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ESTABLISHMENT REPORT FOR THE 1987 SILVICULTURE/BREED TRIALS

J. A. SKINNER
J. D. DUNLOP
S. D. CARSON

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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 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 and 24a).

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 (PSP's) in the six silviculture/breed trial sites planted in 1987.

Plot establishment and silvicultural treatment has gone for the most part according to plan. PSP's 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.

CONTENTS

INTRODUCTION

This report describes basic field procedures for pruning, thinning and establishment of PSPs in the Silvicultural/Breed trials. Pruning, PSP establishment and thinning of the plots in the 1987 plantings of the Silviculture/Breed trial series is fully 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 (Stand Growth Modelling Cooperative Reports 24 & 24a).

Seedlots in most trials represent a wide range of improvement ratings. Long internode seedlot and/or cuttings with high improvement ratings are included at many sites. Many trials include treatments which represent local seedlots and/or locally favoured silvicultural regimes.

The primary objective of this series of trials is to compare the performance of the genetically improved breeds of radiata pine at varying levels of initial and final crop stockings on sites with varying qualities and to provide data for growth modelling. A secondary objective is the demonstration of genetic gain over the eight major forest growing regions in New Zealand.

The design of these trials allows for comparison of response of improved seedlots to different final crop stockings and thinning strategies, comparisons among seedlots for a given silvicultural regime, comparison among sites of different quality within regions, and comparison among regions. The 1987 trials are designed to have common treatments over all locations, with some testing of specific silvicultural treatments relevant to particular locations and forest management requirements (Carson 1987, Moore 1988).

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 existing growth models can be modified to reflect growth increases due to genetic improvement.

TRIAL LOCATIONS

Trials were planted at six sites (Table 1) in 1987 in the first series of the Silviculture/Breeds trials. The sites were chosen to cover a range of site quality from high basal area to low site index.

Table 1. Trial sites planted in 1987 as part of the Silviculture/Breeds trial series.

Trial No.	Location	Owner	Region	BA Fertility
FR 7	Woodhill	Carter Holt Harvey Forests	Auckland	Low/medium
FR 8	Tahorakuri	Tasman Forestry Ltd	Central North Island	Medium
FR 9	Kaingaroa	Forestry Corporation NZ Ltd	Central North Island	Medium
FR 10	Glengarry	Carter Holt Harvey Forests	Hawkes Bay	High
FR 11	Ditchlings	Tasman Forestry Ltd	Marlborough	Medium
FR 12	Otago Coast	Wenita Forestry Ltd	Southland	Medium

CORE EXPERIMENTAL DESIGN

The core experimental design consists of six silvicultural treatments (Table 2) carried out on each of four seedlots. Each seedlot / silvicultural treatment is replicated twice at each of the six trial locations.

Treatments and seedlots were randomly assigned to field replications in an incomplete block design (Carson, 1987 and Moore, 1988 for planting details and for statistical design). Planting spacings and plot areas vary with treatment (Table 2).

The timing of pruning and thinning is dependent on a specified mean crop height (MCH) being achieved.

Table 2. Silviculture treatments in the core experimental design of the 1987 Silviculture/Breeds trials.

Trt	Plot Area (ha)	Spacing (m)	Pruning (crown left)	Thinning (s/ha)	Ratio	MCH(1)
1	0.1960	4 X 10 4 X 5	4m 4m	Three sites 250 - 100 (2) Three sites 500 - 100 (2)	2.5:1 5:1	6.2m
2	0.0980	4 X 5	4m	500 - 200	2.5:1	6.2m
3	0.0490	4 X 2.5	4m	1000 - 400	2.5:1	6.2m
4	0.0510	4 X 1.7	4m	1500 - 600	2.5:1	6.2m
5	0.0980	4 X 5	None	500 - 500	1:1	-
6	0.0980	4 X 5	4m	500 - 200	2.5:1	20 - 25m (3)

(1) See individual trial sections for actual establishment MCH at each site.

(2) The three sites planted at 250 s/ha for treatment 1 were Kaingaroa, Ditchlings and Otago Coast. The remaining three sites (Woodhill, Tahorakuri and Glengarry) were planted at 500 s/ha for treatment 1.

(3) Treatment six was inadvertently thinned at PSP establishment (MCH 6.2m) in Glengarry and Tahorakuri. At these sites this treatment is now equivalent to treatment two.

Four seedlots were used at the six sites. They were:-

1) Seedlot No. 6/3/86/46, GF 21 - a general purpose "268" series seedlot produced by controlled pollination among the best clones.

2) Seedlot No. 9/3/86/166, LI 28 (GF 13) - a long internode "870" series seedlot, control-pollinated by crossing the "best 5" clones specifically for longer clearwood lengths.

3) Seedlot No. 3/3/85/01, GF 14 - a general purpose "850" series seedlot, a commercial seed orchard seedlot which has been commonly used throughout New Zealand.

4) Seedlot No. FRI79/2320, GF 7 - a Kaingaroa climbing select seedlot, from a Kaingaroa forest-wide collection.

A nursery buffer of "850" series stock (Seedlot No. 2/3/85/012) was used at each site as buffer trees between plots.

Three sites (Woodhill, Tahorakuri and Glengarry) had additional plots installed at the request of the forest owner concerned (see individual trial sections for details).

The planting dates were:-

FR 8	Tahorakuri	June 1987
FR 7	Woodhill	June - July 1987
FR 10	Glengarry	July 1987
FR 9	Kaingaroa	July 1987
FR 11	Ditchlings	August 1987
FR 12	Otago Coast	August 1987

The first treatment and PSP establishment dates were:-

FR 10	Glengarry	February - March 1992
FR 8	Tahorakuri	March 1992
FR 7	Woodhill	November - December 1992
FR 11	Ditchlings	January - February 1993
FR 9	Kaingaroa	February - March 1994
FR 12	Otago Coast	March 1994

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 (see trial maps) in the trials are located, 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

a) NZ FRI Mensuration field staff meet with the pruning gang and explain the pruning specifications to be used.

Trees are pruned to leave 4m crown remaining[1]. The crop tree selection criteria is based on size, form and spacing in that order with an emphasis of 50:40:10. Only the crop trees are pruned.

b) NZ FRI 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 4 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 thinning treatment number. Seedlot and GF rating are specified in the PSP variables 'Seedlot' and 'Improvement rating'. (Dunlop, 1994)

Husky HUNTER data loggers are used to record all measurements.

Establishment follows a standard procedure (Appendix 1):

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

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

[1]Trials at Glengarry and Tahorakuri are pruned to a 10cm gauge. This was changed to the current practice in June 1992, after discussions with Cooperative members and FRI staff.

c) The diameter of all trees within the plot are measured. A diameter band is painted with spray paint and a numbered aluminium tag is stapled onto all crop trees (ie. those not selected for thinning at the time of pruning). Trees are numbered consecutively from the Northwest corner moving 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 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 on the ground.

e) Twelve height trees are selected from the crop element; four of these are predominant height trees (used to calculate predominant mean height, PMH), the remaining eight are selected to cover the range of diameters present in the plot (they must not include trees with dead or broken tops or unusually large diameters). They are referred to as sample height trees. A predominant height tree is selected as the tallest tree in 0.01ha. This is found by dividing a circle with diameter of 11.3m, within the plot, into quadrants. (Appendix 1). Each height tree, whether predominant or sample, is measured for total height, pruned height, DOS, DOS height and maximum branch diameter.

3) Thinning

Thinning is carried out by the NZ FRI 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 REPORTS

FR 7 - WOODHILL FOREST, Compartment 86

This trial was planted in June 1987. The trial was released by hand (from the lupin) during early 1988 by local forestry and GTI staff. At the same time obvious regeneration was removed. The first measurements, of total height only, were taken in May 1989 (2 years old).

Pruning, PSP establishment, and thinning of FR 7 was carried out (as per the basic procedures) during late November to early December, 1992. Trial MCH at time of plot establishment was 6.9m.

At Woodhill Forest there are six plots additional to the core experimental design, each with a unique silvicultural treatment (Table 3). These plots were planted with Seedlot No. 2/6/86/29 (GF 19). There are three different initial crop stockings each of two plots. These plots were treated at the same time as the rest of the trial.

Table 3. Additional silvicultural treatments in FR 7 (Woodhill Forest).

Plot No.	Treatment	Initial Stems/Ha	Final Stems/Ha	Pruning(1)	MCH
49	7	800	250	Best 250 s/ha to 2.2m	6.9m
50	8	800	320	Best 320 s/ha to 2.2m	6.9m
51	9	1000	320	Best 320 s/ha to 2.2m	6.9m
52	10	1000	250	Best 250 s/ha to 2.2m	6.9m
53	11	1200	250	Best 250 s/ha to 2.2m	6.9m
54	12	1200	320	Best 320 s/ha to 2.2m	6.9m

(1) All remaining trees in these plots will be pruned to 6.0m with a target DOS of 19cm.

Trial Establishment

The following information was recorded at the time of planting:

Altitude: 80 m

Soil Type: Recent sand

Site preparation: Slash piled in rows

Weeds: Lupin, pampas and some gorse

Regeneration:	Generally light but heavy on the elevated slopes
Slope:	Average of 5 - 10 °
Aspect:	Facing west
Previous land use:	Pinus radiata forest

Pruning

Ian McKinley (NZ FRI) replaced all missing pegs on 30/11/92 and supervised the pruners until they became familiar with the pruning specifications. Missing pegs had been knocked over by cattle while grazing.

The pruning of the core experimental design was carried out by NZ FRI staff, according to specifications. This gave an average crown remaining of 4.4m (actual mean prune height 2.6m) over the whole trial. They started pruning on 30/11/92 and finished on 12/12/92 (approx 30 man-days). Selection of trees in treatments 3 and 4 required care because the planters had to move some trees to avoid stumps and logs during planting, which resulted in somewhat crooked rows. There were three or four people pruning on any one day. The pruning of the six other plots treated as per Carter Holt Harvey Forests prescription was completed on 14/12/92.

PSP Establishment

The Permanent Sample Plots were established, while pruning was continuing, during the week beginning 7/12/92. There were two crews of three people for the first week and one four man crew the following week.

During the first week, the crews consisted of Ian McKinley, Steve Gatenby, Dianne Sanders and Todd Cheeseman (NZ FRI Mensuration) with help from Allister Cooper (Carter Holt Harvey Forests forestry student) and Ken Harcombe (Carter Holt Harvey Forests Mensuration staff).

The following week Ian McKinley, Todd Cheeseman, Allister Cooper and Ken Harcombe finished the plot establishment in the core treatments.

Diameters of all plot trees were measured before thinning. Six height trees (all final crop trees) per plot were selected and measured before thinning for height, pruned height, DOS, DOS height and maximum branch. The required twelve height trees, including the four predominant height trees, were selected and measured at the first winter remeasurement.

The Carter Holt Harvey Forests plots (49 - 54 inclusive) were tagged and measured by Ian McKinley, Todd Cheeseman and Allister Cooper at the same time as the plots were established in the core treatments. Allister Cooper and Ken Harcombe finished the plot establishment and thinning in these plots the following

week. Plot 49 was not measured for total height or prune height at establishment. These have been recorded at subsequent measurements.

Thinning

The thinning of the plots in the main trial was carried out over two days by Ian McKinley, Todd Cheeseman and Allister Cooper (15-16/12/92), for a total of six man-days.

Trial Layout and Site Condition

A total of 54 plots were established at this site. A map, not to scale, (Figure 1) shows the location of each plot. The numbers at the plot corners are the original planting peg numbers.

This trial is on a flat to rolling grassy site. Seedlings were released from lupin in 1988 and there are presently no weed problems. Mortality was high (>10%) in 20 of the 54 plots at establishment, but this did not affect the selection of final crop stocking. Growth appears to be reasonably uniform over the whole trial.

Plot Data

A summary of the measurement data (Table 4) at the time of establishment shows data summarised by treatment and seedlot number (GF rating).

No statistical analysis has yet been carried out and trends in the data may not persist over time. The following trends were noted:

- The long internode seedlot generally shows a smaller basal area but a larger mean height.
- Treatments 3 (400 s/ha) and 4 (600 s/ha) are slightly taller on average.

Acknowledgment

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

TABLE 4

FR 7 : WOODHILL FOREST

Summary of trial data at age 6.0

(1st winter measurement June 1993)

Treatment No.	Seedlot	GF Rating	No. plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq. metres)	Volume (cu. Meters)	Mean * Prune Ht (m)
1	FRI79/2320	7	2	503	102	15.8	7.8	2.0	5.4	2.8
1	9/3/86/166	LI 28 (GF13)	2	516	102	15.0	8.0	1.8	5.0	2.8
1	3/3/85/01	14	2	500	102	16.3	7.8	2.1	5.8	2.7
1	6/3/86/46	21	2	515	102	15.8	7.6	2.0	5.2	2.4
2	FRI79/2320	7	2	500	204	14.6	7.6	3.4	9.1	2.5
2	9/3/86/166	LI 28 (GF13)	2	500	199	14.5	7.7	3.3	9.1	2.2
2	3/3/85/01	14	2	500	204	15.9	7.7	4.1	10.8	2.6
2	6/3/86/46	21	2	500	204	16.2	7.7	4.2	11.2	2.7
3	FRI79/2320	7	2	1010	408	14.1	8.4	6.3	19.0	2.9
3	9/3/86/166	LI 28 (GF13)	2	1010	408	13.8	8.3	6.1	17.9	2.7
3	3/3/85/01	14	2	1010	408	14.3	7.8	6.5	17.9	2.4
3	6/3/86/46	21	2	1010	408	15.1	8.3	7.3	21.1	3.0
4	FRI79/2320	7	2	1559	608	12.7	7.5	7.6	20.6	2.4
4	9/3/86/166	LI 28 (GF13)	2	1510	608	12.7	8.5	7.7	24.0	2.7
4	3/3/85/01	14	2	1520	608	13.6	8.3	8.8	26.1	3.0
4	6/3/86/46	21	2	1539	608	13.8	8.4	9.1	27.4	2.6
5	FRI79/2320	7	2	505	485	14.0	7.6	7.5	20.1	0.0
5	9/3/86/166	LI 28 (GF13)	2	515	434	13.8	7.5	6.4	17.5	0.0
5	3/3/85/01	14	2	505	470	13.4	7.0	6.6	16.7	0.0
5	6/3/86/46	21	2	516	485	14.3	7.3	7.7	20.1	0.0
6	FRI79/2320	7	2	500	414	14.6	7.7	6.9	18.9	2.5
6	9/3/86/166	LI 28 (GF13)	2	516	475	12.9	7.6	6.2	16.9	2.1
6	3/3/85/01	14	2	500	465	13.9	7.7	7.0	19.4	2.6
6	6/3/86/46	21	2	515	480	13.7	7.3	7.2	18.8	2.4
7	2/6/86/29	19	2	340	289	14.8	7.7	5.0	13.5	2.7
8	2/6/86/29	19	2	322	286	14.1	7.9	4.5	12.5	2.9
9	2/6/86/29	19	2	1226	296	14.1	8.0	4.6	13.0	3.0

* Prune Ht 0.0 = unpruned

FR 7/0
Woodhill Forest Cpt 86

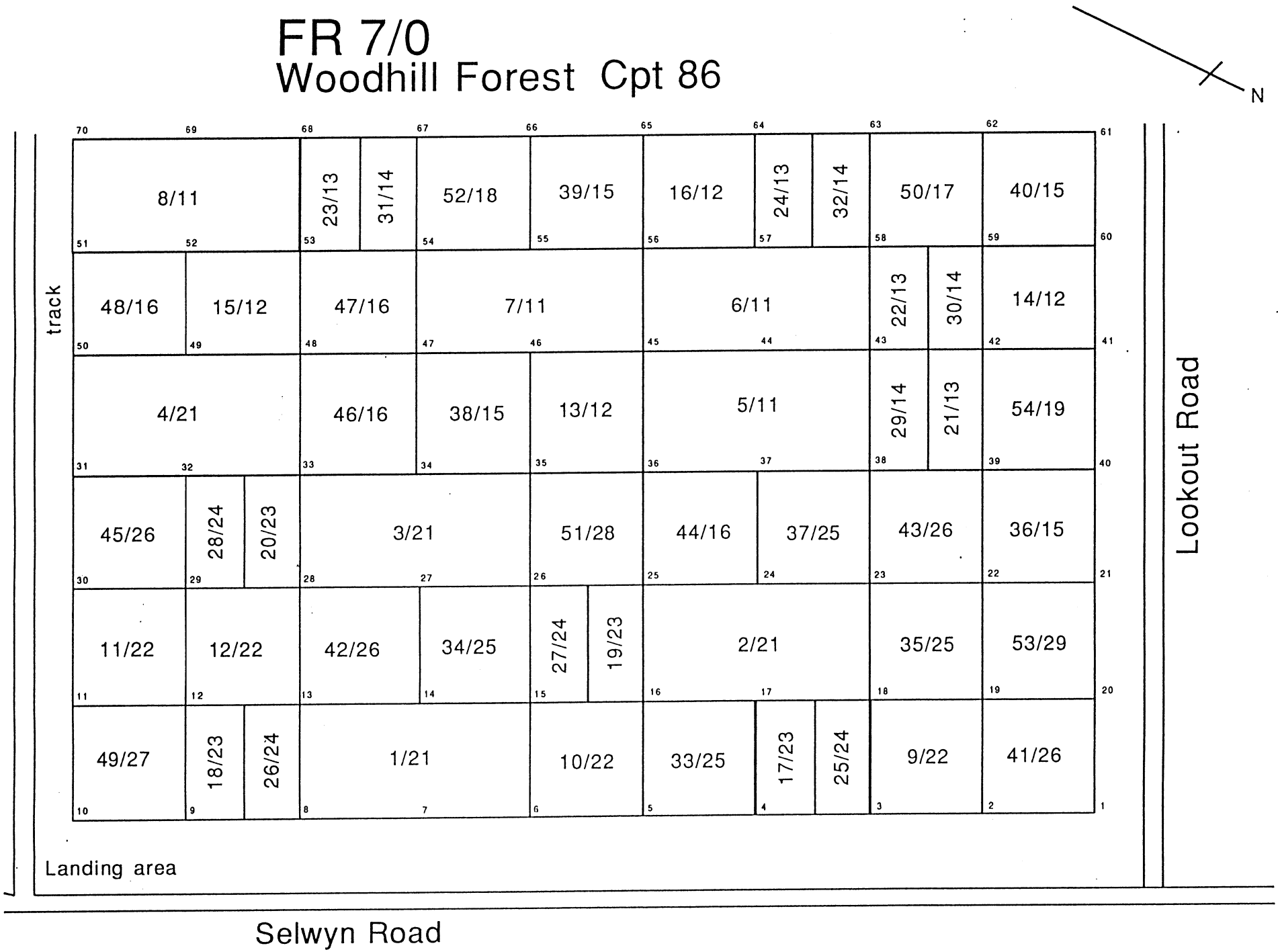


Figure 1

FR 8 - TAHORAKURI FOREST, Compartment 8346

This trial was planted in June 1987. The first measurements, of total height only, were taken in September 1988 (age 1 year). Some radiata regeneration was pulled out by GTI field crew between 1988 and 1990. The trial also had radiata regeneration cut out by Tasman Forestry staff in April 1991. At this stage it was competing with the planted radiata (4.5m MCH).

Pruning, plot establishment and thinning of FR 8 was carried out (as per the basic procedures) during mid to late March 1992. Trial MCH at time of plot establishment was 6.0m.

At Tahorakuri Forest there are six plots additional to the core experimental design. These are planted with "268" stock ("Best 16", GF 21, NZFP). There are two silvicultural treatments, each with three plots (Table 5). Treatment 7, no thinning, was pruned at the time of plot establishment and also received a second pruning at age 6.5 years (MCH 10.0m). Treatment 8, is still to have the silvicultural operations completed (Table 5).

Table 5. Additional silvicultural treatments in FR 8 (Tahorakuri Forest).

Plot Nos	Treatment	Initial Stems/Ha	Final Stems/Ha	Pruning (Crown left)	MCH
49 - 51	7	1000	1000	500 s/ha to leave 4m	6.2m
			1000	300 s/ha to leave 4m	9m
52, 54	8	1000	-	300 s/ha to leave 4m	9m
			-	300 s/ha to leave 4.5m(1)	
			250	250 s/ha to leave 5m	18m
53	8	1000	450	nil	4.5m
				300 s/ha to leave 4m	9m

(1) The timing of the medium pruning is unknown. Plot 53 was accidentally thinned prior to plot establishment and consequently now has a different treatment than planned.

Trial Establishment

The following information was recorded at the time of planting:

Altitude: 375m

Soil Type: Pumice

Site preparation:	Cutover site, V-blading, no burning
Weeds:	Blackberry and gorse
Regeneration:	Medium, especially near mature stand
Slope:	Average 10 °
Aspect:	Facing north east
Previous land use:	Pinus radiata forest

Pruning

The pruning was undertaken, beginning on 9/3/92, by the Forestry Training Centre under contract to Tasman Forestry Ltd. FRI Mensuration crew supervised the pruning selection. Two crews of eight pruned the selected trees to a 10cm gauge rather than the standard prescription (see basic field procedures, p.4). This gave an average crown remaining of 4.5m (actual mean prune height of 2.7m) over the trial.

Silvicultural rate setting plots were scattered throughout the trial area, with 4-5 pruned trees in each rate setting plot. This meant that two plots had to have their treatments switched to compensate (Plots 11 and 35).

A great amount of upper stem sweep was noticed, especially in the long-internode seedlot. The long internode seedlot also had heavier branching.

Robert King (Tasman Forestry Ltd) organised the pruning. The whole operation was efficiently and accurately carried out.

A further unplanned pruning was carried out on all pruned plots by Tasman Forestry in October 1993 (MCH approx. 9m). All trees were variable height pruned to leave 4m of crown. The average prune height of the trial is now 4.5m. Further, plot 40/25 (unpruned treatment) was accidentally partially pruned and now cannot be considered as an unpruned / unthinned treatment (Table 6).

PSP Establishment

The Permanent Sample Plot establishment was carried out between 10-25 March, 1992, by Wayne Blundell, Dianne Sanders, Dianne Jepson, Steve Gatenby and Ian McKinley (NZ FRI). It took 28 man-days to establish the plots.

Diameters of all plot trees were measured before thinning. Pruned height and total height of twelve height trees were measured and recorded during the first winter measurement in May 1992, but not at the time of plot establishment. The predominant height trees were also allocated at this measurement.

Thinning

The thinning took a total of 6 man-days and was done by Ian McKinley and Steve Gatenby. Three plots (21/23, 29/24 and 53/28) were thinned in error during the regeneration cutting operation carried out by Tasman Forestry, in 1991, prior to plot establishment. This prevented the prescribed regime from being implemented in these plots. Plot 21 has the same final crop stocking as for treatment three but was thinned prior to the rest of the trial (Table 6). Plot 29 does not have the same final crop stocking as for treatment four and thus represents an additional treatment (Table 6). Plot 53, one of the additional plots to be treated as per the forest owners schedule, now has a different treatment to plots 52 and 54 (Table 5).

Table 6. Silvicultural treatments in the core design for FR 8 (Tahorakuri Forest)

Treatment	Plot nos.	Initial Stems/Ha	Final Stems/Ha	Pruning (crown left)	MCH
1	1 - 8	500	100	4m 4m	6.2m 9m
2	9-16	500	200	4m 4m	6.2m 9m
3	17-20, 22-24	1000	400	4m 4m	6.2m 9m
3a	21	1000 500	500 400	- 4m	4.5m 6.2m
4	25-28, 30-32	1500	600	4m 4m	6.2m 9m
4a	29	1500 400	400 400	- 4m	4.5m 6.2m
5	33-39	500	500	None	-
5a	40	500	500	4m	9m
6	41-48	500	200	4m 4m	6.2m 9m

Note: Treatments 3a, 4a and 5a are now new treatments, originally unscheduled.

Trial Layout and Site Condition

A total of 54 plots were established at this site. A map, not to scale, (Figure 2) shows the location of each plot. The numbers at the plot corners are the original planting peg numbers.

This trial has a gentle, uniform slope. Natural regeneration was a major problem by 1991, care was required to remove this. More recently blackberry has become, and remains, a problem. Approximately 50% of the plots are badly affected by blackberry and require slashing at each remeasurement. There was high mortality (>10%) in 8 of the 54 plots at the time of establishment. Selection of final crop stocking was not affected. There does not appear to be any major growth differences within the site.

Plot Data

A summary of the measurement data (Table 7) at the time of establishment shows data summarised by treatment and seedlot number (GF rating).

No statistical analysis has yet been carried out and any trends in the data may not persist over time.

Acknowledgment

NZ FRI would like to acknowledge Tasman Forestry Ltd for carrying out maintenance in the trial and organising the pruning at the time of plot establishment.

FR 8 : TAHORAKURI FOREST

TABLE 7

Summary of trial data at age 5.0

(1st winter measurement May 1992)

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	FRI79/2320	7	2	500	102	13.0	6.6	1.4	4.1	2.5
1	9/3/86/166	LI 28 (GF13)	2	500	105	13.5	7.5	1.5	5.0	2.7
1	3/3/85/01	14	2	500	100	13.9	7.4	1.5	4.9	2.8
1	6/3/86/46	21	2	500	102	14.2	7.4	1.6	5.2	3.0
2	FRI79/2320	7	2	500	204	13.2	6.6	2.8	8.4	2.2
2	9/3/86/166	LI 28 (GF13)	2	500	204	14.6	7.6	3.4	11.3	2.9
2	3/3/85/01	14	2	500	204	12.9	6.9	2.6	8.3	2.2
2	6/3/86/46	21	2	500	204	13.1	6.9	2.7	8.4	2.4
3	FRI79/2320	7	2	1000	419	12.8	7.4	5.4	17.7	2.5
3	9/3/86/166	LI 28 (GF13)	2	1000	408	12.2	6.8	4.8	14.9	2.5
3	3/3/85/01	14	1	1000	408	11.5	6.5	4.3	12.9	2.3
3	6/3/86/46	21	2	1000	408	12.8	7.1	5.2	16.7	2.6
4	FRI79/2320	7	1	1510	608	11.6	7.2	6.4	21.2	2.5
4	9/3/86/166	LI 28 (GF13)	2	1510	608	12.2	7.2	7.1	23.3	2.6
4	3/3/85/01	14	2	1510	608	12.6	7.5	7.6	25.3	2.3
4	6/3/86/46	21	2	1510	598	13.0	7.2	7.9	25.6	3.0
5	FRI79/2320	7	2	515	490	11.5	6.6	5.1	15.5	0.0
5	9/3/86/166	LI 28 (GF13)	2	515	424	11.7	5.9	4.5	12.6	0.0
5	3/3/85/01	14	2	515	465	11.8	5.9	5.1	14.5	0.0
5	6/3/86/46	21	2	515	480	12.3	6.8	5.7	17.6	0.0
6	FRI79/2320	7	2	515	204	13.1	7.0	2.8	8.6	2.7
6	9/3/86/166	LI 28 (GF13)	2	515	204	13.4	6.7	2.9	8.6	2.7
6	3/3/85/01	14	2	515	204	12.6	6.1	2.5	7.1	2.4
6	6/3/86/46	21	2	515	204	12.7	7.0	2.6	8.1	2.3
7	NZFP 268	21	3	920	831	11.9	6.8	9.3	29.3	2.3
8	NZFP 268	21	2	920	859	12.8	7.2	8.9	29.1	0.0

* Prune Ht 0.0 = unpruned

FR 8/0

Tahorakuri Forest

Cpt 8346

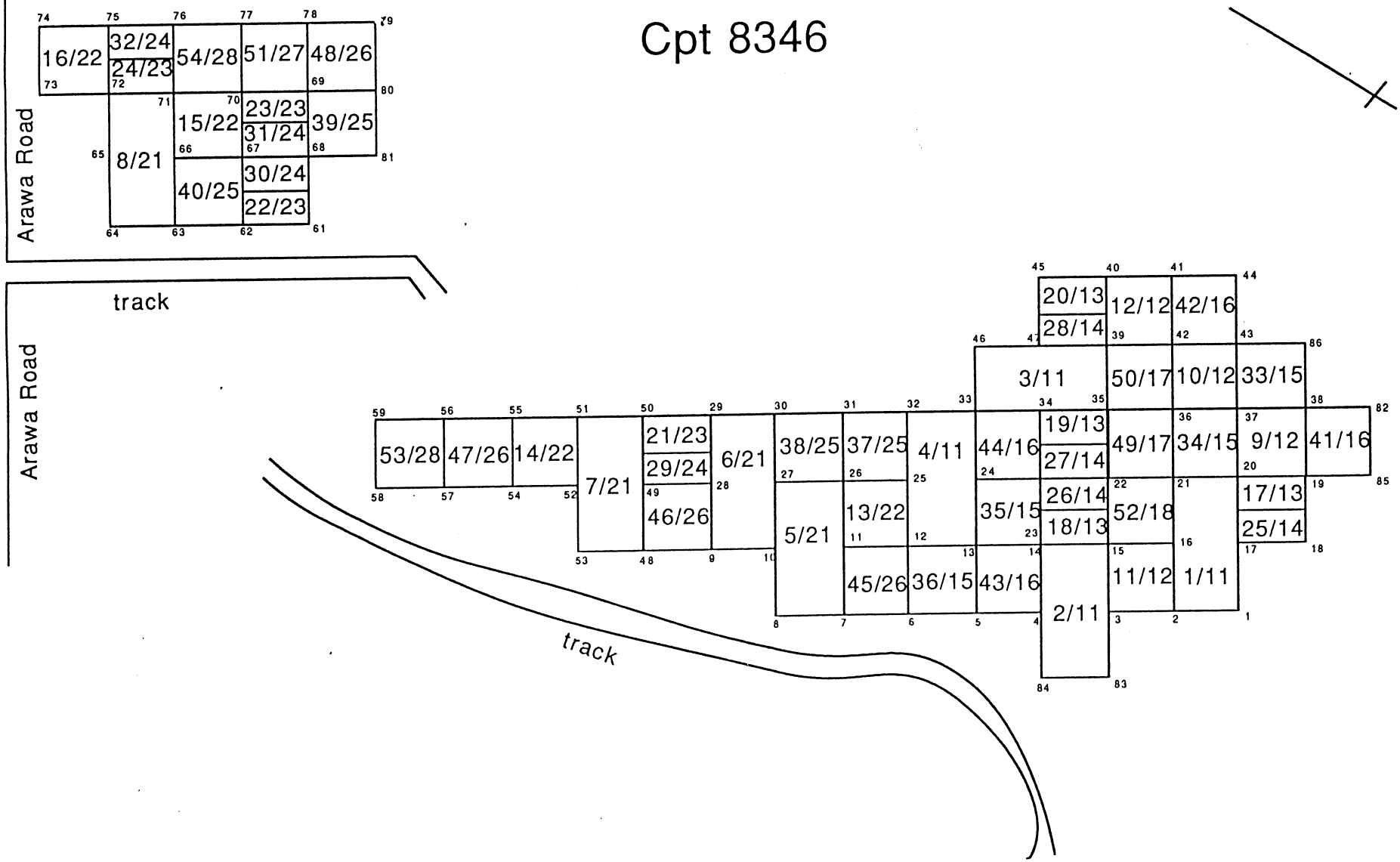


Figure 2

FR 9 - KAINGAROA FOREST, Compartment 481

This trial was planted in July 1987. The first measurements, total height only, were taken in July 1989 (age 2 years). No trial maintenance was required before plot establishment.

Pruning, PSP establishment and thinning of FR 9 in Kaingaroa Forest was carried out during late February to early March, 1994. Trial MCH at time of plot establishment was 6.6m.

There are no plots additional to the core experimental design at this site.

Trial Establishment

The following information was recorded at the time of planting:

Altitude:	750 m
Soil Type:	Pumice
Site preparation:	Old cutover, V-bladed and burnt
Weeds:	None
Regeneration:	None
Slope:	Flat
Previous land use:	Pinus radiata forest

Pruning

Pruning started on 21/2/94 and took approximately 25 man-days to complete. The pruning was carried out by a contract gang organised by the Forestry Corporation of New Zealand and was supervised by NZ FRI Mensuration staff.

There was an average crown remaining of 4.2m (actual mean prune height of 2.5m) over the trial. More than 4m of crown was left after pruning on many trees in the long internode seedlot. However, if the majority of the trees had another whorl removed, they would have been considerably over-pruned. The NZ FRI Mensuration field staff noticed that internode lengths seemed longer than usual on all the seedlots.

PSP Establishment

The plot establishment took 30 man-days, starting on 23/2/94. One three-man crew worked for 4 days and two three-man crews worked for 3 days. Ian McKinley, Paul Klitscher, John Gardiner, Judy Dunlop, Wayne Blundell, Rod Brownlie, Marcia Middlemiss, Iain McInnes, Max Douglas, Judith Skinner and Dianne Sanders (NZ FRI) established the PSP's.

Some of the plots are numbered with tags numbered from 51 - 99 instead of 1 - 49 because of a shortage of the correct tag numbers. These are still numbered on the PSP system as 1 - 49 (i.e. subtract 50 to get the correct tree number when in the field).

Diameters of all plot trees were measured before thinning. Total tree height, pruned height, DOS, DOS height and maximum branch measurements were collected on the twelve height trees, including the predominant height tree in each quadrant. The southern buffer row of plot 12/13 was not planted. Planting lines follow the rip lines which are 0.5m high.

Although this was an easy site, the plot establishment took longer than expected because of the travelling time involved (approximately 2 hours per day).

Thinning

The thinning, done by Ian McKinley, Paul Klitscher and John Gardiner (NZ FRI), took 7 man-days. There was also some regeneration that required thinning at this time.

Trial Layout and Site Condition

A total of 48 plots were established at this site. A map, not to scale, (Figure 3) shows the location of each plot. The numbers at the plot corners are the original planting peg numbers.

The trial is completely flat except for the mounds (0.5m high) created along the rows by V-blading. There was very little mortality at the time of establishment and no obvious growth differences within the site. This is an excellent trial with no major problems to date.

Plot Data

A summary of the measurement data (Table 8) at the time of establishment shows data summarised by treatment and seedlot number (GF rating).

This trial did not reach the required MCH until age 7, indicating that a colder climate may have an effect on overall growth rates.

Acknowledgment

NZ FRI would like to acknowledge Forestry Corporation of New Zealand for organising the pruning.

FR 9 : KAINGAROA FOREST

TABLE 8

Summary of trial data at age 7.0

(1st winter measurement May 1994)

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 (m)
1	FRI79/2320	7	2	265	102	14.3	6.7	1.6	4.7	2.5
1	9/3/86/166	LI 28 (GF13)	2	270	102	14.0	6.6	1.6	4.5	2.3
1	3/3/85/01	14	2	263	105	14.4	6.7	1.7	4.9	2.4
1	6/3/86/46	21	2	268	102	15.0	6.8	1.8	5.2	2.8
2	FRI79/2320	7	2	515	204	13.9	7.0	3.1	9.2	2.6
2	9/3/86/166	LI 28 (GF13)	2	546	204	13.7	6.8	3.0	8.9	2.6
2	3/3/85/01	14	2	510	204	14.5	7.0	3.4	10.0	2.5
2	6/3/86/46	21	2	546	204	15.2	7.3	3.7	11.2	2.8
3	FRI79/2320	7	2	1071	408	12.7	6.9	5.1	15.6	2.4
3	9/3/86/166	LI 28 (GF13)	2	1082	419	12.6	6.8	5.2	15.7	2.6
3	3/3/85/01	14	2	1072	408	13.0	7.1	5.4	16.7	2.8
3	6/3/86/46	21	2	1052	419	13.6	7.1	6.0	18.5	2.9
4	FRI79/2320	7	2	1569	608	12.6	6.9	7.6	23.3	2.7
4	9/3/86/166	LI 28 (GF13)	2	1628	608	12.8	7.5	7.9	25.7	3.0
4	3/3/85/01	14	2	1540	608	12.6	7.2	7.6	24.0	2.8
4	6/3/86/46	21	2	1549	608	13.2	7.5	8.3	26.8	3.0
5	FRI79/2320	7	2	551	541	13.4	6.9	7.6	22.9	0.0
5	9/3/86/166	LI 28 (GF13)	2	525	505	13.2	6.5	6.8	19.7	0.0
5	3/3/85/01	14	2	505	500	13.8	6.8	7.5	22.1	0.0
5	6/3/86/46	21	2	536	536	13.7	6.8	7.8	23.1	0.0
6	FRI79/2320	7	2	526	521	13.4	6.6	7.3	21.2	2.4
6	9/3/86/166	LI 28 (GF13)	2	541	520	12.7	6.5	6.5	19.0	2.4
6	3/3/85/01	14	2	505	495	14.1	7.1	7.7	23.5	2.8
6	6/3/86/46	21	2	536	531	13.8	7.0	7.9	24.0	2.7

* Prune Ht 0.0 = unpruned

FR 9

Kaingaroa Forest

Cpt 481

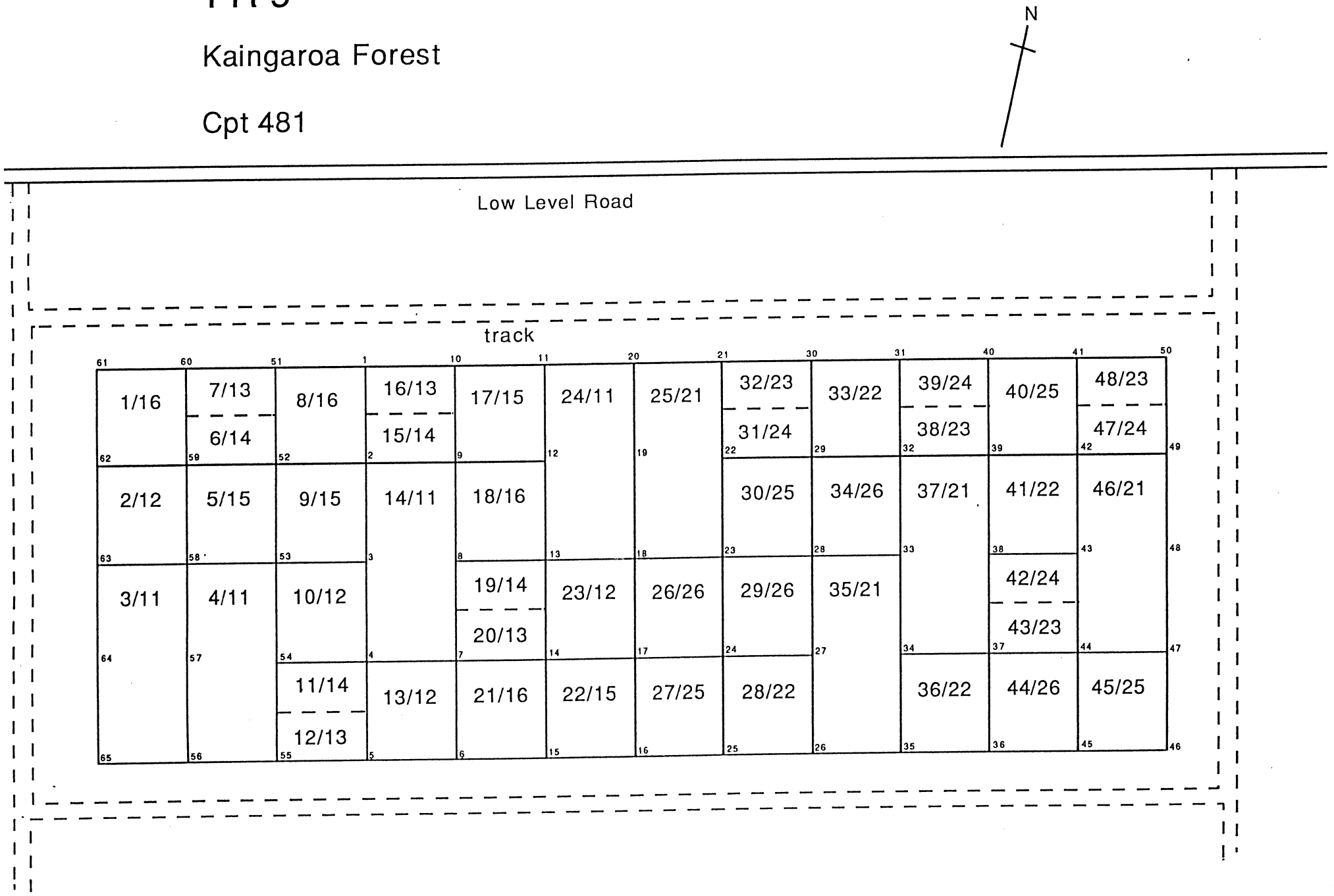


Figure 3

FR 10 - GLENGARRY STATION

This trial was planted in July 1987. The first measurements, total height only, were taken in July 1989 (age 2 years). No maintenance of the trial was required before plot establishment.

Pruning, PSP establishment and thinning of FR 10 at Glengarry Station was carried out during late February to early March, 1992. Trial MCH at time of plot establishment was 7.2m.

At Glengarry Station there are six additional plots planted with Seedlot No. 2/6/86/27, treated with two additional silvicultural regimes (Table 9).

Table 9. Additional silvicultural treatments in FR 10 (Glengarry Station).

Plot Nos.	Trt	Initial s/ha	Final s/ha	Prune height	MCH
49 - 51	7	500	500	2.2m	6.2m
			200	4.2m	20 - 25m
52 -54	8	1000	1000	2.2m	6.2m
			300	4.2m	18m
			200	6m	28m

Trial Establishment

The following information was recorded at the time of planting:

Altitude:	500m
Soil Type:	Pumice overlay
Site preparation:	None
Weeds:	Dense grass (cocksfoot) up to 1m
Regeneration:	None
Slope:	Generally flat
Previous land use:	Grazing pasture

Pruning

The pruning was done in February 1992, by contractors to Carter Holt Harvey Forests Ltd using a 10cm gauge, rather than the standard prescription (see basic field procedures, p.4). One hundred percent of the trees were pruned.

The average crown remaining was 4.5m (actual mean prune height 3.6m) over the whole trial. The pruners commented that the long-internode seedlots took longer than other seedlots because of the heavier branching. They chainsaw pruned for this seedlot after finding pruning with hand tools to be difficult.

PSP Establishment

The PSP establishment of this trial took 26 man-days, between 20/2/92 and 18/3/92. Ian McKinley, Steve Gatenby, Richard Beamish-White, Wayne Blundell (NZ FRI) and two technicians from Carter Holt Harvey Forests Ltd established the PSP's.

Diameters of all plot trees were measured before thinning. Pruned height and total height were not measured at the time of establishment. Twelve height trees were measured, and predominant heights allocated during the winter measurement in June 1992.

Goat damage to the trees at an early age and sweep (a result of wind damage) made final crop selection difficult in parts of the trial. However, damaged trees were generally not included in the final crop (< 0.1%).

Thinning

The plots were thinned by NZ FRI Mensuration staff and took approximately 6 man-days to complete. Strong winds after thinning blew a few tops out, but this was not a widespread problem.

Plots which were supposed to receive a delayed thinning (treatment six) were mistakenly thinned at the same time as the other treatments, making this treatment effectively the same as treatment two.

Trial Layout and Site Condition

A total of 54 plots were established at this site. A map, not to scale, (Figure 4) shows the location of each plot. The numbers at the plot corners are the original planting peg numbers.

Tony Firth, GTI, noticed symptoms of Boron deficiency (wobbly upper stems) in late 1992. Foliage samples confirmed this. Brian Garnett organised a fertilising programme to rectify this. The trial was aerial fertilised in October 1992 with 46.3 Kg/ha of Ulexite (11.5% B). Foliage sampling in April 1993 showed that the Boron content had doubled and was at a satisfactory level.

This trial is on a flat ex-pasture site. Grass was spot sprayed to release seedlings in 1988. The growth of thistles may be a problem in the future for remeasurement. Mortality was very low at establishment, only 2 of the 54 plots had high mortality (>10%). Overall, growth within the trial appears to be extremely good.

Plot Data

A summary of the measurement data (Table 10) at the time of establishment shows data summarised by treatment and seedlot number (GF rating).

This was the first trial to be established and is continuing show excellent growth overall; the mean height being 8.1m only 4 months after establishment.

No statistical analysis has yet been carried out, and any trends in the data may not persist over time. The following trends were noted:

- Treatment 4 (600 s/ha) is slightly taller on average than the other treatments.
- The trends in growth among the seedlots are consistent.

Acknowledgment

NZ FRI would like to acknowledge the help they received from Carter Holt Harvey Forests Ltd for their help with all stages in the trial.

FR 10 : GLENGARRY FOREST

TABLE 10

Summary of trial data at age 5.0

(1st winter measurement June 1992)

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 (m)
1	FRI79/2320	7	2	516	100	17.0	8.0	2.3	7.8	3.7
1	9/3/86/166	LI 28 (GF13)	2	513	102	17.6	8.1	2.5	8.5	3.5
1	3/3/85/01	14	2	503	102	18.3	8.2	2.7	9.3	3.7
1	6/3/86/46	21	2	515	107	17.6	8.1	2.6	8.9	3.7
2	FRI79/2320	7	2	523	220	16.6	7.8	4.8	16.3	3.5
2	9/3/86/166	LI 28 (GF13)	2	526	199	16.4	8.0	4.2	14.6	3.5
2	3/3/85/01	14	2	527	199	18.4	8.3	5.3	18.6	3.5
2	6/3/86/46	21	2	521	204	17.2	7.6	4.7	15.5	3.2
3	FRI79/2320	7	2	1041	408	15.3	7.6	7.5	25.6	3.3
3	9/3/86/166	LI 28 (GF13)	2	1031	408	16.0	8.1	8.2	29.2	3.5
3	3/3/85/01	14	2	1000	408	16.8	8.2	9.1	32.0	3.7
3	6/3/86/46	21	2	1010	408	16.2	8.4	8.4	30.7	3.8
4	FRI79/2320	7	2	1530	608	15.5	8.5	11.4	42.1	3.6
4	9/3/86/166	LI 28 (GF13)	2	1520	608	14.9	8.1	10.5	37.6	3.3
4	3/3/85/01	LI 28 (GF13)	2	1510	608	15.7	8.5	11.8	43.6	3.8
4	6/3/86/46	21	2	1510	608	16.4	8.8	12.8	48.3	3.7
5	FRI79/2320	7	2	500	495	16.5	7.4	10.6	34.6	0.0
5	9/3/86/166	LI 28 (GF13)	2	511	434	16.3	8.7	9.0	34.1	0.0
5	3/3/85/01	14	2	500	475	17.0	8.0	10.8	37.3	0.0
5	6/3/86/46	21	2	505	475	17.3	7.7	11.1	36.6	0.0
6	FRI79/2320	7	2	516	199	16.9	7.7	4.5	15.0	3.7
6	9/3/86/166	LI 28 (GF13)	2	506	204	16.9	7.8	4.5	15.4	3.3
6	3/3/85/01	14	2	505	204	17.4	7.9	4.8	16.5	3.7
6	6/3/86/46	21	2	505	204	17.4	8.0	4.8	16.6	3.5
7	2/6/86/27	16	3	510	469	16.9	7.9	10.6	36.2	3.6
8	2/6/86/27	16	3	933	893	15.6	8.1	17.0	60.8	3.7

* Prune Ht 0.0 = unpruned

FR 10/0

Glengarry Forest

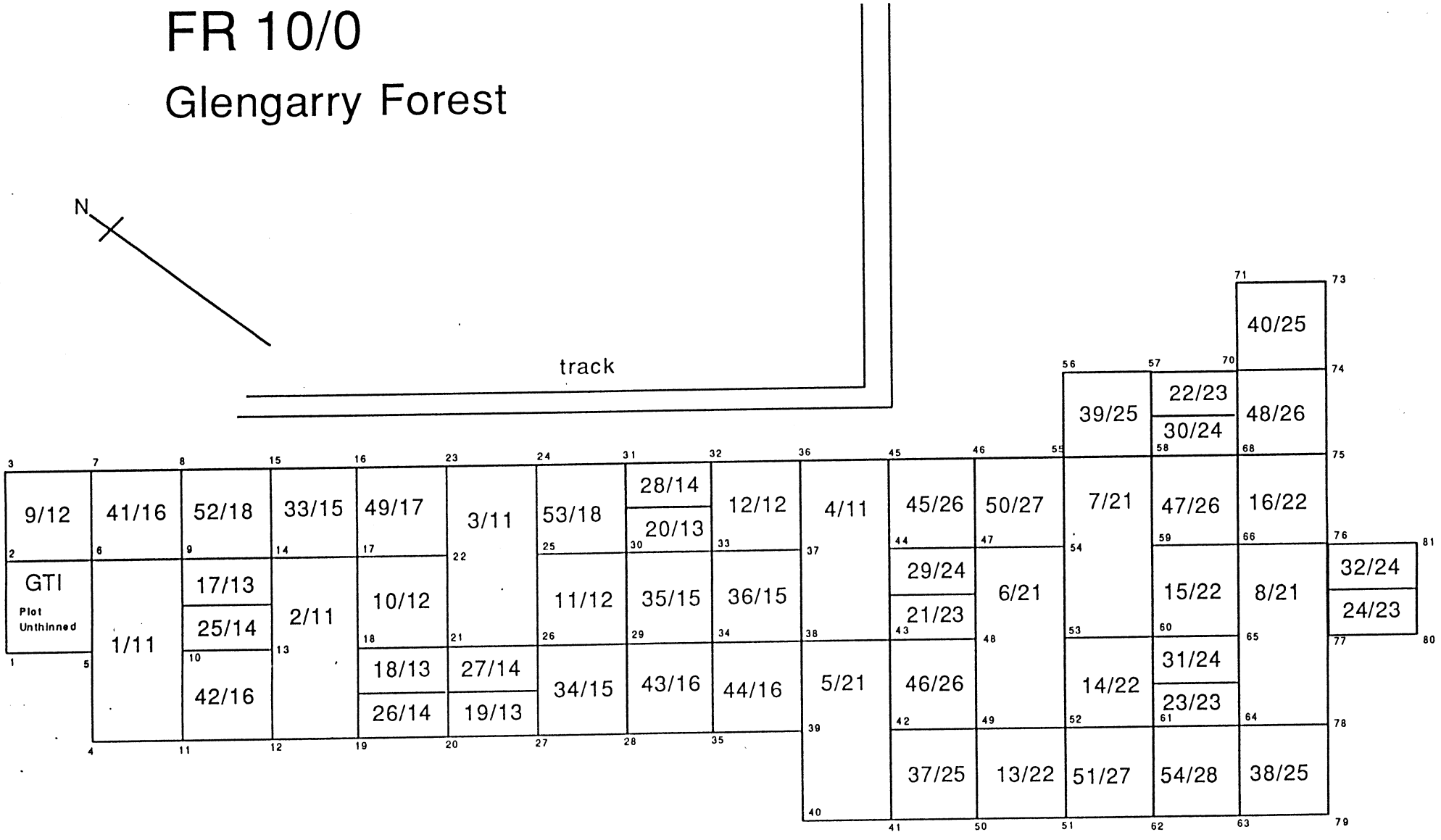


Figure 4

FR 11 - DITCHLINGS BLOCK

This trial was planted in August 1987. The first measurements, total height only, were taken in August 1989 (age 2 years). No maintenance of the trial was required before plot establishment.

Pruning, PSP establishment and thinning of FR 11, Ditchlings Block, was carried out (as per the basic procedures) during late January, early February, 1993. Trial MCH at time of establishment was 6.6m.

A small row plot experiment is planted at this site using the same stock as the rest of the trial. Measurements have not yet been taken. There are no additional plots at this site to be treated as per Tasman's current forest practices.

Trial Establishment

The following information was recorded at the time of planting:

Altitude:	150m
Soil Type:	Stoney yellow-brown earth
Site preparation:	None
Weeds:	Pasture and gorse
Regeneration:	None
Slope:	Average 20 ° (range 8 to 34)
Aspect:	Facing south west
Previous land use:	Grazing pasture

Pruning

Ian McKinley and Steve Gatenby (NZ FRI) supervised the pruners until they became familiar with the pruning specifications. The pruning gang, started on 26/1/93, and was organised by Tasman Forestry Ltd, Nelson. Pruning required 3 man-days for a crew of 9 people. Gorse release was required and is included in this figure, taking 1 man-day for two people.

There was an average crown remaining of 4.1m (actual mean prune height 2.6m) over the whole trial. In the long-internode blocks, 4m of crown left would have meant that only 2 complete whorls would remain on most trees. It was decided to measure to the 4m mark (from the top of the tree) and, on every alternate tree, to leave an extra whorl. Pruning the long-internode seedlot was also made difficult by the large branches.

PSP Establishment

Two teams of people were involved in the plot establishment. Ian McKinley, Steve Gatenby, Dianne Sanders, Todd Cheeseman (NZ FRI) and Phil and Helen Woodward and Ian Stubbs (Tasman Forestry Ltd) made up these teams. The teams took 5 days to establish the PSP's, starting on 27/1/93.

Diameters of all plot trees were measured before thinning. Total tree height, pruned height, DOS, DOS height and maximum branch measurements were collected on the twelve height trees, including the 4 predominant height trees.

Plot 8/11 (Treatment 1, GF 14 seedlot) had only 18 trees remaining instead of 20 because of a cattle camp. All of the remaining trees are on one side of this plot. Spacing is now consistent with a 200 s/ha plot not 100 as prescribed. As growth in this plot may be affected, it has been decided to abandon this plot.

At age seven some trees had grown too close to adjacent power lines and had to be removed. Plot 25/24 (Treatment 4, GF 21 seedlot) has been abandoned due to loss of trees from one corner of the plot.

Thinning

The thinning was done by 4 contractors to Tasman Forestry Ltd after plot establishment was completed on 2/2/93. It took 6.2 man-days.

Trial Layout and Site Condition

A total of 48 plots were established at this site (2 have since been abandoned). A map, not to scale, (Figure 5) shows the location of each plot. The numbers at the plot corners are the original planting peg numbers.

This trial is situated on the side of a hill with up to 120m difference in altitude between the top and bottom. Plots 8 and 40 are at the top of the hill, plots 9 and 33 at the bottom (see Figure 5). There has been no regeneration in the trial. Mortality (>10%) was low at the time of establishment with only 6 of the 48 plots affected. Selection of final crop stocking was not affected. Gorse is a problem at this site and badly affects 25% of the plots ; there is 70% coverage of heavy gorse in 12 plots. The trial has continued to be grazed by sheep, but there is little damage to trees and no gorse control.

There are very definite growth variations between plots in this trial, with a distinct trend with altitude within the trial. The location of a plot may contribute significantly to the overall seedlot mean as shown in Table 11. The following plots, 6/11, 15/12, 16/12, 24/13, 40/15, 48/16, located at the top of the trial, show a noticeable

difference in height (up to 3m shorter) to their respective seedlot/ treatment replications located at the bottom of the trial.

Not all treatments are equally represented at the top and bottom of the trial. Treatment differences are, therefore, confounded with site differences, so that any analysis of variance of data from this trial should be done with care. Calculation of growth rate multipliers (Carson et al., SGM Cooperative Report No. 35), however will not be affected because the tree size is taken into account by the growth models, and valid estimates can be obtained.

Plot Data

A summary of the measurement data (Table 11) at the time of establishment shows data summarised by treatment and seedlot number (GF rating).

Care must be taken when looking at trends in this data as the treatment effects are confounded by site differences.

No statistical analysis has yet been carried out, and any trends in the data may not persist over time. However, the following trends were noted:

- There is a large range of basal area and height growth between the seedlots for treatments 4,5, and 6.
- Treatment 4 (600 s/ha) is taller on average for height over the other treatments.

Acknowledgment

NZ FRI would like to acknowledge Tasman Forestry Ltd for their help in all stages of the trial pruning, PSP establishment and thinning.

TABLE 11

FR 11 : DITCHLINGS FOREST

Summary of trial data at age 6.0

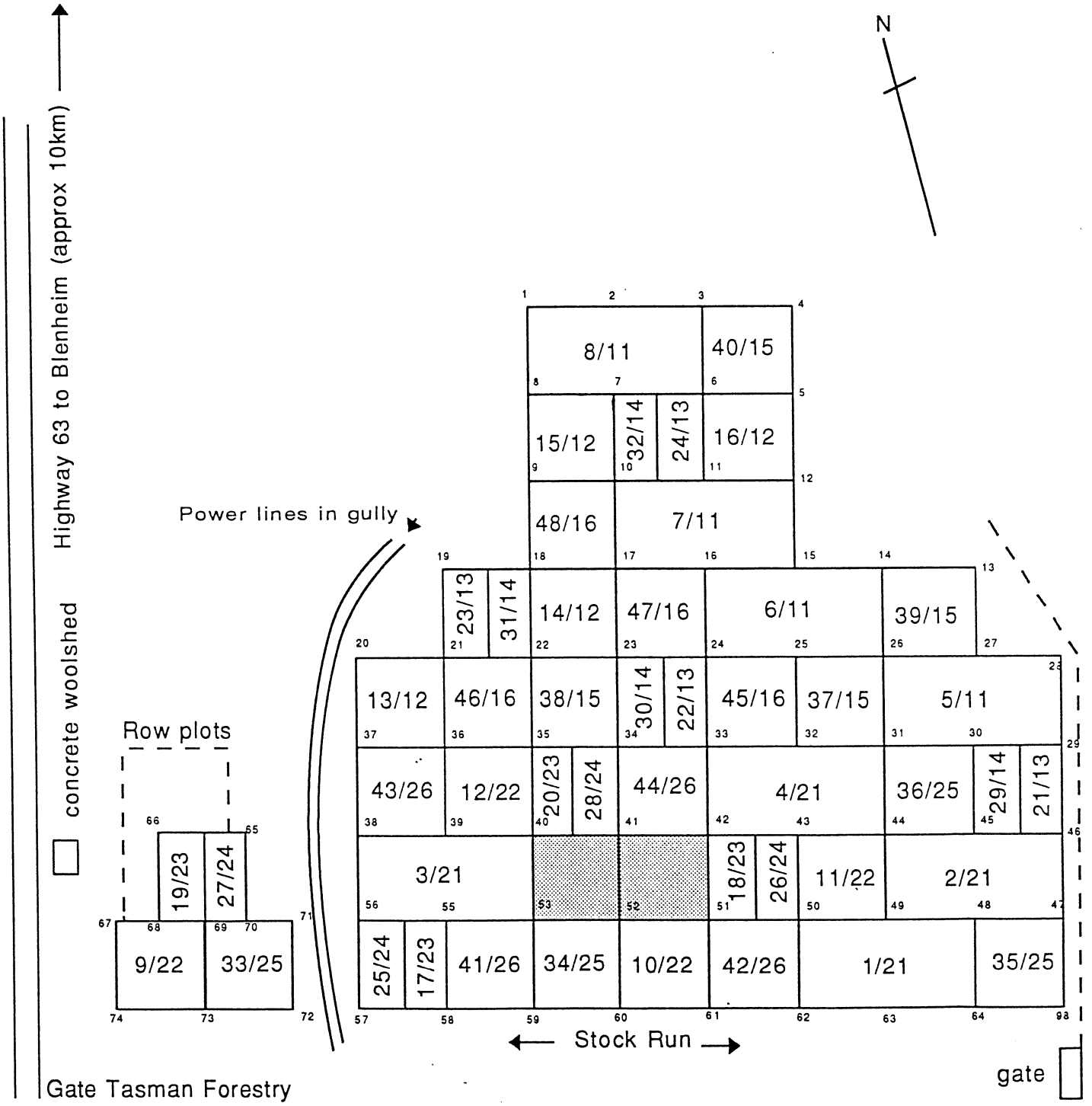
(1st winter measurement July 1993)

Treatment No.	Seedlot	GF Rating	No. plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq. metres)	Volume (cu. Meters)	Mean * Prune Ht (m)
1	FRI79/2320	7	2	251	102	13.6	6.5	1.5	4.6	2.3
1	9/3/86/166	LI 28 (GF13)	2	255	102	13.4	6.9	1.4	4.6	2.3
1	3/3/85/01	14	2	253	102	13.8	6.9	1.5	4.9	2.2
1	6/3/86/46	21	2	253	102	14.6	7.5	1.7	5.9	2.6
2	FRI79/2320	7	2	510	204	13.3	6.9	2.9	9.1	2.1
2	9/3/86/166	LI 28 (GF13)	2	510	209	14.6	7.5	3.5	11.7	2.8
2	3/3/85/01	14	2	505	204	14.9	7.3	3.6	12.4	2.6
2	6/3/86/46	21	2	500	204	12.8	6.3	2.7	8.1	1.8
3	FRI79/2320	7	2	1031	408	13.2	7.5	5.6	19.2	2.8
3	9/3/86/166	LI 28 (GF13)	2	1010	408	14.4	8.0	6.6	23.3	2.9
3	3/3/85/01	14	2	1020	408	13.4	7.5	5.8	19.6	2.8
3	6/3/86/46	21	2	1041	408	14.1	7.6	6.5	22.1	2.8
4	FRI79/2320	7	2	1520	598	12.5	7.6	7.5	26.4	3.3
4	9/3/86/166	LI 28 (GF13)	2	1540	608	13.6	8.1	8.8	31.5	2.6
4	3/3/85/01	14	2	1520	608	14.0	8.5	9.4	35.0	3.2
4	6/3/86/46	21	2	1539	598	14.7	8.1	10.1	35.6	3.2
5	FRI79/2320	7	2	490	424	10.6	5.7	3.8	11.2	0.0
5	9/3/86/166	LI 28 (GF13)	2	526	495	12.9	6.9	6.7	22.8	0.0
5	3/3/85/01	14	2	500	465	14.2	7.7	7.4	25.5	0.0
5	6/3/86/46.	21	2	510	465	11.3	5.8	4.6	13.3	0.0
6	FRI79/2320	7	2	505	465	12.7	6.4	6.1	18.6	1.9
6	9/3/86/166	LI 28 (GF13)	2	510	480	13.1	7.1	6.5	21.1	2.4
6	3/3/85/01	14	2	510	449	12.6	6.6	6.0	20.1	2.3
6	6/3/86/46	21	2	500	495	15.6	8.5	9.4	34.2	3.3

* Prune Ht 0.0 = unpruned

Figure 5

FR 11/0
Ditchlings Block



FR 12 - OTAGO COAST FOREST, Compartment 170

This trial was planted in August 1987. The first measurements, total height only, were taken in August 1989 (age 2 years). No maintenance of the trial was required before plot establishment.??

Pruning, PSP establishment and thinning of FR 12, Otago Coast Forest, was carried out (as per the basic procedures) during mid March 1994. The trial MCH at the time of plot establishment was 6.1m.

There are no plots additional to the core experimental design at this site.

Trial Establishment

The following information was recorded at the time of planting:

Altitude:	150m
Soil Type:	Yellow-brown earth
Site preparation:	None
Weeds:	Pasture and some gorse
Regeneration:	None
Slope:	Average 20 °
Aspect:	Facing west
Previous land use:	Grazed pasture

Pruning

The pruning was done by a contract gang organised by Wenita Forestry Ltd and supervised by NZ FRI's Mensuration staff on the first day. It took 45.5 man-days to prune this trial, beginning on 7/3/94.

There was an average crown remaining of 4.2m (actual mean prune height 2.5m) over the whole trial.

The pruners commented on the extremely large branching in all plots except treatments 3, 4 (high stockings), and 5 (unpruned and unthinned control). These plots were effectively double handled with the pruners going back over the areas they had already pruned with a small chainsaw to remove all the extremely large branches they couldn't remove with pruners and jacksaws.

PSP Establishment

The plot establishment was done by NZ FRI's Mensuration field staff with help from two people organised by Wenita Forestry Ltd from NZ Employment. It took 34 man-days to complete the plot establishment, beginning

on 8/3/94 and finishing on 14/3/94. Ian McKinley, Paul Klitscher, Richard Beamish-White, John Gardiner (NZ FRI) plus two people from NZ Employment established the PSP's.

Diameters of all plot trees were measured before thinning. Total tree height, pruned height, DOS, DOS height and maximum branch measurements were collected on the twelve height trees, including the 4 predominant height trees.

Many of the plots near the top of the trial had thick gorse making the pruning and plot establishment more difficult. Several hours were spent clearing gorse with chainsaws before plot establishment.

Plot 26/16 has been numbered across the rows rather than up and down because of access difficulties encountered down the rows.

Plot 33/21 was not established at all because it was not possible to determine which trees were in the plot, leaving only one replication in treatment 1, LI 28 seedlot. The top half of the plot is in thick gorse and appears to have an extra row in between the ten metre spacings. The rows in the top half of the plot are also offset from the rows in the bottom half by at least a couple of rows but the direction is unclear. There is also a fence running through the plot.

Thinning

Thinning was done by Ian McKinley, Richard Beamish-White, Paul Klitscher and John Gardiner (NZ FRI) and took a total of 5.2 man-days.

Trial Layout and Site Condition

A total of 47 plots were established at this site. A map (not to scale) (Figure 6) shows the location of each plot. The numbers at the plot corners are the original peg numbers.

The trial is situated on an ex-pasture site on the top and side of a ridge. Plots along the fenceline (see Figure 6) are situated on the top of the ridge. There is a problem with dense gorse in 30% of the plots and light gorse in the remainder. A chainsaw was required for some clearing and this will need to be done regularly. There was little mortality at establishment though, only 2 of the 47 plots had high mortality (>10%).

Trees seem to have suffered considerable wind-damage in the plots along the ridge at the top of the trial. Some are severely swept for the first metre or two; others are lying on the ground or have broken tops. Most are stunted in comparison with the trees below the ridge. There may also be snow damage over the whole trial. The following plots, 12/15, 13/16, 14/11, 15/11, 19/12, 23/12, located along the ridge at the top of the

trial show a noticeable difference in height growth to their respective seedlot / treatment replications at the bottom of the trial.

Not all treatments are equally represented at the top and bottom of the trial. Treatment differences are, therefore, confounded with site differences, so that any analysis of variance of data from this trial should be done with care. Calculation of growth rate multipliers (Carson et al., SGM Cooperative Report No. 35) , however will not be affected because the tree size is taken into account by the growth models, and valid estimates can be obtained.

Plot Data

A summary of the measurement data (Table 12) at the time of establishment shows data summarised by treatment and seedlot number (GF rating).

The location of a plot may contribute significantly to the overall seedlot mean as shown in Table 12. Care must be taken when looking at trends in this data, as the treatment effects are confounded by site differences.

No statistical analysis has yet been carried out, and any trends in the data may not persist over time. However, the following trends were noted:

- The long internode seedlot generally shows a smaller basal area but a larger mean height.
- Treatment 4 (600 s/ha) is slightly taller on average.

Acknowledgment

NZ FRI would like to acknowledge Wenita Forestry Ltd for their help in organising the pruning and supplying man-power for PSP establishment.

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TABLE 12

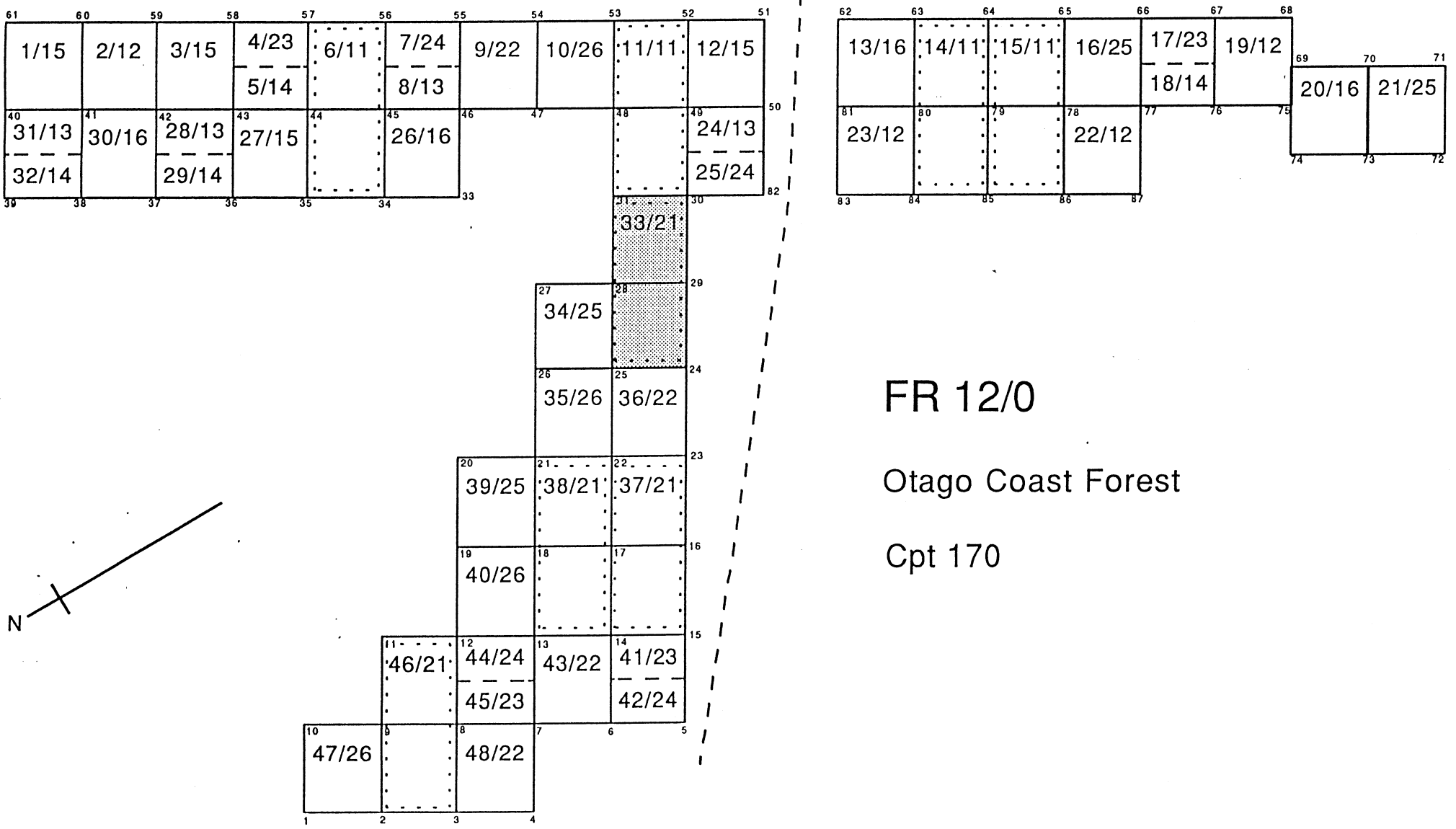
Summary of trial data at age 7.0

(1st winter measurement June 1994)

Treatment No.	Seedlot	GF Rating	No. plots	Initial SPH	Residual SPH	Mean DBH (cm)	Mean Height (m)	Basal Area (sq. metres)	Volume (cu. Meters)	Mean * Prune Ht (m)
1	FRI79/2320	7	2	268	102	14.9	6.6	1.8	5.2	2.2
1	9/3/86/166	LI 28 (GF13)	1	265	87	14.5	6.7	1.4	4.2	2.2
1	3/3/85/01	LI 28 (GF13)	2	255	95	16.0	6.6	1.9	5.5	2.2
1	6/3/86/46	21	2	253	100	15.8	6.7	1.9	5.6	2.6
2	FRI79/2320	7	2	515	199	15.0	6.4	3.5	9.8	2.2
2	9/3/86/166	LI 28 (GF13)	2	541	199	15.2	7.1	3.6	11.2	2.4
2	3/3/85/01	14	2	516	199	15.1	6.5	3.6	10.2	2.1
2	6/3/86/46	21	2	530	204	16.0	6.9	4.2	12.5	2.5
3	FRI79/2320	7	2	1051	378	14.7	6.8	6.4	19.0	2.6
3	9/3/86/166	LI 28 (GF13)	2	1051	419	15.2	7.5	7.6	24.4	2.8
3	3/3/85/01	14	2	1020	419	16.2	7.6	8.6	27.3	2.9
3	6/3/86/46	21	2	1041	419	15.1	7.3	7.5	23.5	2.7
4	FRI79/2320	7	2	1579	589	13.5	6.9	8.4	25.6	2.5
4	9/3/86/166	LI 28 (GF13)	2	1550	579	14.3	7.3	9.3	29.0	2.6
4	3/3/85/01	14	2	1520	608	15.8	7.8	11.9	39.1	3.0
4	6/3/86/46	21	2	1559	608	15.0	7.7	10.8	35.2	2.8
5	FRI79/2320	7	2	536	490	13.5	6.3	7.2	21.0	0.0
5	9/3/86/166	LI 28 (GF13)	2	526	480	10.3	5.6	4.0	10.7	0.0
5	3/3/85/01	14	2	521	459	13.5	6.0	6.7	23.1	0.0
5	6/3/86/46	21	2	520	480	16.7	6.8	10.5	30.2	0.0
6	FRI79/2320	7	2	500	444	13.4	6.4	6.8	21.3	1.9
6	9/3/86/166	LI 28 (GF13)	2	520	485	14.4	7.4	7.9	25.2	2.5
6	3/3/85/01	14	2	515	480	16.0	6.7	9.6	27.6	2.8
6	6/3/86/46	21	2	506	470	13.8	6.3	7.0	19.9	2.2

* Prune Ht 0.0 = unpruned

Trial is up Taieri Mouth Road from Waihola.



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Cpt 170

Figure 6

Overall Results at establishment of the 1987 Silviculture/Breed Plantings

It is still too early to make any conclusions about the growth of the various seedlots within this series of trials. No statistical analysis has yet been carried out, however, there do seem to be some overall trends showing at this stage:

- The 600 s/ha treatment has the tallest trees at every site.
- Trees in the unthinned, unpruned treatments tend to be the shortest trees.
- The long internode seedlots show a trend towards the lowest basal area and largest height on several sites.
- The growth differences among seedlots are small at this stage.
- The long internode seedlots generally show a lower average pruned height, probably due to the larger distance between whorls. Fewer whorls are removed to leave the required 4m of crown.

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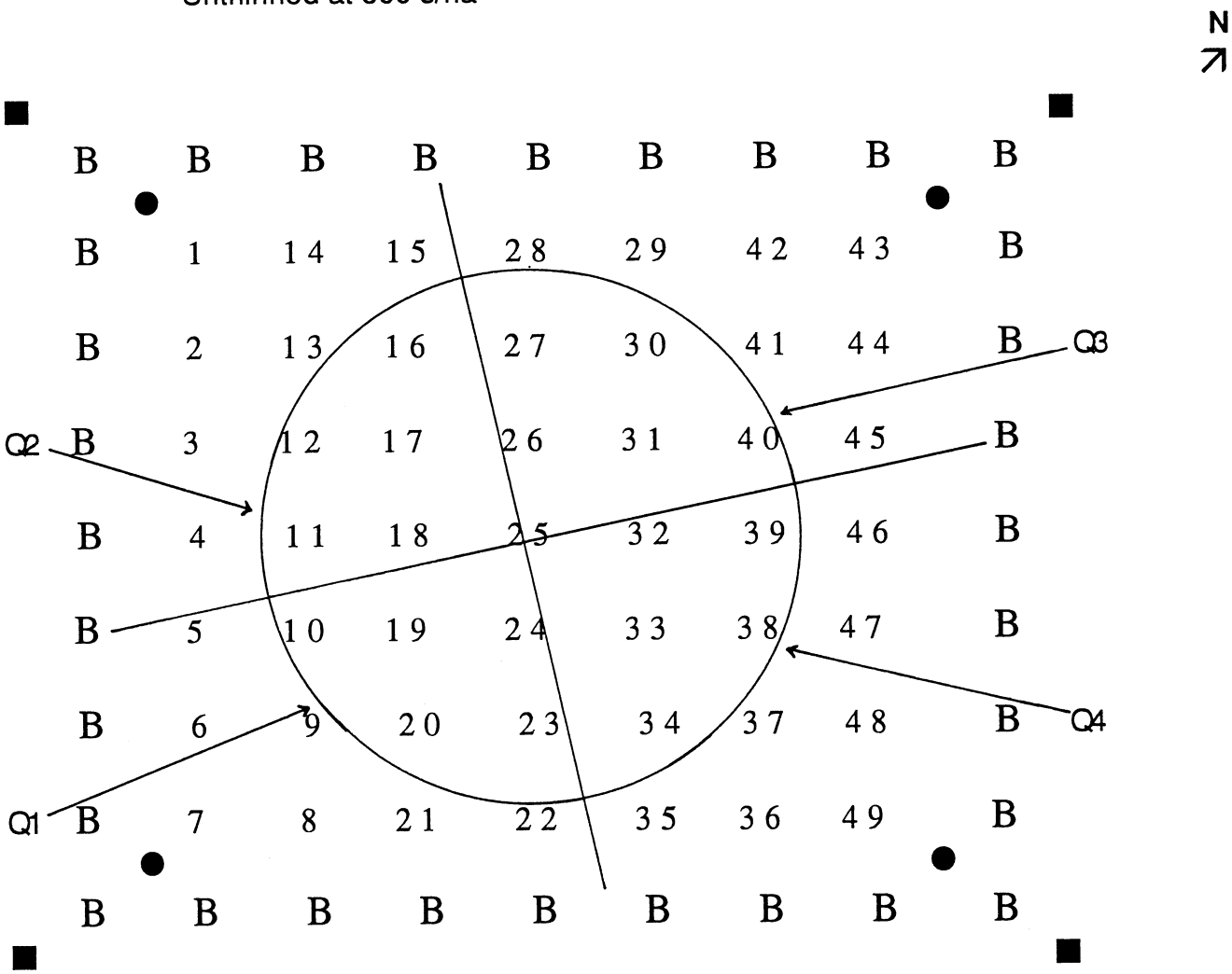
Appendix 1

Location of Buffers and Permanent Sample Plot

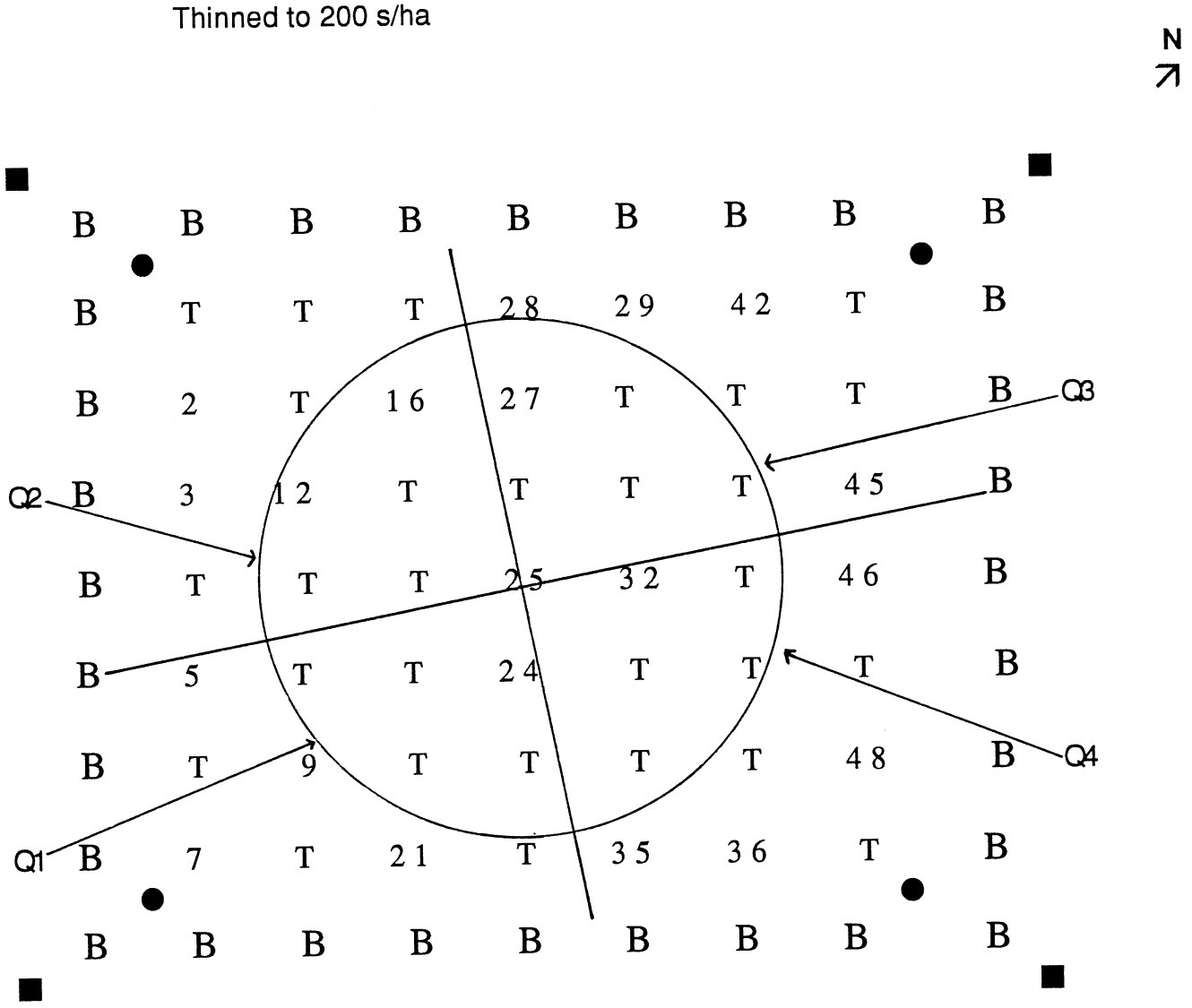
Example 1 Treatment 2
4 x 5 m spacing
Unthinned at 500 s/ha



O	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

Location of Buffers and Permanent Sample Plot

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



O	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 5 variables, making up a unique number combination e.g FR 9/0/29/13. It 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 9/0/29/13 is plot 29 of trial FR 9. The plot replication is 1 and the treatment is 3.

In addition, Seedlot is stored in the PSP system as the variable 'Seedlot' and 'Improvement Rating' (Dunlop, 1994).