FRI Project Record

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PSP ESTABLISHMENT REPORT FOR THE 1988 SILVICULTURE/BREED TRIALS

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NZ FRI/INDUSTRY RESEARCH COOPERATIVE

EXECUTIVE SUMMARY

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. This project coordinates the efforts of tree breeders and forest mensurationists, in order to ensure that information required to meet genetic gain objectives is obtained in an efficient and productive manner (SGMC Report Nos 24, 24a and 40).

One group of trials, known as the Silviculture/Breed series, was designed and planted specifically to compare the performance of genetically improved breeds and to provide growth data for growth modelling. Twenty eight trial sites were planted over a five year period. Each trial has seedlots of differing genetic quality planted in large blocks with several different spacing regimes.

This report documents the basic field procedures which are being utilised for all Silviculture/Breed trials, as well as describing the pruning, thinning, and establishment of permanent sample plots (PSPs) in the four silviculture/breed trial sites planted in 1988.

Plot establishment and silvicultural treatment has gone for the most part according to plan. PSPs are being measured annually starting from the first winter after plot establishment. Each trial, once established, is measured during the same winter month each year.

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INTRODUCTION

PSP establishment, thinning and pruning of the 1988 plantings of the Silviculture/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. This work is supported by the Stand Growth Modelling Cooperative.

Trials in the Silviculture/Breed series were planted from 1987 to 1991 inclusive. These trials, when combined, will represent New Zealand's eight major forest growing regions with up to four levels of site quality tested within each region (Dunlop and Carson 1995). This series of trials is designed to compare the performance of genetically improved breeds of radiata pine at varying levels of initial and final crop stockings on sites with varying qualities to provide data for growth modelling.

The primary objective of the 1988 plantings is to extend the trials established in 1987 (Skinner et.al 1994) over a wider range of sites, for the purpose of quantifying genetic gain in growth rate and other traits, over the eight major forest growing regions in New Zealand. Also, the testing of specific treatments (eg. initial crop stockings) relevant to particular locations is incorporated into the trials to provide further management information. 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 modified to reflect growth increase due to genetic improvement.

TRIAL LOCATIONS

Trials were planted in three regions, at four sites in 1988 in the second series of the Silviculture/Breed trials (Table 1). The sites were chosen to cover a range of site qualities from high basal area to low site index.

TABLE 1. Trial sites planted in 1988 as part of the Silviculture/Breed trial series.

Trial No.	Location	Forest Owner	Region	Site Category
FR 54	Mamaranui	Carter Holt Harvey Forests Ltd	Northland Clays	High BA
FR 55	Eyrewell	Carter Holt Harvey Forests Ltd	Canterbury Plains	Low SI
FR 56	Dalethorpe	Selwyn Plantation Board	Canterbury Hills	Medium SI
FR 57	Tikokino	NZ Forest Research Institute	Hawkes Bay	High SI

CORE EXPERIMENTAL DESIGN

In the 1988 trials there is a core experimental design of three treatments planted at each site (Table 2). Additional treatments were assigned at each of the different sites (see Tables 4,5,7,8,10,11,13,14 for the detailed experimental design for each site).

TABLE 2. Core experimental design for the 1988 Silviculture/breed trials.

Trt	Pruning	Thinning at MCH 6.2 m			
	4m crown remaining	Initial Planting	Final Crop Stocking	Initial Spacing *	Plot area (ha)
1	✓	250	100	4 x 10	0.196
2	✓	500	200	4 x 5	0.098
3	✓	1000	400	4 x 2.5	0.049

* The plot dimensions at Eyrewell differ from the other three sites. Spacings at Eyrewell are 6 x 6.67, 6 x 3.33, and 6 x 1.67 for treatments 1,2 and 3 respectively.

Different seedlots were used on different sites (Table 3). All sites included a 'seedlot' propagated by rooted cuttings from three year old ortets of "268" origin, which were planted across a limited range of stocking levels. In all 1988 trial plantings the buffer rows on each plot are of the same stock as the experimental (PSP) plots.

The trial planting dates were:

FR 54	Mamaranui	July 1988
FR 55	Eyrewell	July 1988
FR 56	Dalethorpe	August 1988
FR 57	Tikokino	August 1988

The first treatment and PSP establishment dates were:

FR 54	Mamaranui	October	1992	4.3 years	MTH 5.7m
FR 57	Tikokino	December	1993	5.6 years	MTH 6.3m
FR 55	Eyrewell	December	1994	6.6 years	MTH 6.1m
FR 56	Dalethorpe	March	1995	6.9 years	MTH 6.1m

TABLE 3. Seedlots used in the 1988 Silviculture/breeds trials.

Stock	Seedlot Number	Seedlot Rating	Breeding Series	Description
Mamaranui (FR54) and Dalethorpe (FR56)				
Seedlings	6/6/87/21 (A)	GF22	"268"	Control-pollinated seed, Amberley seed orchard
Seedlings	9/3/86/70 (B)	LI23 (GF9)	"870"	Open-pollinated seed orchard seed collected from 'best 5' long internode parents
Seedlings	3/3/87/1 (C)	GF14	"850"	Open-pollinated commercial seed, Gwavas seed orchard
Cuttings	9/0/83/96 (D)	GF17	"268"	Cuttings from 3 year old trees
Eyrewell (FR 55)				
Seedlings	6/6/87/21 (A)	GF22	"268"	Control-pollinated seed, Amberley seed orchard
Seedlings	2/6/87/34 (B)	GF16	"268"	Locally raised seedlings
Cuttings	9/0/83/96 (C)	GF17	"268"	Cuttings from 3 year old trees
Tikokino (FR 57)				
Seedlings	2/6/87/35 (A)	GF19	"268"	'Best 16' open-pollinated seed
Seedlings	3/3/87/3 (B)	LI15 (GF10)	"870"	Open-pollinated seed orchard, 'top 10' long internode clones, Tasman seed orchard
Cuttings	2/3/84/53 (C)	GF17	"268"	Cuttings from 3 year old 'top 25' open-pollinated trees

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 are located (see trial maps), released and repainted where necessary. A check is also done to ensure that the plot location map is correct. Plots that are not to be treated are surrounded with cruising tape to prevent accidental pruning or thinning.

The field work then proceeds as follows.

1) Pruning and marking for thinning

a) NZFRI Mensuration field staff meet with the pruning gang and explain the pruning specifications to be used. Trees, including those in buffer rows, are pruned to leave a 4m crown.

b) Trees are marked for thinning. Crop tree selection criteria are based on size, form and spacing, in that order, with an emphasis of 50:40:10. Buffer rows are also thinned to the prescribed stocking.

c) Only trees <u>not</u> selected for thinning are pruned. NZFRI Mensuration field staff supervise the pruners for at least a day. Height poles are used to show the exact position of 4m from the top of the tree. Periodic height and pruned height measurements are taken to ensure that the pruning requirements are being met. Measurements are taken from the lowest remaining whorl, which is closest to the point four metres from the top of tree.

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). The plots are 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 are specified in the PSP variables 'Seedlot' and 'Improvement rating' (Dunlop, 1995).

Husky HUNTER data loggers are used to record all measurements. Establishment follows a standard procedure as follows.

a) The width of the buffer zone is determined and pegs are placed in the four corners of the permanent sample plot (Appendix 1).

b) The Northwest corner peg is labelled with the plot identification and seedlot rating.

c) The diameter of all trees within the plot is measured and recorded before thinning. A diameter band is painted with spray paint at the appropriate level. A numbered aluminium tag is stapled above the diameter band onto all crop trees (ie. those not marked for thinning at the time of pruning). Trees are numbered consecutively from the northwest corner, up and down the planted rows. Dead trees and those to be felled are included in the numbering but do not get tagged.

d) The total number of tagged trees are counted to make sure that the correct stocking will remain after thinning. If necessary, extra trees are pruned and/or marked for culling to correct the number of final crop trees. The trees, which are recorded as being alive on the Husky HUNTER, are also counted to make sure they correspond with the required number of live trees remaining after thinning.

e) Twelve height trees are selected from the crop element. Four of these are the tallest trees within each 0.01 ha quadrant (used to calculate predominant mean height, PMH). A predominant height tree is 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 are selected to cover the range of diameters present in the plot and are referred to as sample height trees. Trees with dead or broken tops or unusually large diameters are not included as sample height trees. Each height tree, whether predominant or sample, is measured for total height, pruned height, DOS, DOS height and maximum branch diameter. These measurements are recorded along with the tree diameter.

3) Thinning

Thinning is carried out by the NZFRI Mensuration field staff unless otherwise noted in the individual trial sections.

a) All unpruned trees and/or trees marked for culling are felled (with no felling in unpruned/ unthinned treatments).

b) Buffer trees are 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 are also felled.

INDIVIDUAL TRIAL DESIGNS AND PSP ESTABLISHMENT REPORTS

FR 54 - MAMARANUI Forest

This trial was planted in July 1988 with a cyclic incomplete block design containing 42 rectangular 45 x 36m plots. It occupies 6.6 hectares (NZFRI WP No.1633; Townley and Wilcox, 1988). A Nelder trial of a '268' open pollinated seedlot was planted at the same time on an adjacent site. Some trees were blown over at an early age, then straightened and pegged, causing some butt sweep by the time of plot establishment.

The first measurements, of total height only, were taken in May, 1990 (age 2 years). Pruning, PSP plot establishment and thinning was carried out (as per the basic field procedures) during early October 1992 (age 4.3 years). The trial MCH at the time of plot establishment was 5.7m with a range of 3.9 - 8.3 m.

Trial Design

This trial was designed with seven silvicultural treatments and four different seedlots, with each seedlot/silvicultural treatment combination replicated twice (Table 4). All treatment combinations were randomly allocated within field replications.

TABLE 4. Trial design for FR 54, Mamaranui Forest

Silviculture					Planting stock [1]			
Trt	Pruning	Thinning			Seedlings			Cuttings
		Initial	Final	MCH (m)	GF14 3/3/87/1 C	GF22 6/6/87/21 A	LI23 (GF9) 9/3/86/70 B	GF17 9/0/83/96 D
1	✓	250	100	6.2	••	••	••	
2	✓	500	200	6.2	••	••	••	••
3	✓	1000	400	6.2	••	••	••	••
4	✓	1555	600	6.2	••	••	••	
5	x	500	500	-	••	••	••	
6	✓	500	200	20	••	••	••	
7	✓	200	200	-				••

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

Pruning

Pruning was carried out one week before plot establishment (beginning 1 October, 1992) by three Carter Holt Harvey contractors following instructions from NZFRI, but without FRI staff present. Selection for thinning was carried out by CHHF staff at the same time and only selected crop trees were pruned. Trees were generally not pruned to specifications (to leave 4m of crown) and contractors had to return to take off another lift where required, this time under FRI supervision. The final pruning gave an average crown remaining of 3.4m (mean pruned height was 2.3m) over the whole trial. Pruned heights of the selected height trees were measured in October, 1992 at the time of plot establishment. DOS measurements (DOS, DOS height and maximum branch diameter) were taken in November, 1992.

PSP Plot Establishment

Forty two permanent sample plots were established by four NZ FRI field crew, with help from three Carter Holt Harvey staff, beginning on 6 October, 1992 (a total 21 mandays). Table 5 shows the plot establishment requirements for each of the assigned treatments.

TABLE 5. Plot establishment specifications, FR 54, Mamaranui Forest.

Trt	Plot Area	Spacing	No. trees planted	Initial no. trees buffer	plot	Final no. trees buffer	plot	Thinning ratio	PSP Plots	Pruning
1	0.1960	4 x 10	81	32	49	13	20	2.5 : 1	6	4m crown
2	0.0980	4 x 5	81	32	49	13	20	2.5 : 1	8	"
3	0.0490	4 x 2.5	81	32	49	13	20	2.5 : 1	8	"
4	0.0510	4 x 1.6	126	42	84	16	33	2.5 : 1	6	"
5	0.0980	4 x 5	81	32	49	32	49	1 : 1	6	None
6	0.0980	4 x 5	81	32	49	32	49	late thin	6	4m crown
7	0.0980	4 x 11.3	36	22	14	22	14	1 : 1	2	"

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

Thinning

Thinning was carried out by three Carter Holt Harvey Forest staff beginning on 12 October, 1992 (a total nine mandays). Plots 39/26 and 40/26 (see map), scheduled as unthinned, accidentally had their buffers thinned.

Trial Layout and Site Information

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

Altitude:	122 m
Soil Type:	Whatoro Clay
Site Preparation:	Heavily grazed pasture
Weeds:	Grass
Regeneration:	Nil
Slope:	Range 0 - 8°
Previous land use:	Farmland

All the original 42 plots planted were established as PSPs at this site (see map, Figure 1). The original planting peg numbers are shown at the plot corners, also codes for treatment and seedlot (Tables 4 & 5).

Site growth is extremely variable on this site, with the top half of the trial approximately one to two metres taller than the bottom half at the time of plot establishment. There was no problem with regeneration or weeds at plot establishment. There was evidence of grazing, but the overall mortality was very low.

Plot Data

A summary (Table 6) at the time of the first winter measurement (age 5 years) shows data (mean diameter, mean height, basal area, volume and prune height) summarised by treatment and seedlot. No statistical analysis has yet been carried out and any trends in data may not persist over time. Because of the variability in the site, the seedlot averages over rep may be misleading. The following trends were noted:

- The GF17 seedlot is not performing as well as expected.
- The long internode seedlot shows a higher mean height on average (except for treatment 4).

Acknowledgments

NZFRI would like to acknowledge the help they received from Carter Holt Harvey Forests Ltd (formerly known as NZFP Ltd) in all stages of the development of this trial.

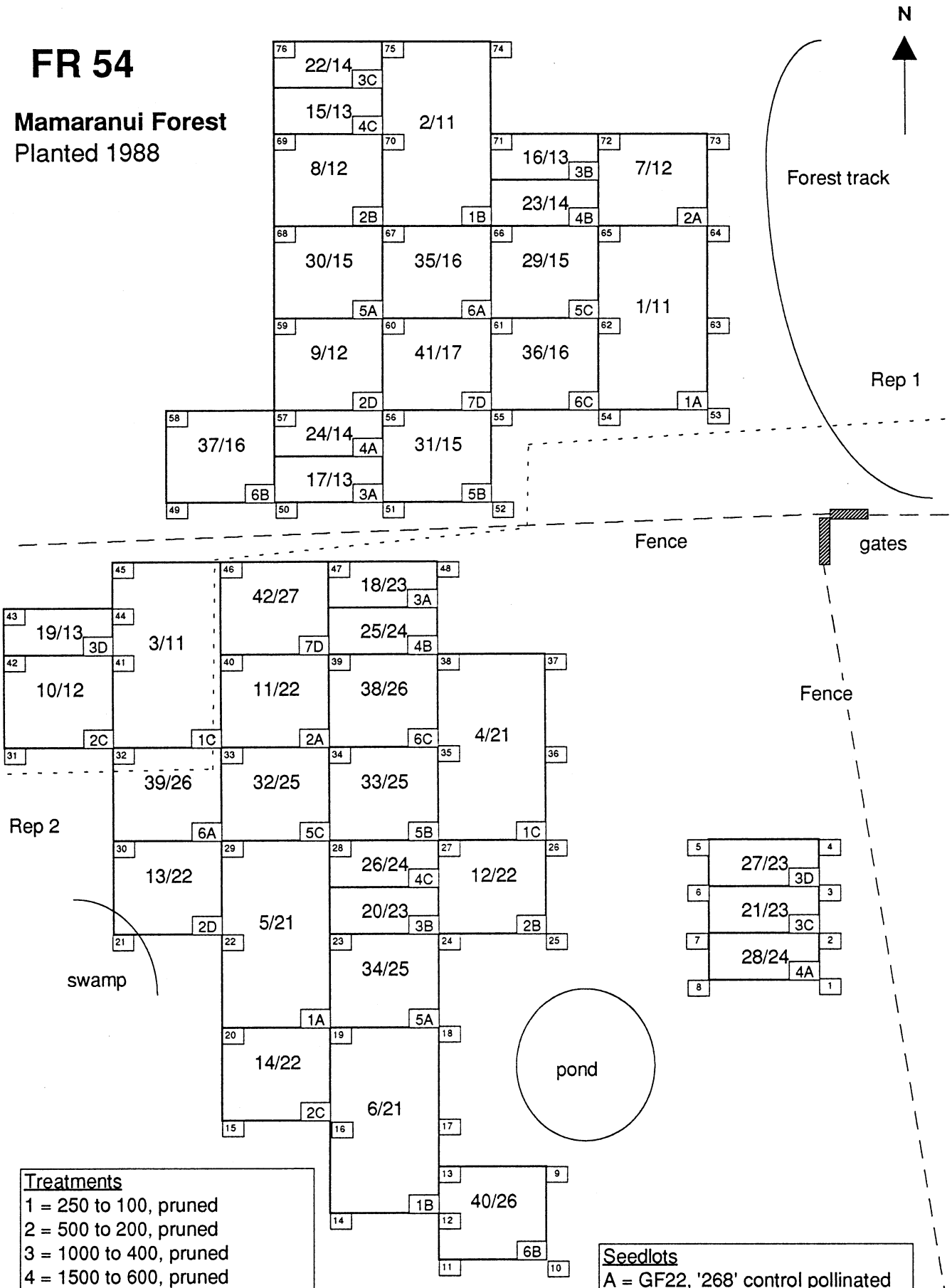
STAND GROWTH MODELLING COOPERATIVE

Silviculture / Breed Trial

FIGURE 1

FR 54

Mamaranui Forest
Planted 1988



Treatments
1 = 250 to 100, pruned
2 = 500 to 200, pruned
3 = 1000 to 400, pruned
4 = 1500 to 600, pruned
5 = 500, unthin, unpruned
6 = 500 to 200, late thin, pruned
7 = 200, unthin, pruned

Seedlots
A = GF22, '268' control pollinated
B = GF9 (LI23), long internode
C = GF14, '850' open pollinated
D = GF17, '268' cuttings

TABLE 6. **FR 54 : MAMARANUI FOREST**
Summary of Trial Data at age 5.0

Treatment No.	Seedlot	GF Rating	No. Plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq. metres)	Volume (cu. metres)	Mean * Prune Ht
1	9/3/86/70	LI23(GF9)	2	243	100	16.0	7.2	2.0	6.3	2.2
1	3/3/87/01	14	2	248	102	15.3	5.9	1.9	5.0	1.9
1	6/6/87/21	22	2	253	102	16.1	6.8	2.1	6.3	2.2
2	9/3/86/70	LI23(GF9)	2	526	204	16.3	7.4	4.3	13.6	2.2
2	3/3/87/01	14	2	495	199	14.7	6.0	3.4	9.1	1.7
2	9/0/83/96	17	2	470	204	14.1	6.6	3.3	9.7	1.9
2	6/6/87/21	22	2	505	204	16.8	7.4	4.5	14.4	2.8
3	9/3/86/70	LI23(GF9)	2	990	398	16.5	8.4	8.5	30.0	2.7
3	3/3/87/01	14	2	1011	408	17.8	8.2	10.1	34.4	2.9
3	9/0/83/96	17	2	1041	408	14.4	7.0	6.6	20.7	2.5
3	6/6/87/21	22	2	1020	408	17.1	7.9	9.4	31.4	2.6
4	9/3/86/70	LI23(GF9)	2	1481	608	15.8	8.0	12.0	42.9	3.1
4	3/3/87/01	14	2	1510	628	16.3	8.6	13.1	47.6	2.8
4	6/6/87/21	22	2	1510	608	16.5	8.6	13.0	47.2	3.4
5	9/3/86/70	LI23(GF9)	2	490	490	16.0	7.8	10.0	33.1	0.0
5	3/3/87/01	14	2	521	521	17.4	7.9	12.4	41.2	0.0
5	6/6/87/21	22	2	526	526	14.6	6.8	8.9	27.6	0.0
6	9/3/86/70	LI23(GF9)	2	500	500	15.2	7.5	9.0	29.4	2.0
6	3/3/87/01	14	2	500	500	16.0	7.1	10.2	31.8	2.3
6	6/6/87/21	22	2	480	480	16.7	7.2	10.4	32.3	2.2
7	9/0/83/96	17	2	221	221	11.1	5.3	2.2	6.2	1.8

* Mean Prune Ht 0.0 = unpruned plot

FR 55, EYREWELL Forest, Compartment 33

This trial, planted in July 1988, was designed as a randomised complete block and replicated twice (NZFRI WP No.1633; Townley and Wilcox, 1988). It consists of 22 rectangular 54 x 30m plots occupying 3.4 hectares (Table 7) . The plot dimensions (Table 8) were altered in this trial from the others in the 1988 series to 'fit' the 6m ripping.

The long internode seedlot was considered inappropriate for the Canterbury plains region due to climatic constraints, so this seedlot was not planted. In addition, the '850' series was represented at a nearby final crop stocking trial (CY 597), so it was not included in this trial.

The planting strip was not wide enough to avoid influence of the adjacent catch crop, thus necessitating a single row layout (Figure 2). The strip of land available was considered sufficiently uniform to enable this layout to be established.

The first measurements of total height only were taken in May 1990 (age 2 years). Pruning, PSP plot establishment and thinning was carried out (as per the basic field procedures) during mid December, 1994 (age 6.6 years). The trial MCH at the time of plot establishment was 6.1m.

Trial Design

This trial was designed with nine silvicultural treatments and three different seedlots, with each seedlot/silvicultural treatment combination replicated twice (Table 7). All treatment combinations were randomly allocated within field replications.

Pruning

Pruning was carried out by Carter Holt Harvey Forests contractors beginning on 13 December, 1994 under supervision of NZFRI staff. Due to the inexperience of the contractors, some further pruning of branches left at the base was required at a later date. Fortunately branching was light throughout the trial which made the pruning easier overall. The trial took four people two days to prune. The average crown height remaining after pruning was 3.9m (mean pruned height of 2.2m).

TABLE 7. Trial design for FR 55, Eyrewell Forest

Silviculture					Planting stock[1]		
Trt	Pruning	Thinning			Seedlings		Cuttings
		Initial	Final	MCH (m)	GF16 2/6/87/34 B	GF22 6/6/87/21 A	GF17 9/0/83/96 C
1	✓	250	100	6.2		••	
2	✓	500	200	6.2		••	••
3	✓	1000	400	6.2		••	••
4	x	500	500	6.2		••	
5	✓	1200	600	6.2		••	
6	✓	550	275	6.2	••		
7	✓	830	300	6.2	••		
8	✓	200	200	-			••
9	✓	275	275	-	••		

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

PSP Plot Establishment

Twenty two permanent sample plots were established by five NZFRI field staff, with the help of two Carter Holt Harvey staff, beginning on 15 December, 1994 (a total of 20 mandays). Table 8 shows the plot establishment requirements for each of the assigned treatments.

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

Thinning

Thinning of the sixteen plots was carried out in December by NZFRI field staff, immediately following the plot establishment. A total of five mandays was required for thinning.

Trial Layout and Site Information

All of the original 22 plots planted were established as PSPs at this site (see map, Figure 2). The original planting peg numbers are shown at the plot corners, also codes for treatment and seedlot (Tables 7 & 8).

The following information was recorded at the time of planting:

Altitude:	142 m
Soil Type:	Lismore very stony silt loam
Site Preparation:	V-blading and deep ripping lengthwise along the strip at 6m centres
Weeds:	Nil
Regeneration:	Light/medium
Slope:	Flat
Previous land use:	Pinus radiata forest

Regeneration was a problem in the early years of this trial and removal was carried out by the GTI section in 1990 and 1993. There was some toppling and lean due to the strong NW winds, but most of the severely affected trees were selected for thinning and removed during plot establishment. Mortality in the trial is insignificant. The trial area is flat with no weed problems.

TABLE 8. Plot establishment specifications, for FR 55, Eyrewell Forest

Trt	Plot Area	Spacing	No. trees planted	Initial no. trees buffer : plot		Final no. trees buffer : plot		Thinning ratio	PSP plots	Pruning
1	0.1960	6 x 6.67	81	32	49	13	20	2.5 : 1	2	4m crown
2	0.0980	6 x 3.33	81	32	49	13	20	2.5 : 1	4	"
3	0.0490	6 x 1.67	81	32	49	13	20	2.5 : 1	4	"
4	0.0980	6 x 3.33	81	32	49	32	49	1 : 1	2	None
5	0.0530	6 x 1.39	99	36	63	18	32	2 : 1	2	4m crown
6	0.1008	6 x 3	90	34	56	17	28	2 : 1	2	"
7	0.1092	6 x 2	135	44	91	15	33	2.8 : 1	2	"
8	0.0700	6 x 8.33	36	22	14	22	14	1 : 1	2	"
9	0.0700	6 x 6	45	24	21	24	21	1 : 1	2	"

Plot data

A summary (Table 9) at the time of the first measurement (age 6.6 years) shows data (mean diameter, mean height, basal area, volume and prune height) summarised by treatment and seedlot. No statistical analysis has yet been carried out and any trends in data may not persist over time.

Acknowledgments

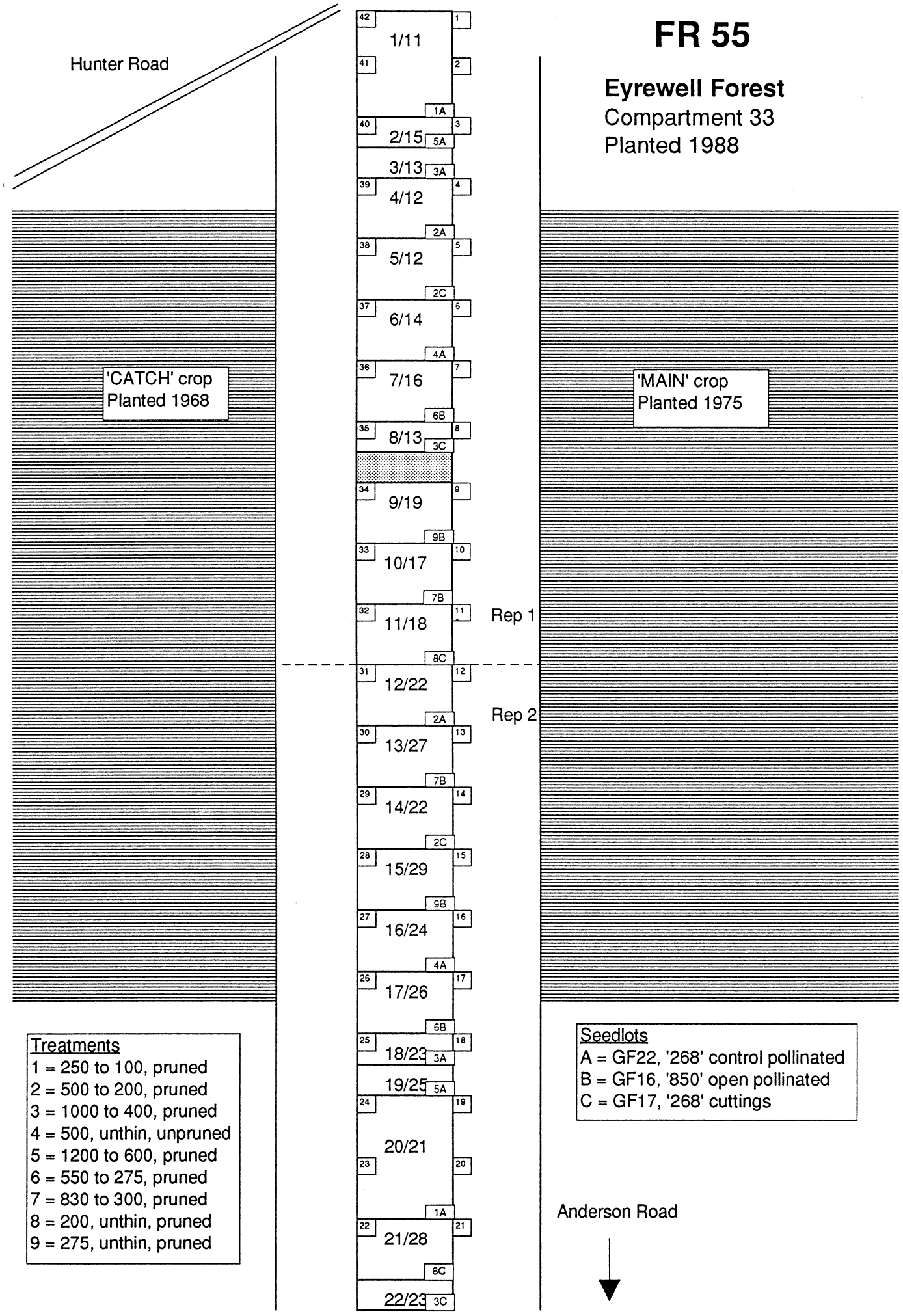
NZFRI would like to acknowledge the help they received from Carter Holt Harvey Forests Ltd in all stages of the development of this trial.

STAND GROWTH MODELLING COOPERATIVE
Silviculture / Breed Trial

FIGURE 2

FR 55

Eyrewell Forest
Compartment 33
Planted 1988



Treatments
1 = 250 to 100, pruned
2 = 500 to 200, pruned
3 = 1000 to 400, pruned
4 = 500, unthin, unpruned
5 = 1200 to 600, pruned
6 = 550 to 275, pruned
7 = 830 to 300, pruned
8 = 200, unthin, pruned
9 = 275, unthin, pruned

Seedlots
A = GF22, '268' control pollinated
B = GF16, '850' open pollinated
C = GF17, '268' cuttings

TABLE 9. **FR 55 : EYREWELL FOREST**
Summary of Trial Data at age 6.6

Treatment No.	Seedlot	GF Rating	No. plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq.m)	Volume (cu.m)	Mean * Prune Ht
1	6/6/87/21	22	2	253	102	10.5	6.2	0.9	2.7	2.3
2	9/0/83/96	17	2	500	204	9.1	6.1	1.3	4.0	2.2
2	6/6/87/21	22	2	515	204	10.2	6.5	1.6	5.2	2.4
3	9/0/83/96	17	2	970	408	8.6	6.0	2.4	7.2	2.1
3	6/6/87/21	22	2	1021	408	9.6	6.2	2.9	9.0	2.3
4	6/6/87/21	22	2	500	500	9.7	6.2	3.7	11.2	0.0
5	6/6/87/21	22	2	1218	604	9.4	6.4	4.1	12.9	2.3
6	2/6/87/34	16	2	566	278	9.8	6.3	2.1	6.4	2.4
7	2/6/87/34	16	2	838	302	9.6	6.4	2.2	6.8	2.3
8	9/0/83/96	17	2	200	200	9.3	5.8	1.4	4.1	1.9
9	2/6/87/34	16	2	276	276	9.9	6.2	2.1	6.4	2.3

* Mean Prune Ht 0.0 = unpruned plot

FR 56, DALETHORPE Forest

This trial was planted in July 1998 with a cyclic incomplete block design containing 42 rectangular 45 x 36m plots and occupying 6.6 hectares (NZFRI WP No.1633; Townley and Wilcox, 1988). Surface water was encountered during planting of the lower, southeast corner of the trial.

The first measurements of total height only were taken in May, 1992 (age 4 years). Pruning, PSP plot establishment and thinning was carried out (as per the basic field procedures) during March, 1995 (age 6.9 years). The trial MCH at the time of plot establishment was 6.1m.

Trial Design

This trial was designed with seven silvicultural treatments and four different seedlots, with each seedlot/silvicultural treatment combination replicated twice (Table 10). All treatment combinations were randomly allocated within field replications.

TABLE 10. Trial design for FR 56, Dalethorpe Forest

Silviculture					Planting stock[1]			
Trt	Pruning	Thinning			Seedlings			Cuttings
		Initial	Final	MCH (m)	GF14 3/3/87/1 C	GF22 6/6/87/21 A	LI23 (GF9) 9/3/86/70 B	GF17 9/0/83/96 D
1	✓	250	100	6.2	••	•■	••	
2	✓	500	200	6.2	••	•■	••	••
3	✓	1000	400	6.2	••	••	•■	■■
4	✓	1555	600	6.2	••	••	•■	
5	x	500	500	-	••	••	••	
6	✓	500	200	20	••	••	••	
7	✓	200	200	-				••

1 Each • represents one PSP plot with a buffer which receives the same treatment as the inner PSP plot. Each ■ represents a plot that was planted but had insufficient or damaged trees remaining to be established as a PSP.

Pruning

Pruning was carried out by 14 forest industry trainees and supervisors supplied by Selwyn Plantation Board and supervised by NZ FRI staff. Due to their inexperience, pruning took a total of 34 mandays between 1 - 3

March, 1995. There was large branching throughout all the seedlots. The largest branches were chainsaw pruned. The average crown height remaining after pruning was 3.8m (mean pruned height of 2.5m).

PSP Plot Establishment

Thirty-six permanent sample plots were established by four NZ FRI field crew, with the help of two staff from Selwyn Plantation Board. Establishment was carried out between 1 - 6 March, 1995 (a total of 34 mandays). Three plots were not established and a further three plots were abandoned after the first winter re-measurement due to lack of trees, severe wind damage and poor form (Table 10). The plots affected (1/11, 11/14, 12/13, 13/12, 14/13, 15/13) were all planted in and around a swamp. Table 11 shows the plot establishment requirements for each of the assigned treatments.

TABLE 11. Plot establishment specifications, FR 56, Dalethorpe Forest

Trt	Plot Area	Spacing	No. trees planted	Initial no. trees buffer : plot		Final no. trees buffer : plot		Thinning ratio	PSP Plots	Pruning
1	0.1960	4 x 10	81	32	49	13	20	2.5 : 1	5	4m crown
2	0.0980	4 x 5	81	32	49	13	20	2.5 : 1	7	"
3	0.0490	4 x 2.5	81	32	49	13	20	2.5 : 1	5	"
4	0.0510	4 x 1.6	126	42	84	16	33	2.5 : 1	5	"
5	0.0980	4 x 5	81	32	49	32	49	1 : 1	6	None
6	0.0980	4 x 5	81	32	49	32	49	late thin	6	4m crown
7	0.0980	4 x 11.3	36	22	14	22	14	1 : 1	2	"

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

Thinning

Thinning was carried out NZ FRI field staff on 7/8 March, 1995 (a total of 8 mandays). All plots were thinned according to the schedule.

Trial Layout and Site Information

Only 36 of the original 42 plots planted are established as PSPs at this site (see map, Figure 3). The original planting peg numbers are shown at the plot corners, also codes for treatment and seedlot (Tables 10 & 11).

The following information was recorded at the time of planting:

Altitude:	500 m
Soil Type:	Kakahu
Site Preparation:	Ripped to 1 m, 4 metres between rows, line spraying
Weeds:	Matagouri, grass
Regeneration:	Nil
Slope:	Range 5-10°
Aspect:	NW
Previous land use:	Farmland

Many trees at this site are deformed, stunted in growth or damaged in some way. Much of the damage appears to be from wind (which is not unusual for this site) and possibly snow damage. Mortality at this site is high. Sixteen plots have more than 10% mortality and seven plots more than 20% mortality. However, most plots which have been established are at the allocated final crop stocking after thinning.

Plot data

A summary (Table 12) at the time of the first measurement (age 6.9 years) shows data (mean diameter, mean height, basal area, volume and prune height) summarised by treatment and seedlot. No statistical analysis has yet been carried out and any trends in data may not persist over time. The following trend was noted:

- The long internode seedlot is appreciably smaller in mean diameter but not height with respect to the other seedlots over the different treatments.

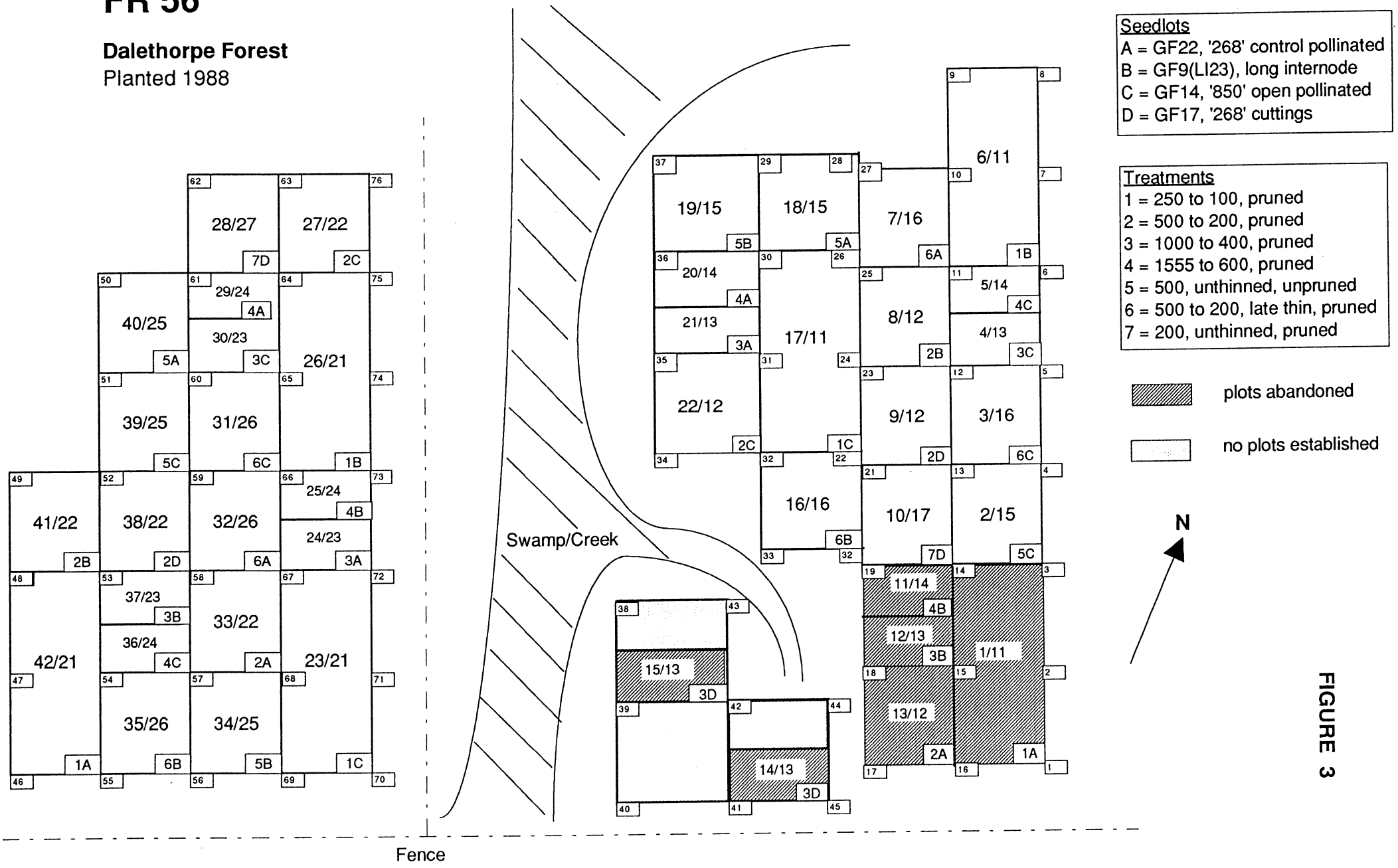
Acknowledgments

NZFRI would like to acknowledge the help they received from Selwyn Plantation Board in all stages of the development of this trial.

STAND GROWTH MODELLING COOPERATIVE
Silviculture / Breed Trial

FR 56

Dalethorpe Forest
Planted 1988



Seedlots
A = GF22, '268' control pollinated
B = GF9(LI23), long internode
C = GF14, '850' open pollinated
D = GF17, '268' cuttings

Treatments
1 = 250 to 100, pruned
2 = 500 to 200, pruned
3 = 1000 to 400, pruned
4 = 1555 to 600, pruned
5 = 500, unthinned, unpruned
6 = 500 to 200, late thin, pruned
7 = 200, unthinned, pruned

plots abandoned

no plots established

FIGURE 3

TABLE 12

FR 56 : DALETHORPE FOREST
Summary of Trial Data at age 6.9

Treatment No.	Seedlot	GF Rating	No. plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq.m)	Volume (cu.m)	Mean * Prune Ht
1	9/3/86/70	LI23 (GF9)	2	217	102	13.9	6.2	1.6	4.7	2.3
1	3/3/87/1	14	2	204	102	14.4	6.3	1.7	5.1	2.4
1	6/6/87/21	22	1	179	102	14.8	6.1	1.8	5.1	2.1
2	9/3/86/70	LI23 (GF9)	2	383	204	13.5	5.9	2.9	8.5	2.1
2	3/3/87/1	14	2	465	204	15.0	6.8	3.6	11.4	2.7
2	9/0/83/96	17	2	465	204	14.8	6.7	3.5	10.9	2.6
2	6/6/87/21	22	1	480	204	16.0	7.2	4.1	13.5	2.6
3	9/3/86/70	LI23 (GF9)	1	837	408	14.7	7.1	6.9	22.7	2.8
3	3/3/87/1	14	2	847	408	14.9	6.8	7.1	22.5	2.7
3	6/6/87/21	22	2	888	408	15.1	6.7	7.3	22.9	2.7
4	9/3/86/70	LI23 (GF9)	1	1333	608	14.1	7.0	9.5	30.8	2.4
4	3/3/87/1	14	2	1324	608	15.1	7.1	10.9	35.5	3.1
4	6/6/87/21	22	2	1226	608	14.8	6.9	10.4	33.7	3.0
5	9/3/86/70	LI23 (GF9)	2	500	500	12.3	5.7	6.0	17.4	0.0
5	3/3/87/1	14	2	464	464	14.7	6.1	7.8	23.2	0.0
5	6/6/87/21	22	2	449	449	14.2	6.2	7.1	21.1	0.0
6	9/3/86/70	LI23 (GF9)	2	434	434	14.2	6.2	6.9	20.6	2.2
6	3/3/87/1	14	2	444	444	14.8	6.5	7.7	23.7	2.5
6	6/6/87/21	22	2	475	475	14.6	6.3	8.0	24.0	2.3
7	9/0/83/96	17	2	174	174	14.2	6.5	2.7	8.5	2.6

* Mean Prune ht 0.0 = unpruned plot

FR 57, TIKOKINO Forest

This trial was planted in August 1988 with a split plot design containing 36 rectangular 45 x 36m plots and occupying 5.8 hectares (NZFRI WP No.1633; Townley and Wilcox, 1988). Silvicultural treatments were assigned to major-plot treatments and stock types to minor-plot treatments. A Nelder trial was planted at the same time on an adjacent site. The condition of the tree stock at time of planting was not ideal, some of the cuttings being particularly dry and the seedlings damaged by late frosts.

Planting, pruning and establishment operations were complicated because the land was up for sale and there were problems with land ownership. The land has since been purchased by NZFRI in 1995.

The first measurements of total height only were taken in August 1991 (age 3 years). Pruning, PSP plot establishment and thinning was carried out (as per the basic field procedures) during December, 1993 (age 5.6 years). The trial MCH at the time of plot establishment was 6.3m.

Trial Design

This trial was designed with seven silvicultural treatments and three different seedlots, with each seedlot/silvicultural treatment combination replicated twice (Table 13). All treatment combinations were randomly allocated within field replications.

TABLE 13. Trial design for FR 57, Tikokino Forest

Silviculture					Planting stock[1]		
Trt	Pruning	Thinning			Seedlings		Cuttings
		Initial	Final	MCH (m)	GF19 2/6/87/35 A	LI15 (GF10) 3/3/87/3 B	GF17 2/3/84/53 C
1	✓	250	100	6.2	••	••	••
2	✓	500	200	6.2	••	••	••
3	✓	1000	400	6.2	••	••	••
4	✓	1500	600	6.2	••	••	••
5	✓	500	200	20	••	••	••
6	x	600	600	-	••	••	•■
7	✓	400	400	-	••	••	•■

1 Each • represents one PSP plot with a buffer which receives the same treatment as the inner PSP plot. Each ■ represents a plot that was planted but not established as a PSP.

Pruning

Pruning was carried out by a Carter Holt Harvey contractor with no supervision by NZFRI staff during the first week in December 1993. FRI staff returned in February, 1994, to tidy up the very poor quality pruning. 90% of the trees had not been pruned to the specifications. On average 2 extra whorls per tree had to be removed plus epicormics and missed branches low down. Prune heights of all crop trees were remeasured at this time by NZFRI staff. The DOS measurements (DOS, DOS height and maximum branch diameter) were recorded at the time of plot establishment. The average crown remaining after the 'second' prune was 3.8m (mean pruned height 2.5m).

PSP Plot Establishment

Forty permanent sample plots were established by three NZ FRI staff, beginning on 6 December, 1993 (a total of 24 mandays). This trial was grazed by cattle and sheep prior to plot establishment. Many corner pegs had been knocked over and required repegging. Two plots (36/26 and 42/27) were not established due to mortality (Table 13). Table 14 shows the plot establishment requirements for each of the assigned treatments.

TABLE 14. Plot establishment specifications, FR 57, Tikokino Forest

Trt	Plot Area	Spacing	No. trees planted	Initial no. trees buffer : plot		Final no. trees buffer : plot		Thinning ratio	PSP Plots	Pruning
1	0.1960	4 x 10	81	32	49	13	20	2.5 : 1	6	4m crown
2	0.0980	4 x 5	81	32	49	13	20	2.5 : 1	8	"
3	0.0490	4 x 2.5	81	32	49	13	20	2.5 : 1	8	"
4	0.0510	4 x 1.6	126	42	84	16	33	2.5 : 1	6	"
5	0.0980	4 x 5	81	32	49	32	49	late thin	6	None
6	0.0980	4 x 5	81	32	49	32	49	1 : 1	6	4m crown
7	0.0980	4 x 11.3	36	22	14	22	14	1 : 1	2	"

Measurements were taken and recorded as described in the section on 'Basic field procedures'. The height trees were measured for prune height, DOS, DOS height and maximum branch diameter two months after plot establishment, when the corrective pruning was carried out.

Thinning

Thinning was carried out by NZ FRI field staff following plot establishment (a total of six mandays). Thinning was carried out more quickly than normal as mortality resulted in much fewer trees to fell. However, most plots were thinned according to plan. Only the unthinned plots had noticeably fewer trees than the scheduled treatment.

Trial Layout and Site Information

The following information was recorded at the time of planting:

Altitude:	240 m
Soil Type:	Kopua Series
Site Preparation:	Rotary hoed to a depth of 20 cm
Weeds:	Thistle, ryegrass, ragwort, yarrow
Regeneration:	Nil
Slope:	Average 5°
Aspect:	SSW
Previous land use:	Seed Orchard

Only 40 of the original 42 plots planted were established as PSPs at this site (see map, Figure 4). The original planting peg numbers are shown at the plot corners as well as codes for treatment and seedlot (Tables 13 & 14). This trial is a flat and grassy site, was easy to establish and will be very easy to remeasure.

Mortality at this site was high and more prevalent in cuttings. Sixteen plots had more than 20% mortality and ten plots more than 10% mortality. However, most plots are at the prescribed final crop stocking after thinning. Plots in treatment 6 (initial stocking 600 stems/ha and unthinned), however, have noticeable mortality, with an average stocking at plot establishment of 450 stems/ha.

Plot data

A summary (Table 15) at the time of the first measurement (age 5.6 years) shows data (mean diameter, mean height, basal area, volume and prune height) summarised by treatment and seedlot. No statistical analysis has yet been carried out and any trends in data may not persist over time. The following trend was noted:

- Treatments 3 and 4 (400 & 600 stems/ha) are taller on average than the other treatments.

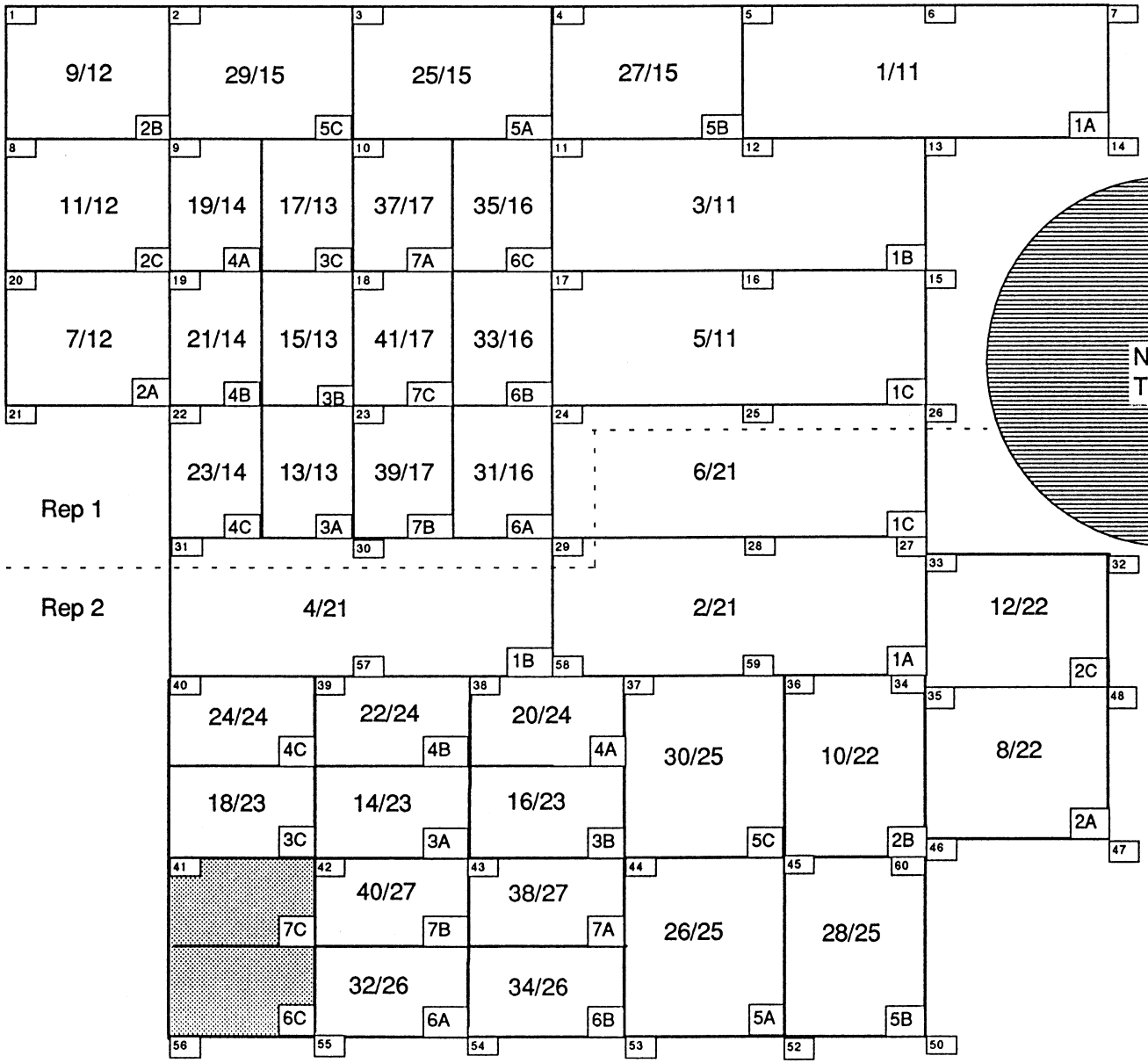
STAND GROWTH MODELLING COOPERATIVE
Silviculture/Breed Trial

FR 57

Tikokino Forest

Planted 1988

Holden Road



Nelder Trial

N

Seedlots
A = GF19, '268' control pollinated
B = GF10 (LI15), long internode
C = GF17, '268' cuttings

Treatments
1 = 250 to 100, pruned
2 = 500 to 200, pruned
3 = 1000 to 400, pruned
4 = 1500 to 600, pruned
5 = 500 to 200, late thin, pruned
6 = 600 unthinned, unpruned
7 = 400, unthinned, unpruned

plots not established

FIGURE 4

TABLE 15. **FR 57 : TIKOKINO FOREST**
Summary of Trial Data at age 5.6

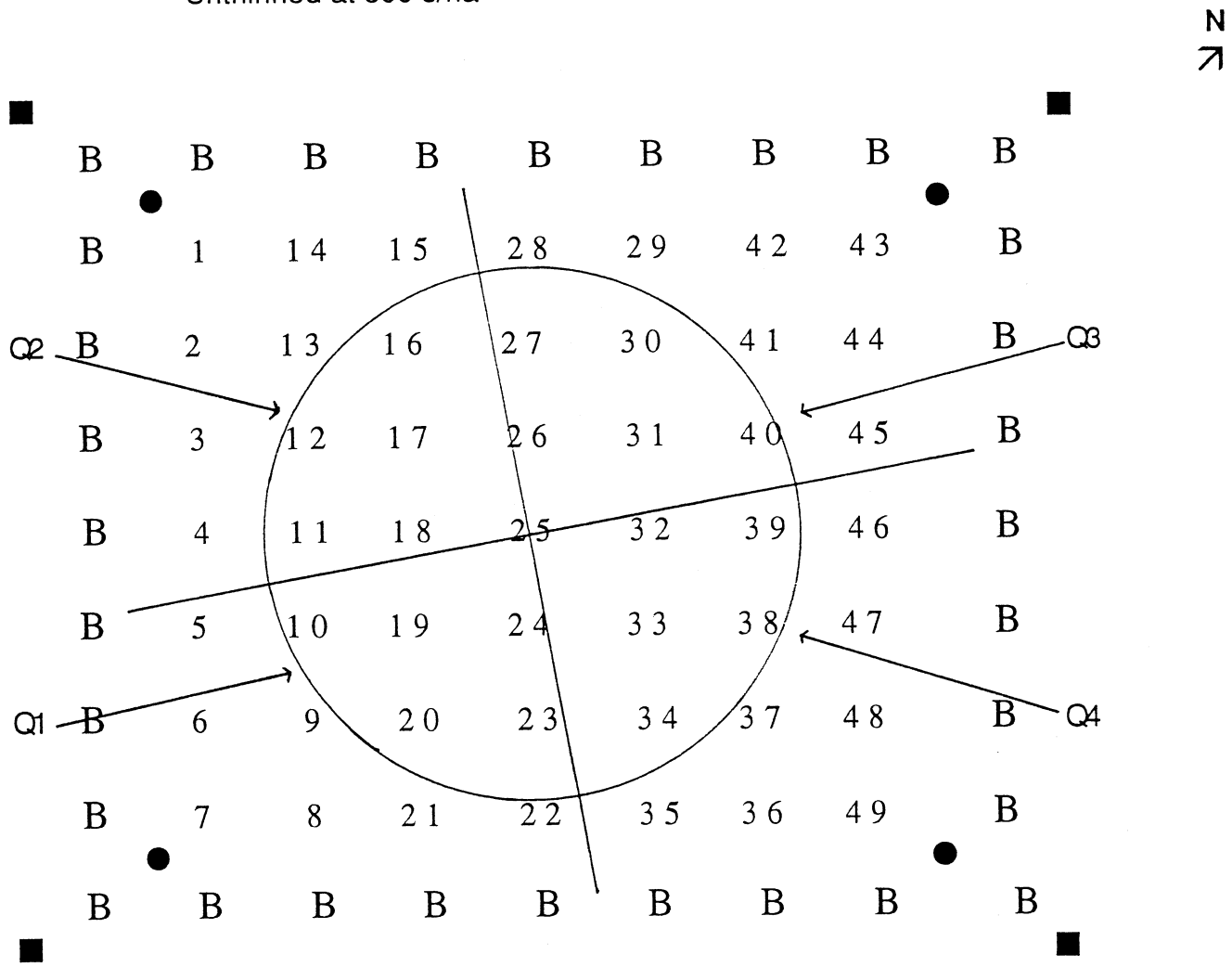
Treatment No.	Seedlot	GF Rating	No. Plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq. metres)	Volume (cu. metres)	Mean * Prune Ht
1	3/3/87/3	LI15 (GF10)	2	225	100	12.7	6.3	1.3	3.9	2.2
1	2/3/84/53	17	2	156	102	11.4	6.1	1.1	3.3	2.3
1	2/6/87/35	19	2	245	102	15.0	6.9	1.8	5.9	3.0
2	3/3/87/3	LI15 (GF10)	2	408	204	13.1	6.7	2.8	8.9	2.6
2	2/3/84/53	17	2	383	204	12.2	6.6	2.4	7.7	2.5
2	2/6/87/35	19	2	449	204	13.6	6.8	3.0	9.5	2.8
3	3/3/87/3	LI15 (GF10)	2	939	408	13.0	7.1	5.4	18.1	2.9
3	2/3/84/53	17	2	500	408	11.3	6.4	4.1	13.0	2.3
3	2/6/87/35	19	2	878	408	13.5	7.2	5.9	19.7	2.9
4	3/3/87/3	LI15 (GF10)	2	1473	607	12.2	7.1	7.1	24.3	3.0
4	2/3/84/53	17	2	1018	607	11.1	6.4	5.9	19.1	2.3
4	2/6/87/35	19	2	1295	616	13.8	7.4	9.1	30.9	3.3
5	3/3/87/3	LI15 (GF10)	2	429	429	9.9	5.8	3.3	10.2	2.3
5	2/3/84/53	17	2	352	352	11.6	6.3	3.6	11.4	2.6
5	2/6/87/35	19	2	403	403	13.1	6.5	5.5	17.4	2.7
6	3/3/87/3	LI15 (GF10)	2	529	529	9.2	5.2	3.6	9.8	0.0
6	2/3/84/53	17	1	514	514	10.3	5.6	4.3	12.7	0.0
6	2/6/87/35	19	2	300	300	12.6	6.2	3.8	11.7	0.0
7	3/3/87/3	LI15 (GF10)	2	371	371	10.2	5.9	3.0	9.5	0.0
7	2/3/84/53	17	1	371	371	7.5	4.9	1.6	4.8	0.0
7	2/6/87/35	19	2	357	357	12.9	5.8	4.7	12.5	0.0

* Mean Prune Ht 0.0 = unpruned plot

Appendix 1

Location of Buffers and Permanent Sample Plots

Example 1 Treatment 2
4 x 5 m spacing
Unthinned at 500 s/ha

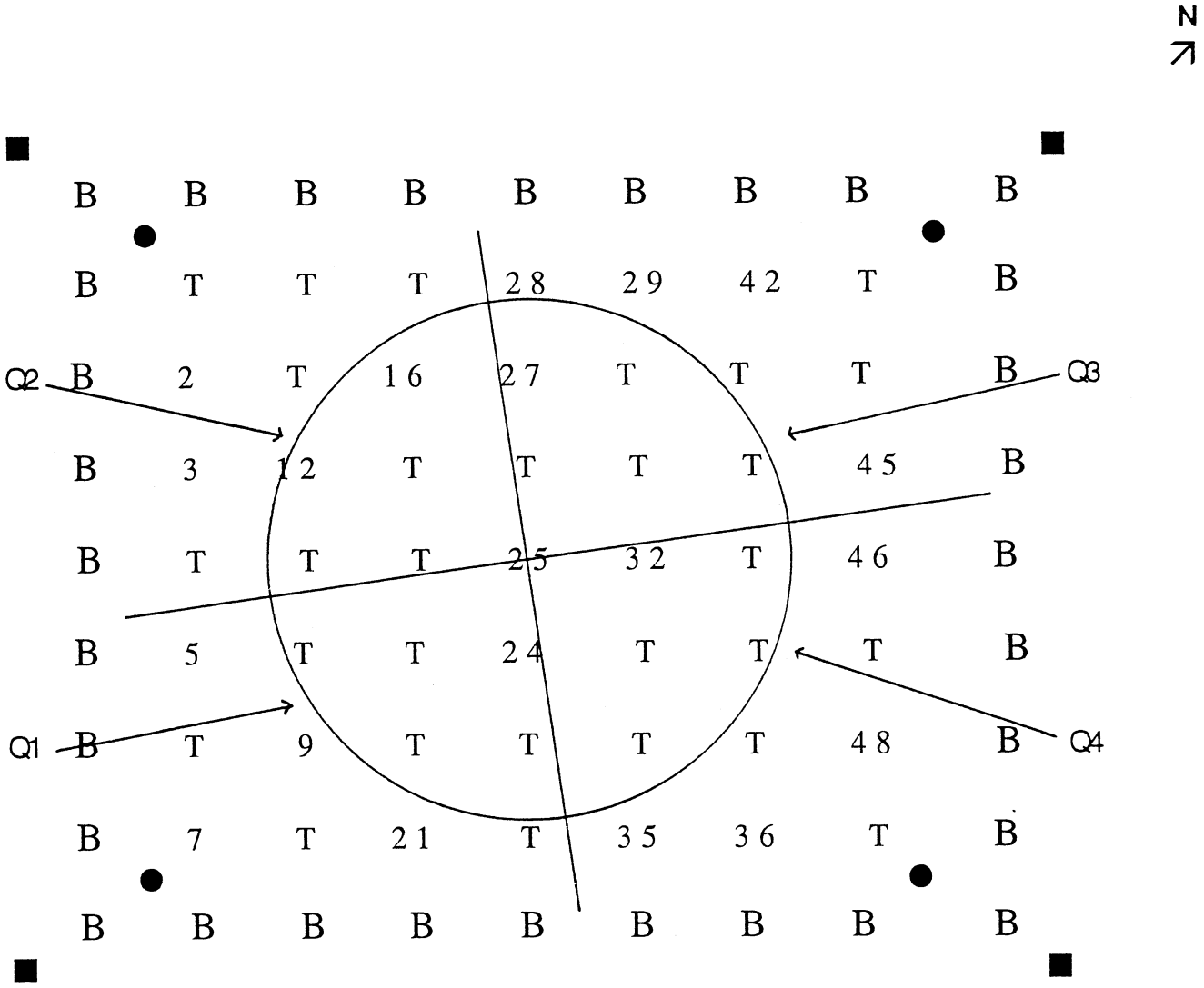


⊙	Inner circular plot, 11.3m radius, to determine position of predominant height trees
Q1, Q2, Q3, Q4	Quadrants to determine the predominant height trees
B	Buffer tree
1,4,7, ...	Plot trees
25	Plot centre
■	Planting corner peg
●	PSP Plot corner peg

Appendix 1 cont.

Location of Buffers and Permanent Sample Plots

Example 2 Treatment 2
4 x 5 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 Plot 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 54/0/28/24 is made up of the following fields:

CONS	=	Regional Code
EXPNO	=	Experiment / trial number as allocated by FRI
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 54/0/28/24 is plot 28 of trial FR 54. The plot replication number is 2 and the treatment is 4.

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

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