	0.6	3.7
2	'268'/875' mix	25	1000	408	16.0	8.4	8.2	28.6	2.1	2.0	19.3	0.4	2.7
2	'850'x'268'	30	1000	408	19.0	10.5	11.6	46.7	2.2	2.2	23.0	0.4	3.2
2	'850'x'268'	30	1000	408	18.5	10.3	11.0	43.6	2.4	2.3	22.7	0.5	4.1
2	'850'x'268'	30	1000	408	16.5	9.3	8.7	32.5	2.0	2.1	19.8	0.5	3.1
2	'850'x'268'	30	1000	408	15.5	8.8	7.7	27.9	2.2	2.1	18.8	0.7	3.5

TABLE 10b. FR 215/1: Trial data averaged by treatment and seedlot replication (age 6.0 years)

Trt	Seedlot	GF rating	No. of Reps	Mn DBH	Mn HT	Basal Area	Volume	MnCRHT	Mn PRHT	DOS	DOS HT	Max Branch
1	88/102	7	2	15.3	8.2	8.9	29.9	0.3				
1	3/03/87	14	2	14.9	8.0	6.7	22.9	0.2				
1	'870'mix(LI)	15	2	16.2	8.5	7.2	24.6	0.4				
1	'268'/'875' mix	18	2	16.4	8.4	7.5	25.5	0.4				
1	'268'/'875' mix	25	2	16.5	8.5	7.8	26.3	0.2				
1	'850'x'268'	30	2	17.0	9.0	9.9	35.5	0.3				
2	88/102	7	4	15.8	9.0	8.0	29.2	2.2	2.1	19.9	0.6	3.4
2	3/03/87	14	4	16.7	9.1	8.9	32.3	2.2	2.1	20.9	0.5	3.3
2	'870'mix(LI)	15	4	16.3	9.3	8.6	31.9	2.1	2.1	20.4	0.6	3.6
2	'268'/'875' mix	18	4	16.4	9.5	8.6	33.0	2.0	2.0	20.0	0.6	3.0
2	'268'/'875' mix	25	4	15.8	8.4	7.9	27.3	2.1	2.1	20.2	0.5	3.3
2	'850'x'268'	30	4	17.4	9.7	9.8	37.7	2.2	2.2	21.1	0.5	3.5

FR 215/2, RAKAUTAO FOREST, Auckland Clays

This trial was planted in July 1994 with 22 rectangular 45 x 18m plots and 11 rectangular 45 x 36m plots (a total of 33 plots). The total trial area occupies 3.88 hectares.

Pruning, PSP establishment and thinning was carried out (as per the basic field procedures) during September 2000 (age 6.2 years). A total of 31 plots were established - 2 plots were not established due to high mortality and too few crop trees available. The trial MCH after thinning, at the time of plot establishment, was 11.9m with a range of 10.6m to 12.9m.

Trial Design

This trial was re-designed before plot establishment (see section on 'experimental design'). It now consists of two silvicultural treatments and six different seedlots (all seedlings), with two replications for treatment 1 and four replications for treatment 2 (Table 11).

TABLE 11. Trial design for FR 215/2, Rakautao Forest

Trt	Silviculture				Planting stock					
	Pruning	Stocking (stems/ha)		Thinning	Seedlings					
	Access only	Initial	Final	Ratio	GF7 (88/102)	GF14 (3/3/87)	GF18 (875'/268')	GF25 (875'/268')	GF30* (850'x'268')	GF15 (LI27) (870' mix)
1	Unpruned	500	500	1:1	•	•▲	••	••	••	••
2	2m	1000	400	2.5:1	•▲	••••	••••	••••	••••	••••

Each • represents one PSP with a buffer which receives the same treatment as the inner PSP.

▲ Plots not established due to malformation, Dothistroma and high mortality

* only a small number of parents have contributed, thus less confidence should be placed on the GF rating

Pruning

Carter Holt Harvey Forest contractors carried out pruning of the 10 plots (a total of 8 mandays help). Selection for thinning was carried out by **Forest Research** staff at the same time, and only selected crop trees were pruned. The average crown remaining of the pruned plots was 9.4m (mean pruned height was 2.4m). Pruned heights and DOS measurements (DOS, DOS height and maximum branch diameter) of the selected height trees were measured at the time of plot establishment.

PSP Establishment

Thirty-one of the thirty-three planted plots were established as PSPs by four **Forest Research** field crew beginning on 25 September 2000. Plot establishment was carried out over 4 days (18 mandays). Table 7 shows the plot establishment requirements for each of the treatments (nos. 1 & 2).

Measurements were taken and recorded as described in the section on 'Basic field procedures'.

Thinning

Thinning was carried out, two weeks after plot establishment, by Fletcher Challenge Forest contractors on 29 September 2000 (2 mandays). Twenty-one of the twenty-two plots scheduled for thinning were thinned from 1000 to 400sph. One of the thinned plots was not established due to excessive malformation and severe dothistroma.

Most thinned plots had a significant number of dead trees, but the prescribed stocking was achieved in all plots, although much fewer trees were actually felled.

Trial Layout and Site Information

Thirty-one of the thirty-three plots in the new plot design were established as PSPs at this site (see map, Figure 2). The original planting peg numbers are shown at the plot corners. A full description of each treatment and seedlot is given in Tables 3, 5 & 7 and Appendix 3.

The following information was recorded at the time of planting:

Altitude:	200m
Soil Type:	Clay
Site Preparation:	Ripping
Weeds:	Grass
Regeneration:	None
Slope:	10-20°
Aspect:	Various (generally between south and west)
Previous land use:	Pasture
Site:	High fertility, ex pasture site

Some mortality had been suffered in the trial, although all the thinned plots are at the prescribed stocking of 400sph. Two plots were abandoned before plot establishment. Plot 32/12 (GF7) was abandoned due to excessive malformation and severe dothistroma (50% of the trees had 95% needle drop). Plot 18/11 (GF14)

was abandoned due to severe mortality (40% of trees in one area of the plot). Two of the ten unthinned plots have suffered more than 25% mortality, but were still established as PSPs.

There was a lot of butt swept trees recorded at the time of plot establishment in this trial; this may be due to the pre-plant rip and bed treatment, wind damage and/or bad planting. Dothistroma was also prevalent at this site at the time of plot establishment. By the time of the first winter remeasurement (age 7 years), the health and form of the trees in the trial had improved significantly.

This trial has not had a problem with regeneration, there is good access and it is grassy underfoot.

Plot data

GTI form assessments were carried out on all plots at the time of plot establishment in 2000; 25 trees in the treatment 1 plots and 49 trees in treatment 2. A full Cooperative report will be completed.

A summary (Table 12a) at the time of the first winter measurement in July 2001 (age 7.0 years) shows data (mean diameter, mean height, basal area, volume and prune height/crown height) sorted by treatment and seedlot. Note, prune data was recorded at the time of plot establishment at age 6.2 years. Means by replication are shown in Table 12b. No statistical analysis has yet been carried out and any trends in data may not persist over time.

The average DOS at this site is 26.9cm and the average maximum branch diameter is 4.2cm.

The following trends were noted:

- The average maximum branch diameter is largest in the long internode seedlot (5.3cm) and smallest in the GF25 seedlot (3.6cm).
- In the unpruned plots, crown height has risen significantly; mean crown height at age 7 is 2.4m.
- The mean crown ht of the pruned plots has also risen to 3.6m (following pruning to 2.4m) by age 7.
- The GF30 seedlot is performing the best for both diameter and height growth on average, in both the thinned and unthinned treatments.
- Diameter growth of the GF30 seedlot is inconsistent within plot replication, but overall is significantly larger than all other average diameters.
- The GF18 seedlot thinned plots are the tallest on average and are very consistent within plot replication.

FIGURE 2. Map showing plot locations, FR 215/2

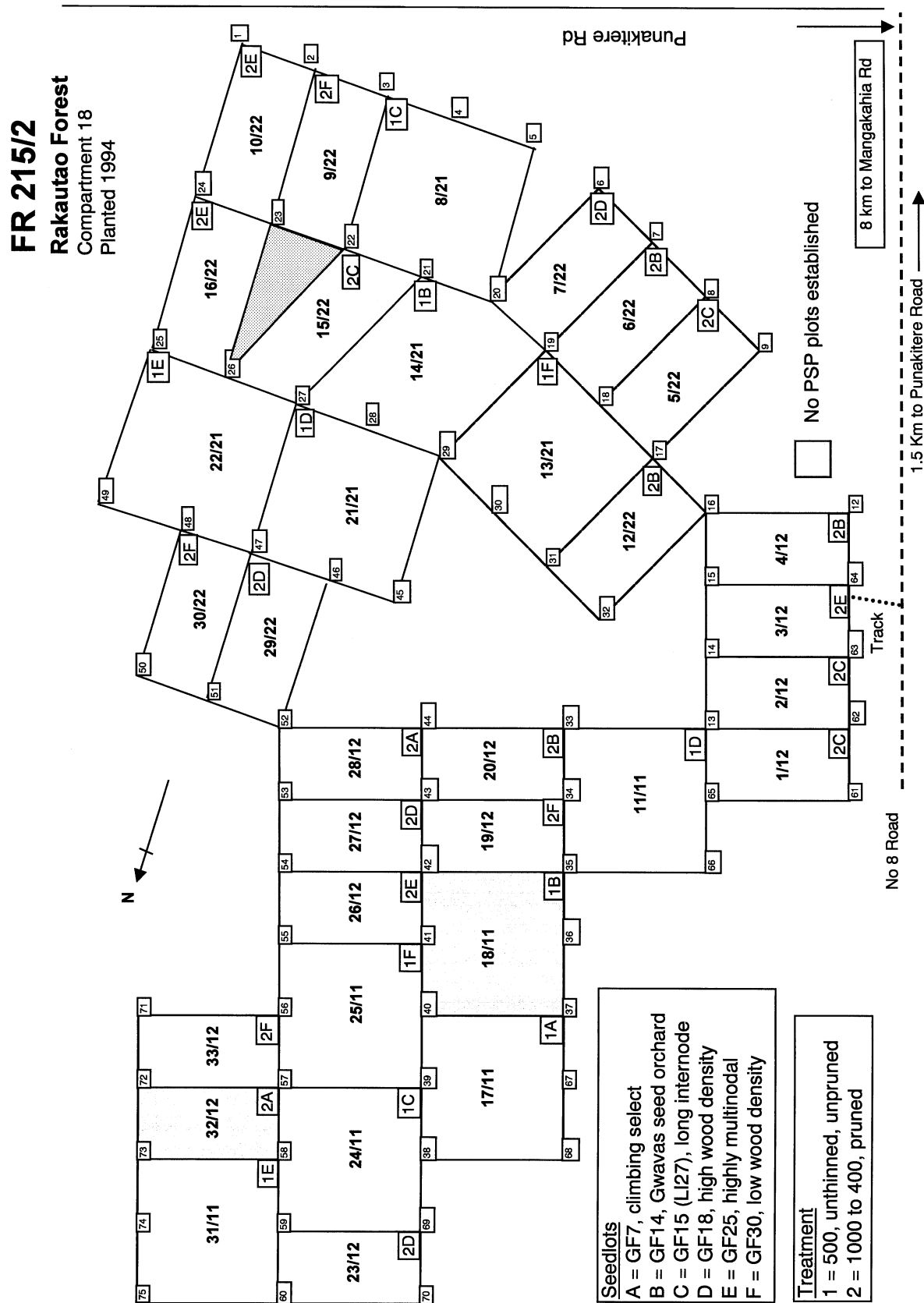


TABLE 12a. FR 215/2: Trial data at the first winter remeasurement (age 7.1 years)

Trt	Seedlot	GF rating	SPH estab	SPH live	Mn DBH	Mn HT	Basal Area	Volume	Mn CRHT	Mn PRHT	DOS	DOS HT	Max Branch
1	88/102	7	500	340	25.7	12.7	17.6	84.1	2.6				
1	3/03/87	14	500	440	24.1	12.4	20.1	92.2	2.3				
1	'870'mix(LI)	15	500	440	24.6	12.3	20.8	94.2	1.8				
1	'870'mix(LI)	15	500	380	26.0	12.2	20.2	92.5	2.0				
1	'268/'875' mix	18	500	460	25.9	13.0	24.3	111.6	2.1				
1	'268/'875' mix	18	500	460	24.3	12.5	21.3	99.9	2.0				
1	'268/'875' mix	25	500	480	25.5	13.1	24.5	117.7	2.9				
1	'268/'875' mix	25	500	480	24.8	12.0	23.2	103.5	2.7				
1	'850'x'268'	30	500	500	27.0	13.6	28.6	141.9	2.7				
1	'850'x'268'	30	500	440	27.5	12.9	26.2	122.9	2.3				
2	88/102	7	1000	388	23.3	13.4	16.5	83.7	3.4	2.3	28.4	0.9	4.6
2	3/03/87	14	1000	408	22.7	14.0	16.5	87.6	3.5	2.5	25.7	1.2	4.0
2	3/03/87	14	1000	408	22.7	13.9	16.6	86.7	2.9	2.3	26.3	1.1	3.8
2	3/03/87	14	1000	408	22.9	13.8	16.8	88.3	3.1	2.3	25.5	1.1	3.8
2	3/03/87	14	1000	408	23.2	13.9	17.3	90.5	4.9	2.4	27.7	1.2	5.0
2	'870'mix(LI)	15	1000	408	23.9	13.6	18.3	92.9	3.1	2.5	29.2	1.0	5.4
2	'870'mix(LI)	15	1000	388	21.9	13.0	14.6	72.0	3.8	3.0	27.5	1.2	5.9
2	'870'mix(LI)	15	1000	408	23.2	12.8	17.3	83.6	3.1	2.8	28.3	1.0	5.0
2	'870'mix(LI)	15	1000	408	22.4	14.1	16.2	88.3	3.6	2.7	27.7	1.0	4.7
2	'268/'875' mix	18	1000	408	23.4	14.5	17.6	96.1	3.4	2.5	26.9	1.1	3.8
2	'268/'875' mix	18	1000	408	22.9	14.1	16.9	90.3	3.8	2.4	26.1	1.1	4.1
2	'268/'875' mix	18	1000	408	23.5	14.3	17.7	94.9	4.0	2.4	27.4	0.9	3.9
2	'268/'875' mix	18	1000	408	22.3	14.4	16.0	87.6	3.7	2.3	25.1	1.0	3.3
2	'268/'875' mix	25	1000	408	24.7	14.5	19.5	105.0	4.1	2.3	27.4	1.1	4.1
2	'268/'875' mix	25	1000	408	21.8	13.6	15.3	79.3	2.9	2.3	25.0	1.3	3.4
2	'268/'875' mix	25	1000	408	23.2	13.7	17.2	88.1	3.4	2.2	25.1	1.2	3.2
2	'268/'875' mix	25	1000	408	25.0	13.9	20.0	102.2	3.8	2.4	28.0	1.1	3.7
2	'850'x'268'	30	1000	408	24.9	14.3	20.0	105.5	4.0	2.4	26.9	1.2	3.8
2	'850'x'268'	30	1000	408	26.8	14.5	23.0	122.8	4.1	2.5	28.0	1.3	4.7
2	'850'x'268'	30	1000	408	23.5	14.0	17.7	93.2	3.4	2.4	24.4	1.1	3.8
2	'850'x'268'	30	1000	408	25.8	13.4	21.3	105.9	2.9	2.3	28.3	1.0	4.5

TABLE 12b. FR 215/2: Trial data averaged by treatment and seedlot replication (age 7.1 years)

Trt	Seedlot	GF rating	No. of Reps	Mn DBH	Mn HT	Basal Area	Volume	Mn CRHT	Mn PRHT	DOS	DOS HT	Max Branch
1	88/102	7	1	25.7	12.7	17.6	84.1	2.6				
1	3/03/87	14	1	24.1	12.4	20.1	92.2	2.3				
1	'870'mix(LI)	15	2	25.3	12.3	20.5	93.4	1.9				
1	'268'/875' mix	18	2	25.1	12.8	22.8	105.8	2.1				
1	'268'/875' mix	25	2	25.2	12.6	23.9	110.6	2.8				
1	'850'x'268'	30	2	27.3	13.3	27.4	132.4	2.5				
2	88/102	7	1	23.3	13.4	16.5	83.7	3.4	2.3	28.4	0.9	4.6
2	3/03/87	14	4	22.9	13.9	16.8	88.3	3.6	2.4	26.3	1.2	4.2
2	'870'mix(LI)	15	4	22.9	13.4	16.6	84.2	3.4	2.8	28.2	1.1	5.3
2	'268'/875' mix	18	4	23.0	14.3	17.0	92.2	3.7	2.4	26.4	1.0	3.8
2	'268'/875' mix	25	4	23.7	13.9	18.0	93.7	3.6	2.3	26.4	1.2	3.6
2	'850'x'268'	30	4	25.3	14.1	20.5	106.9	3.6	2.4	26.9	1.2	4.2

FR 215/3, TOKOITI FOREST, Southland

This trial was planted in June 1994 with 22 rectangular 45 x 18m plots and 11 rectangular 45 x 36m plots (a total of 33 plots). The total trial area occupies 3.88 hectares.

Pruning, PSP establishment and thinning was carried out (as per the basic field procedures) during November 2000 (age 6.6 years). A total of 33 plots were established. The trial MCH at the time of plot establishment after thinning was 7.9m with a range of 6.4m to 9.3m.

Trial Design

This trial was re-designed before plot establishment (see section on 'experimental design'). It now consists two silvicultural treatments and six different seedlots (all seedlings), with two replications for treatment 1 and four replications for treatment 2 (Table 13).

TABLE 13. Trial design for FR 215/3, Tokoiti Forest

Trt	Silviculture				Planting stock					
	Pruning	Stocking (stems/ha)		Thinning	Seedlings					
	Access only	Initial	Final	Ratio	GF7 (88/102)	GF14 (3/3/87)	GF18 (875'/268')	GF25 (875'/268')	GF30* (850'x'268')	GF15 (LI27) (870' mix)
1	Unpruned	500	500	1:1	•	••	••	••	••	••
2	2m	1000	400	2.5:1	••	••••	••••	••••	••••	••••

Each • represents one PSP with a buffer which receives the same treatment as the inner PSP.

* only a small number of parents have contributed, thus less confidence should be placed on the GF rating

Pruning

Pruning of 22 plots was carried out by City Forests contractors (a total of 8 mandays help). The average crown length remaining after pruning was 6.0m (mean pruned height 2.1m). Selection for thinning was carried out by **Forest Research** staff at the same time, and only selected crop trees were pruned. Pruning measurements (prune height, DOS, DOS height and maximum branch diameter) were recorded at the time of plot establishment.

PSP Establishment

Thirty-three permanent sample plots were established by four **Forest Research** staff, between 6-10 November 2000 (28 mandays). Table 7 shows the plot establishment requirements for each of the assigned treatments (nos. 1 & 2).

Measurements were taken and recorded as described in the section on 'Basic field procedures'.

Thinning

Thinning was carried out by City Forests contractors following plot establishment (2 mandays). Twenty-two of the 33 plots were thinned, as scheduled, from 1000 to 400sph.

Trial Layout and Site Information

All thirty-three plots in the new plot design were established as PSPs at this site (see map, Figure 3). The original planting peg numbers are shown at the plot corners. A full description of each treatment and seedlot is given in Tables 3, 5 & 7 and Appendix 3.

The following information was recorded at the time of planting:

Altitude:	65m
Soil Type:	unknown
Site Preparation:	Ripping
Weeds:	Thistles (minor)
Regeneration:	None
Slope:	3-15°
Aspect:	North-west or North
Previous land use:	Pasture
Site:	High fertility, ex pasture site

This compartment had been grazed before the plot establishment, consequently many of the plot pegs were knocked over and buried in the long grass. This did not affect plot establishment at all.

All plots suffered some mortality, although all the thinned plots are at the prescribed stocking of 400sph. Only one of the eleven unthinned plots suffered more than 25% mortality. There is a lot of butt sweep and toppling in the trial though. A problem with snow at the time of planting could be the cause of the butt sweep. The toppling mainly occurs in the plots on the exposed ridges with low planting stockings (planted 500sph).

The trees that remain in the trial are in excellent health and have good vigour.

Plot data

GTI form assessments were carried out on all plots at the time of plot establishment; 25 trees in the treatment 1 plots and 49 trees in treatment 2. A full Cooperative report will be completed.

A summary (Table 14a) at the time of the latest winter measurement in June 2001 (age 7 years) shows data (mean diameter, mean height, basal area, volume and prune height/crown height) sorted by treatment and seedlot. Note, prune data was recorded at the time of plot establishment at age 6.6 years. Means by replication are shown in Table 14b. No statistical analysis has yet been carried out and any trends in data may not persist over time.

The average DOS at this site is 24.4cm and the average maximum branch diameter is 3.9cm.

The following trends were noted:

- The average maximum branch diameter is largest in the long internode seedlot (4.6cm) and smallest in the GF7 seedlot (3.5cm).
- In the unpruned plots crown height has not risen significantly; mean crown height at age 7 is still 0.3m.
- The GF30 seedlot is performing the best for both diameter and height growth on average, in both the thinned and unthinned treatments.
- The GF7 seedlot is the worst performer for diameter growth on average but not for height growth (note, that there are very few replications).
- Overall in the thinned treatment there are only small growth differences at age 7 (85% of the plots are between 19.3 and 21.4cm).

FIGURE 3 Map showing plot locations, FR 215/3

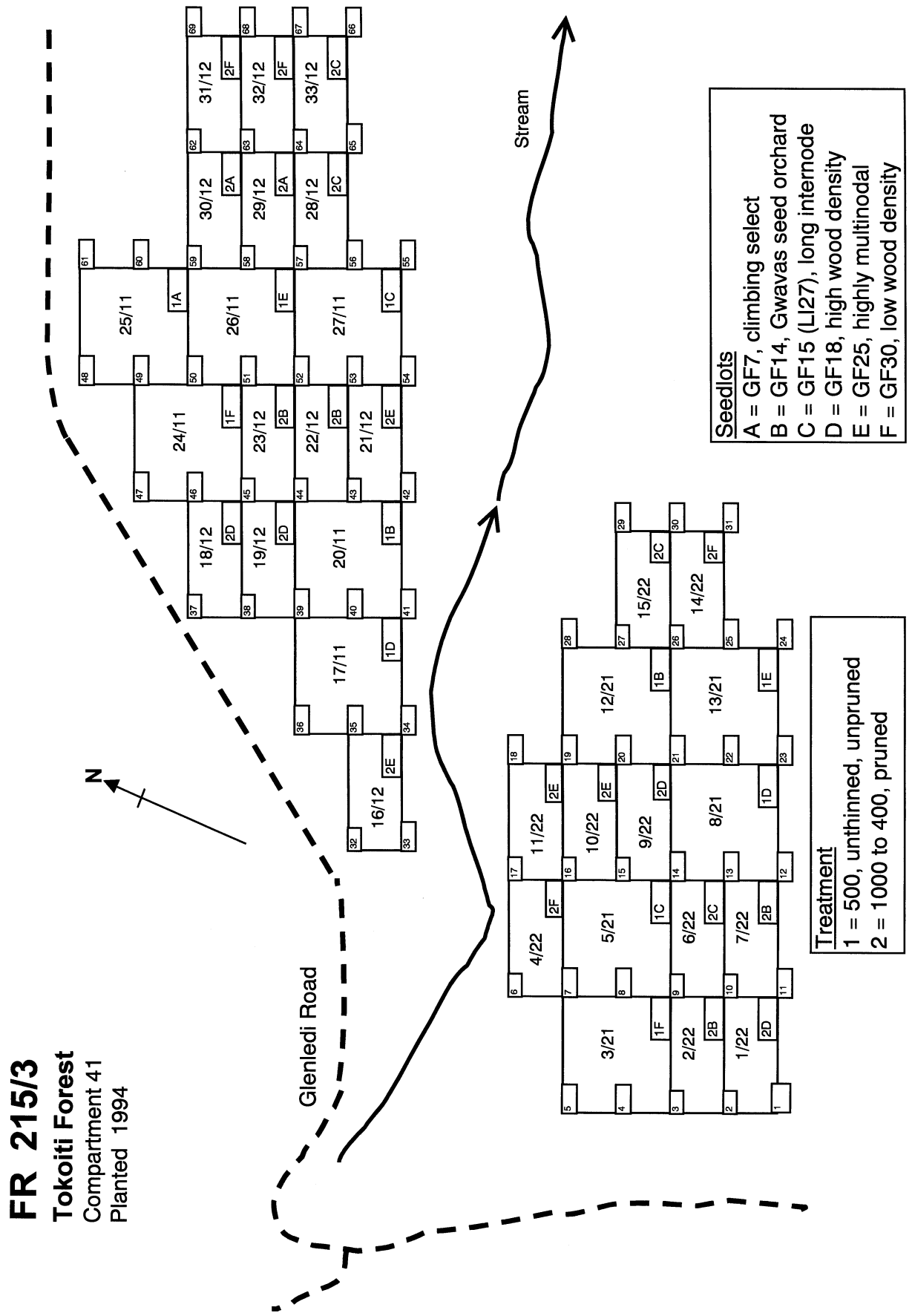


TABLE 14a. FR 215/3: Trial data at the first winter measurement (age 7.0 years)

Trt	Seedlot	GF rating	SPH estab	SPH live	Mn DBH	Mn HT	Basal Area	Volume	Mn CRHT	Mn PRHT	DOS	DOS HT	Max Branch
1	88/102	7	500	480	18.3	9.1	12.6	45.0	0.3				
1	3/03/87	14	500	420	20.0	8.2	13.2	42.7	0.3				
1	3/03/87	14	500	440	17.9	7.8	11.0	34.6	0.3				
1	'870'mix(LI)	15	500	360	20.0	9.1	11.3	40.3	0.3				
1	'870'mix(LI)	15	500	460	19.0	8.3	13.1	42.7	0.3				
1	'268'/875' mix	18	500	400	17.9	8.6	10.1	34.8	0.3				
1	'268'/875' mix	18	500	400	19.3	8.2	11.7	38.2	0.3				
1	'268'/875' mix	25	500	380	17.6	7.1	9.2	26.0	0.3				
1	'268'/875' mix	25	500	460	19.1	8.4	13.2	44.2	0.3				
1	'850'x'268'	30	500	320	22.0	10.0	12.1	46.5	0.3				
1	'850'x'268'	30	500	440	21.3	9.6	15.8	59.0	0.3				
2	88/102	7	1000	429	18.7	8.7	11.7	40.8	2.0	2.1	22.2	0.7	3.3
2	88/102	7	1000	408	19.8	9.6	12.5	47.4	2.1	2.1	24.3	0.7	3.7
2	3/03/87	14	1000	408	20.8	9.2	13.9	50.6	2.2	2.2	26.2	0.6	4.6
2	3/03/87	14	1000	408	20.8	8.6	13.9	47.3	2.1	2.1	25.4	0.6	4.6
2	3/03/87	14	1000	408	20.0	9.0	12.8	45.5	2.0	2.0	23.5	0.6	3.3
2	3/03/87	14	1000	408	19.8	9.2	12.6	45.7	2.0	2.0	22.2	0.7	3.4
2	'870'mix(LI)	15	1000	408	21.4	9.1	14.7	52.6	2.1	2.2	27.6	0.8	5.9
2	'870'mix(LI)	15	1000	408	19.3	8.6	12.0	41.6	1.9	2.0	24.3	0.6	4.3
2	'870'mix(LI)	15	1000	408	20.0	8.9	12.8	45.2	2.2	2.1	25.2	0.7	3.6
2	'870'mix(LI)	15	1000	408	19.8	9.3	12.6	46.7	2.0	2.0	24.1	0.7	4.4
2	'268'/875' mix	18	1000	408	19.9	8.4	12.7	42.9	2.0	2.0	24.6	0.6	3.9
2	'268'/875' mix	18	1000	408	20.8	9.8	13.9	53.2	2.2	2.2	25.8	0.6	4.1
2	'268'/875' mix	18	1000	408	19.6	9.5	12.3	46.4	2.0	2.1	22.2	0.8	3.2
2	'268'/875' mix	18	1000	408	19.9	9.2	12.7	46.7	2.0	2.1	22.6	0.7	3.3
2	'268'/875' mix	25	1000	408	20.6	9.9	13.6	52.3	2.1	2.1	25.1	0.7	3.7
2	'268'/875' mix	25	1000	408	22.2	10.3	15.8	63.2	2.2	2.1	26.5	0.7	3.8
2	'268'/875' mix	25	1000	408	20.1	8.4	13.0	43.7	2.1	2.1	24.4	0.7	4.3
2	'268'/875' mix	25	1000	408	19.5	8.8	12.2	42.4	2.1	2.1	24.5	0.5	3.9
2	'850'x'268'	30	1000	408	22.1	11.0	15.6	65.7	2.1	2.1	25.6	0.6	4.1
2	'850'x'268'	30	1000	408	20.4	9.4	13.3	49.1	2.0	2.1	23.4	0.5	3.8
2	'850'x'268'	30	1000	408	20.3	10.2	13.2	52.4	2.1	2.1	22.9	0.6	3.4
2	'850'x'268'	30	1000	408	20.7	10.5	13.7	55.3	2.1	2.1	23.5	0.6	3.4

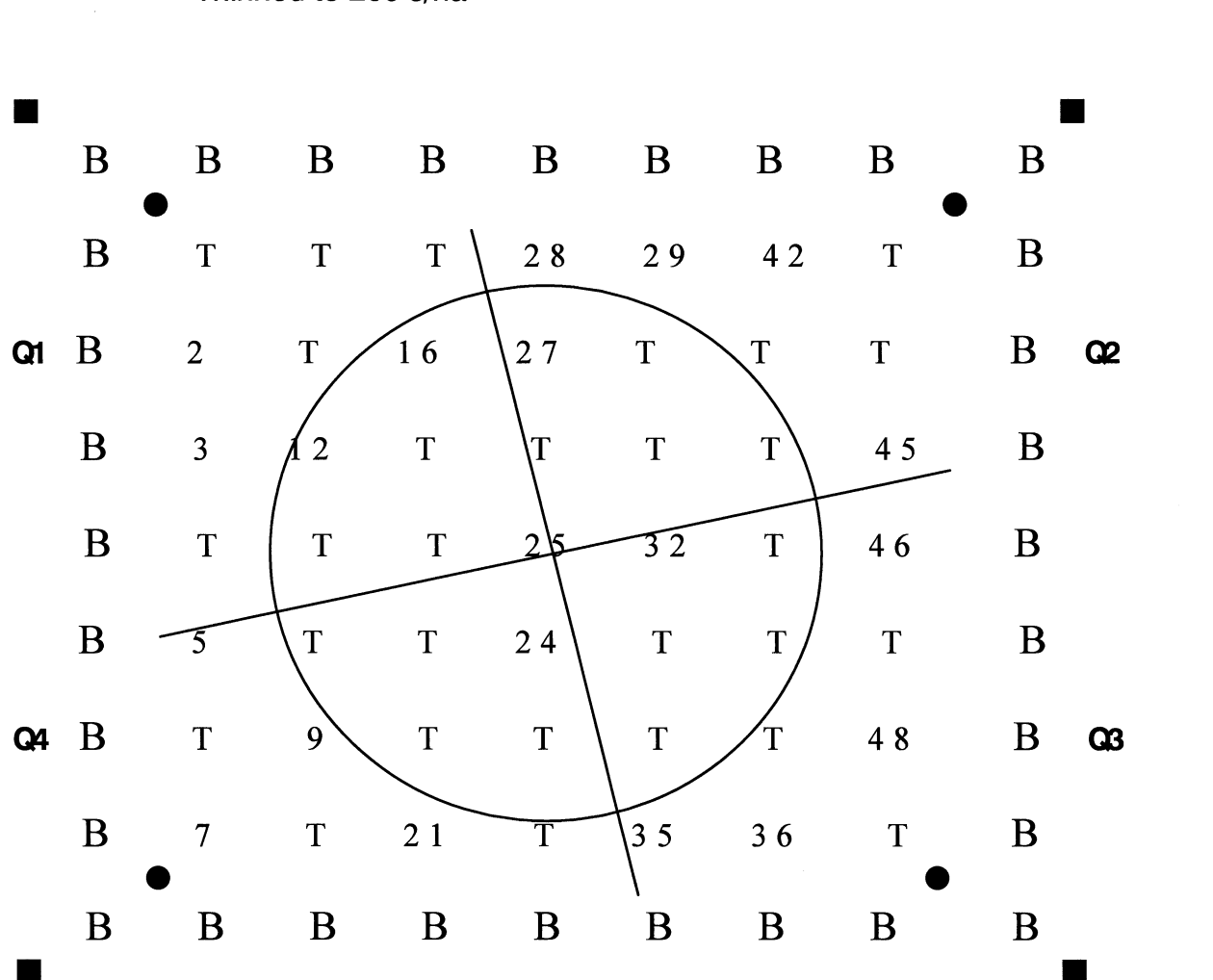
TABLE 14b. FR 215/3: Trial data averaged by treatment and seedlot replication (age 7.0 years)

Trt	Seedlot	GF rating	No. of Reps	Mn DBH	Mn HT	Basal Area	Volume	MnCRHT	Mn PRHT	DOS	DOS HT	Max Branch
1	88/102	7	1	18.3	9.1	12.6	45.0	0.3				
1	3/03/87	14	2	19.0	8.0	12.1	38.7	0.3				
1	'870'mix(LI)	15	2	19.5	8.7	12.2	41.5	0.3				
1	'268'/875' mix	18	2	18.6	8.4	10.9	36.5	0.3				
1	'268'/875' mix	25	2	18.4	7.8	11.2	35.1	0.3				
1	'850'x'268'	30	2	21.7	9.8	13.9	52.8	0.3				
2	88/102	7	2	19.3	9.2	12.1	44.1	2.1	2.1	23.3	0.7	3.5
2	3/03/87	14	4	20.4	9.0	13.3	47.3	2.1	2.1	24.3	0.6	4.0
2	'870'mix(LI)	15	4	20.1	9.0	13.0	46.5	2.1	2.1	25.3	0.7	4.6
2	'268'/875' mix	18	4	20.1	9.2	12.9	47.3	2.1	2.1	23.8	0.7	3.6
2	'268'/875' mix	25	4	20.6	9.4	13.6	50.4	2.1	2.1	25.1	0.7	3.9
2	'850'x'268'	30	4	20.9	10.3	14.0	55.6	2.1	2.1	23.9	0.6	3.7

Appendix 1

Location of Buffers and Permanent Sample Plots

Example 1 Treatment 2
5 x 4 m spacing
Thinned to 200 s/ha



Inner circular plot, 11.3m radius, to determine position of predominant height trees

Q1, Q2, Q3, Q4

Quadrants to determine the predominant height trees

B

Buffer tree

T

Thinned tree

1,4,7,

Plot trees

25

Plot centre



Planting corner peg

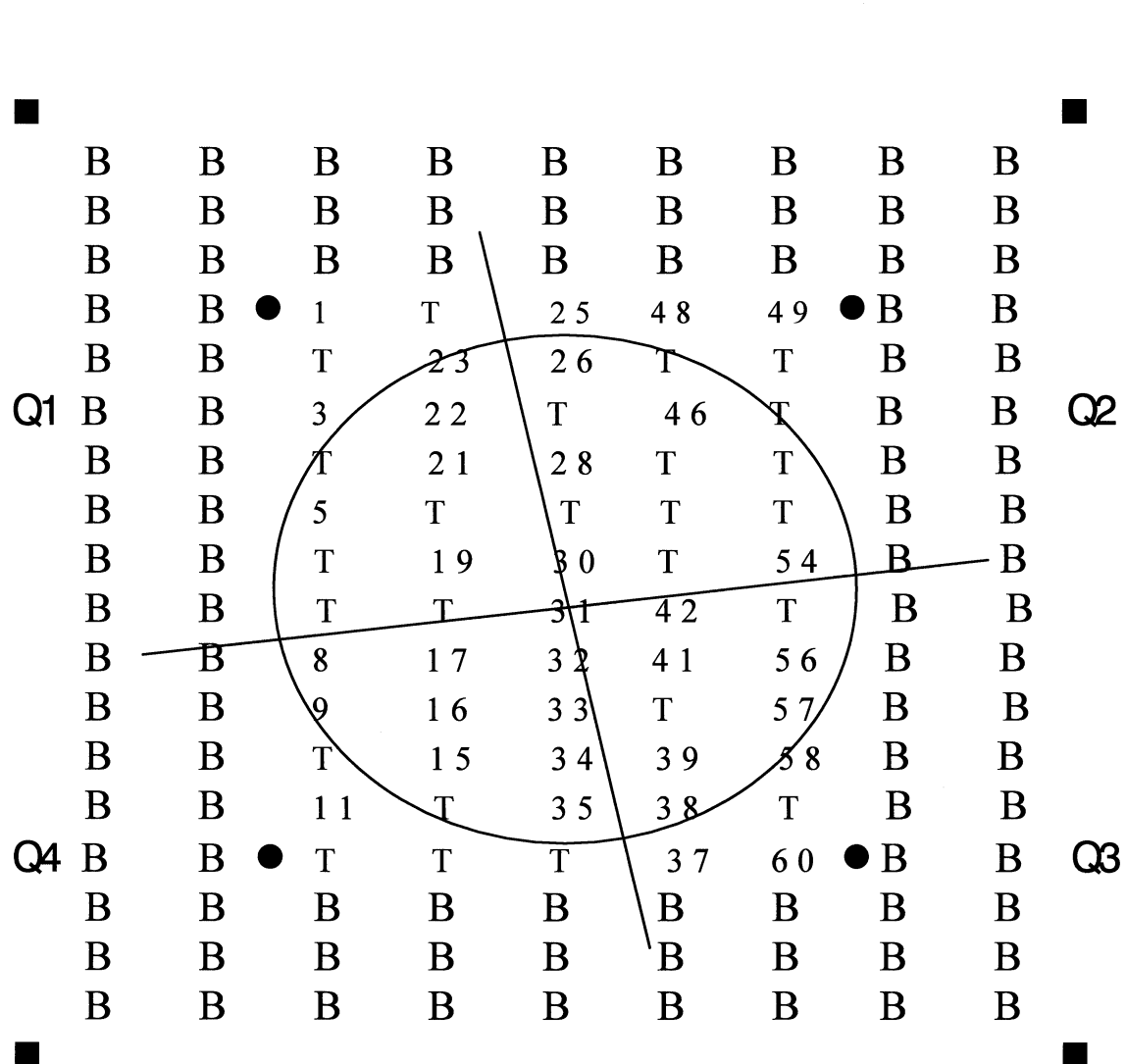


PSP corner peg

Appendix 1 cont.

Location of Buffers and Permanent Sample Plots

Example 2 Treatment 6
5 x 2 m spacing
Thinned to 600 s/ha



Inner circular plot, 11.3m radius, to determine position of predominant height trees

Q1, Q2, Q3, Q4

Quadrants to determine the predominant height trees

B

Buffer tree

1,3,5,

Plot trees

31

Plot centre



Planting corner peg



PSP corner peg

Appendix 2

Plot Numbering System

The plot identification number is a combination of five variables, making up a unique number combination for each plot. FR 215/2/25/17 is made up of the following fields:

CODE	=	Regional/Controller Code
EXPNO	=	Experiment / trial number as allocated by Forest Research
SUBEXP	=	Sub-experiment number related to the experiment
PLOTNO	=	Actual plot number within the trial allocated in a sequential manner
SUBPLOT	=	Replication number is the first digit Treatment number is the second digit

Thus FR 215/2/25/17 is plot 25 of trial FR 215/2. The plot replication number is 1 and the treatment is 7.

In addition, Seedlot is stored in the PSP system as the variable 'Seedlot' and 'Improvement Rating' (Dunlop, 1995).

Appendix 3

Parental composition of the seedlot crosses

SEEDLOT	Mother	Father	Pollen Mix
GF18 - '875' / '268' mix	875.251	PM5	PM5 875.66 875.292 268.262 268.248
	875.257	PM5	
	875.284	PM5	
	268.123	PM5	
	268.131	PM5	
	268.162	PM5	
GF25 - '875' / '268' mix	850.101	PM3	PM3 PM4 268.345 850.91 268.494 850.101 268.532 875.054 268.169 875.223 268.514 875.242 875.244
	875.242	PM3	
	268.345	PM4	
	268.494	PM4	
	268.532	PM4	
GF30 - '850'x'268'	850.55	268.539	
GF15 (LI27) - '870' Mix	870.529	PM1	PM1 PM2 870.609 870.589 870.573 870.608 870.567
	870.613	PM1	
	870.567	PM2	

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ACKNOWLEDGMENTS

Forest Research would like to acknowledge the help they received from the following companies in all stages of the development of these trials and subsequent remeasurements:

Fletcher Challenge Forests Ltd Trial FR 215/1
(was Forestry Corporation at the time of planting)

Carter Holt Harvey Forests Ltd Trial FR 215/2

City Forests Ltd Trial FR 215/3

The author would like to acknowledge Sue Carson (Forest Genetics) and Bob Shula (**Forest Research**) for their advice and direction in establishing PSPs and carrying out the silviculture in these trials.