SINGLE CLONAL BLOCKS VS TWO & SIXTEEN CLONE MIXTURES TRIAL, TARAWERA FOREST — ESTABLISHMENT REPORT

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Report No. 34 November 1996

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FOREST & FARM PLANTATION MANAGEMENT COOPERATIVE

EXECUTIVE SUMMARY

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J.A. TURNER, J.D. TOMBLESON & C. TE RIINI

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A radiata pine clonal management trial was established at Tarawera Forest in the Bay of Plenty in 1995 jointly between the NZ Forest Research Institute and Fletcher Challenge Forests Ltd. Tree growth and quality will be compared between sixteen tissue cultured clones, selected from 14 families, planted as single clonal blocks, two-clone mixtures (and its reciprocal) and sixteen-clone mixtures. GF23 seedlings were also planted as a control. This replicated 19 hectare trial is an expansion of the pilot trials established at Kawerau, New Zealand and Tumbarumba, NSW, Australia in 1989. It will provide important information on the tree growth and quality performance of clones deployed as either single clonal blocks or as clonal mixtures.

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STUDY OBJECTIVE

To compare the growth and quality of *Pinus radiata* clones planted as clonal mixtures versus single clonal blocks.

BACKGROUND

Any move towards clonal forestry (using tested clones) will provide forest managers with an opportunity to further optimise tree growth and yield. A question forest managers may ask when adopting clonal forestry is 'do clones perform better, because of reduced competition, when planted as single clonal blocks versus clonal mixtures?' This study will provide, via a well designed trial the basis to quantify any tree growth and quality differences between clones deployed as single-clonal blocks versus clonal mixtures.

INTRODUCTION

Through the provision of tissue cultured plantlets and a planting site by Fletcher Challenge Forests Ltd a clonal management trial has been established in Tarawera Forest, Bay of Plenty. The trial will compare the tree growth and quality performance of *Pinus radiata* clones planted as 2-clone and 16-clone mixtures versus single clonal blocks. The trial serves as an expansion of two pilot trials established in 1989, located at Kawerau, New Zealand (Darling & Tombleson 1989), and Tumbarumba, NSW, Australia (Jamieson, Borough & Tombleson, 1989) which compare the performance of clones planted as clonal mixtures versus single clonal blocks.

Both these pilot trials were recently assessed at age six years. Four clones were compared for height , diameter, and diameter over stubs when grown in mixtures of 16 clones, 4 clones and as single clonal blocks. Results showed clones performed better for diameter growth by an average of 1.3cm when grown as single clonal blocks compared to four-clone mixtures. There were no significant differences in height growth between clones grown as single clonal blocks, .four-clone mixtures or sixteen-clone mixtures.

The Tumbarumba trial was also assessed which showed there were no significant differences between the treatments for diameter, however one of the clones was 1.0m taller when grown as a sixteen-clone mixture (Tombleson, Straker, Borough & Darling, 1996). Both the Kawerau and Tumbarumba pilot trials will be reassessed closer to mid rotation.

CLONAL MATERIAL

The trial incorporates 16 radiata pine clones from 14 families. The clones selected for this trial (as shown in Appendix I) are considered to be representative of the latest genetically improved parents selected from the Growth & Form Breed. The approximate GF rating for this material is GF28+.

TRIAL LOCATION AND DESIGN

The trial area is 13.0 ha planted in radiata pine cut-over on a flat site. The trial is located in compartment 45/1A (see Appendix II and III for trial location maps). The soil type is described as being ash tephras. Large boulders are present on the trial site which is located adjacent to the Tarawera River.

Trees have been planted in blocks (see Appendix IV for layout) with a between tree spacing of 5 x 5 m (400 spha). It is noted on the layout shown in Appendix IV) that the shaded areas relate the different block sizes of the two clone mix and mixtures treatments which contain 7 and 6 rows receptively. The gap associated with the mixtures blocks contains an extra buffer row. The trial comprises two replications each of the following three treatments:

- 16-clone mixture x 8 blocks;
- 2-clone mix x 10 blocks;
- reciprocals of the 2-clone mix x 10 blocks.

There are also three replications each of a single-clone x 16 blocks. Appendix V shows the layout of clones in each of the mixtures blocks. Each block contains an inner block of clones surrounded by a single buffer of the same clones. A single buffer row of clonal material was established around the entire trial.

The 'single clone block' treatment contains 16 trees with a one row buffer. The clone used for the buffer is the same as the clone in the same block (as shown in Figure 1). Each of the '16-clone mixture' blocks contains 16 trees, one each of the 16 clones distributed randomly in the block. A one row buffer using a random mix of the 16 clones planted within the block has been established around the outside of each mixtures block (see Figure 1 for details).

Fig. 1. Layout within '16-clone mix blocks' and 'single clone blocks'. Each number represents a different clone. 'Single clone blocks' are on the left, the '16-clone mix blocks' are on the right.

1	1	1	1	1	1		1	2	3	4	5	6
1	1	1	1	1	1		7	1	8	9	16	13
1	1	1	1	1	1		8	10	12	2	13	14
1	1	1	1	1	1		9	4	6	5	15	15
1	1	1	1	1	1		10	3	11	7	14	16
1	1	1	1	1	1		11	12	8	10	3	9
2	2	2	2	2	2		1	2	3	4	5	6
2	2	2	2	2	2		7	2	15	1	13	13
2	2	2	2	2	2		8	7	12	9	16	14
2	2	2	2	2	2		9	4	6	5	8	15
2	2	2	2	2	2		10	3	11	10	14	16
2	2	2	2	2	2		11	12	19	5	10	7
3	3	3	3	3	3		1	2	3	4	5	6
3	3	3	3	3	3		7	14	8	9	3	13
3	3	3	3	3	3		8	10	13	5	12	14
3	3	3	3	3	3		9	4	6	2	15	15
3	3	3	3	3	3		10	16	11	7	1	16
3	3	3	3	3	3		11	2	1	9	14	2
4	4	4	4	4	4		1	2	3	4	5	6
4	4	4	4	4	4		7	1	11	5	16	13
4	4	4	4	4	4		8	14	12	2	13	14
4	4	4	4	4	4		9	4	6	3	15	15
4	4	4	4	4	4		10	9	8	7	10	16
4	4	4	4	4	4		11	12	9	7	4	2

The two-clone mixture blocks each contain 49 trees comprising 9 ramets of the surrounded clone (shown in bold) and 40 ramets of a surrounding clone. Each clone is surrounded by 8 trees of the other clone. There are two treatments in this component of the trial due to each of the two clones being planted as their reciprocal (see Figure 2). This layout will compare the two-way interaction between 5 clones, with each clone being tested against the other 4 clones both as the surrounding clone and as the surrounded clone.

Fig. 2. Layout within and between two-clone mix blocks. Each number represents a different clone. The top two blocks represent the first treatment and the lower two blocks represent the second, reciprocal treatment.

1	1	1	1	1	1	1	3	3	3	3	3	3	3
1	**2**	1	**2**	1	**2**	1	3	**1**	3	**1**	3	**1**	3
1	1	1	1	1	1	1	3	3	3	3	3	3	3
1	**2**	1	**2**	1	**2**	1	3	**1**	3	**1**	3	**1**	3
1	1	1	1	1	1	1	3	3	3	3	3	3	3
1	**2**	1	**2**	1	**2**	1	3	**1**	3	**1**	3	**1**	3
1	1	1	1	1	1	1	3	3	3	3	3	3	3
2	2	2	2	2	2	2	1	1	1	1	1	1	1
2	**1**	2	**1**	2	**1**	2	1	**3**	1	**3**	1	**3**	1
2	2	2	2	2	2	2	1	1	1	1	1	1	1
2	**1**	2	**1**	2	**1**	2	1	**3**	1	**3**	1	**3**	1
2	2	2	2	2	2	2	1	1	1	1	1	1	1
2	**1**	2	**1**	2	**1**	2	1	**3**	1	**3**	1	**3**	1
2	2	2	2	2	2	2	1	1	1	1	1	1	1

A control, comprising GF 23 seedlings, established in four 36 tree blocks has been incorporated into the trial. This control will serve as a genetic bench mark, and will also quantify the tree growth and quality physiological maturation effects of the clonal material.

Table Summary of treatments

Treatment	single clonal block	16 clone mixture	2-clone mixture	2-clone mix reciprocal
Clone No.				
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✓
4	✓	✓	✓	✓
5	✓	✓	✓	✓
6	✓	✓	✓	✓
7	✓	✓	✓	✓
8	✓	✓	✓	✓
9	✓	✓	✓	✓
10	✓	✓	✓	✓
11	✓	✓		
12	✓	✓		
13	✓	✓		
14	✓	✓		
15	✓	✓		
16	✓	✓		

TRIAL ESTABLISHMENT

Pinus radiata regeneration growing on the site was sprayed in April, two months prior to trial establishment using Roundup herbicide. At the time of trial establishment the regeneration was yellowing but still standing.

The trial was established in mid-June using tissue cultured plantlets grown at the Fletcher Challenge, Te Teko nursery. Some of the material planted into the two-clone-mix (C2 1,2) had been topped. Plants in the treatment blocks were all labelled using numbered tags to aid future identification for early measurement and also to ensure the tissue cultured plantlets are not mistaken for regeneration at the time of regeneration removal.

The site was ripped and mounded in rows approximately 5 m apart. Trees were planted generally in the rips which took priority over planting at the 5 m spacing. This has resulted in a maximum variation in the between row spacing of approximately 1 m. Trees were planted at 5 m apart within the rows using a string line.

TRIAL MANAGEMENT

Future management will involve weed control via a post plant chemical application. The removal of radiata pine regeneration will also be carried out at years one and two. A pruning prescription will be developed closer to commencement of the first lift pruning, estimated to commence at age four years. The trial will not be thinned.

FUTURE ASSESSMENTS

Tree heights will be measured at year one for purposes of future covariate analysis. The trial will then be assessed for height and diameter at age five years (approx). Future assessments will be carried out at approximately five yearly intervals.

ACKNOWLEDGMENTS

The authors gratefully acknowledge Julie Hohepa and all the staff at the Fletcher Challenge Forests nursery, Te Teko, who were involved in the establishment of the trial. The assistance of Toby Stovold with trial layout and direction on management of planting and Dave Darling, Bill Libby, Tony Shelbourne, Paul Jefferson, Mark Kimberley and Bruce Manley for valuable input on an appropriate trial design is also acknowledged. The provision of the clonal tree stocks and planting site by Fletcher Challenge is also gratefully acknowledged.

REFERENCES

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Jamieson D. Borough C. & Tombleson J. D., 1989: New South Wales clonal management trial — Establishment report **Stand Management Cooperative Report No. 17.** NZ Forest Research Institute, Rotorua (unpublished)

Tombleson, J.D., Straker, A., Borough C., & Darling D., 1996: Single clonal blocks vs clonal mixtures — Kawerau & Tumbarumba trial assessment results. **Forest and Farm Plantation Management Cooperative Report No. 32.** NZ Forest Research Institute, Rotorua. (unpublished)

MOTHER ♀	FATHER ♂

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		X															
2																	
3				X X	X												
4																	
5																	
6							X X										
7																	
8									X								
9																	
10							X										
11					X												
12		X							X								
13																	X
14		X					X										
15									X								
16									X								16
Family		**1**		**2** **10**	**3**		**4** **11**		**5**								
		9			**7**		**6**		**8**								
		13					**12**		**14**								
									15								

APPENDIX II: TRIAL LOCATION

WALLYS

- MAR- 1995

Magnetic North

gistration
: 2821435
: 6333005
: 2624185
: 6334935

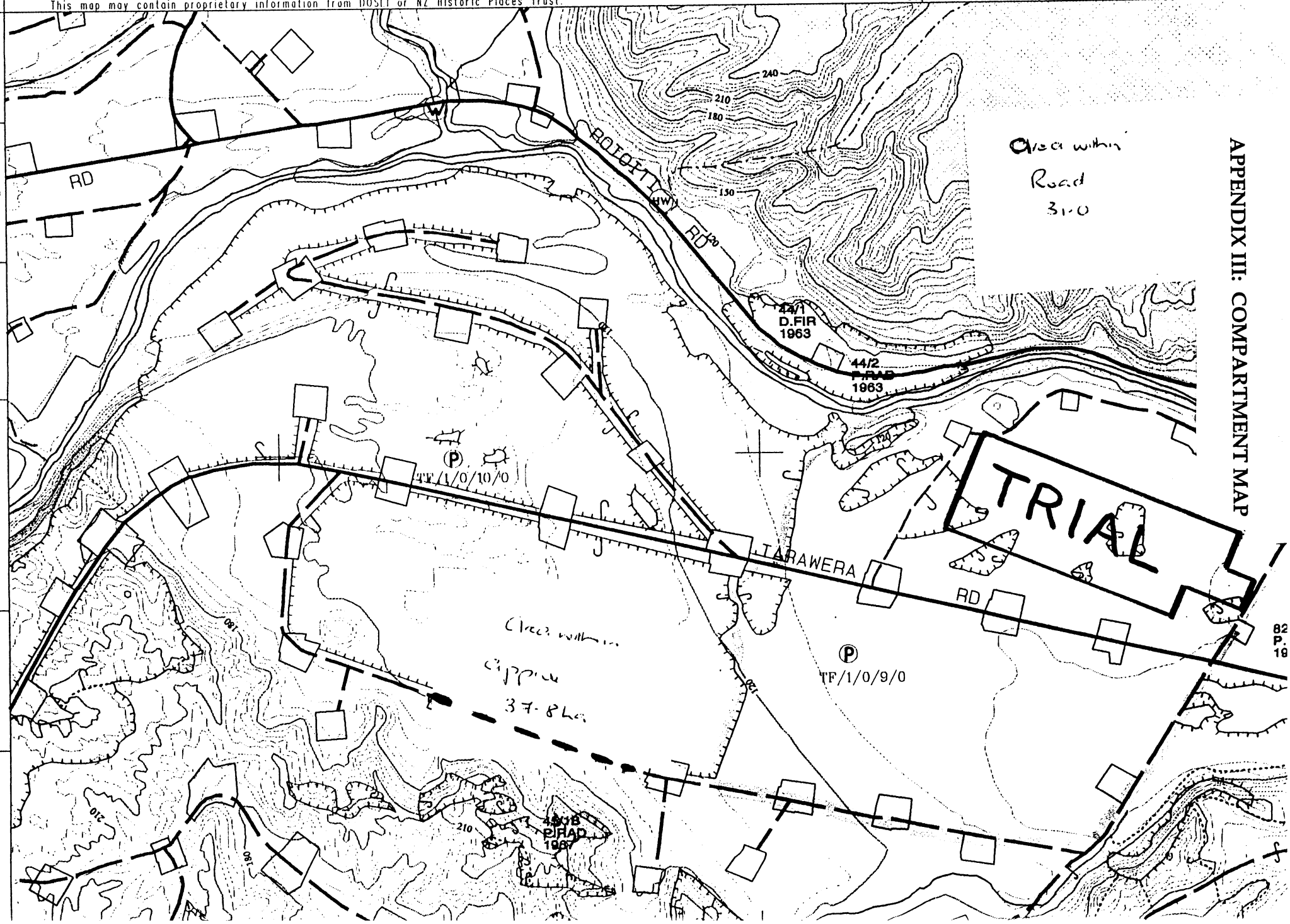
1 s/ha
mxdos
RIAL-

Ps (1)

Scale
:10000
C.I.
6M
V 16/3.1

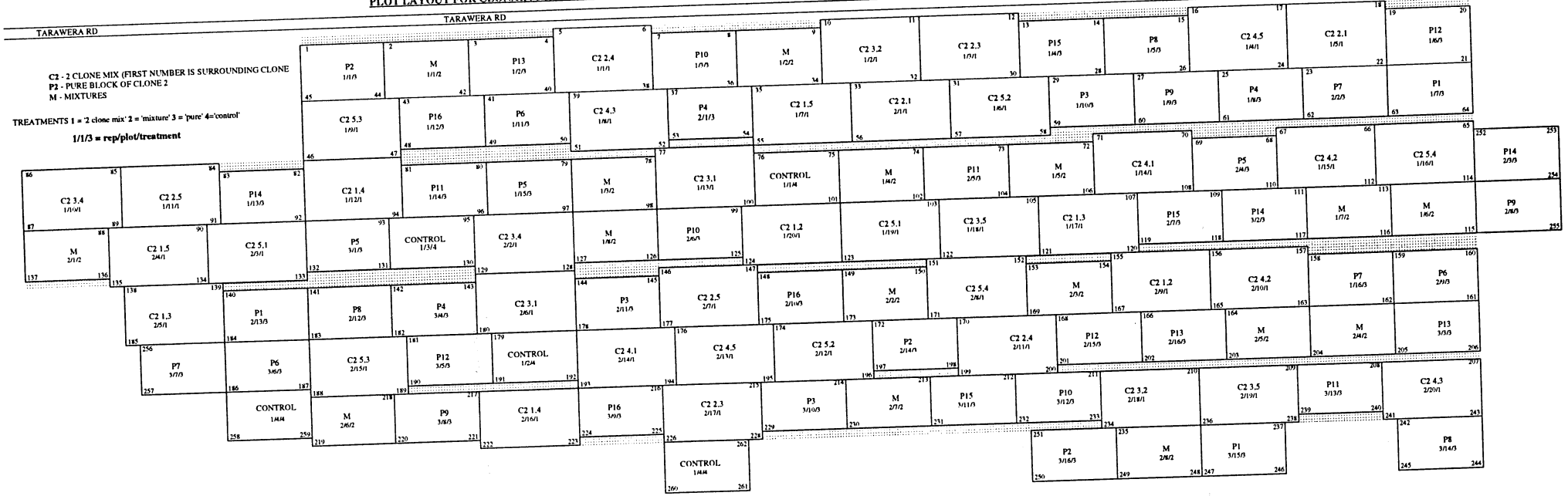
401
TARAWERA
45/1A
105.5 ha (9)

APPENDIX III: COMPARTMENT MAP



APPENDIX IV: TRIAL LAYOUT

PLOT LAYOUT FOR CLONAL MIXTURES TRIAL - TARAWERA FOREST



PLOT LAYOUT FOR CLONAL MIXTURES TRIAL - TARAWERA FOREST

PLOT LAYOUT FOR CLONAL MIXTURES TRIAL - TARAWERA FOREST

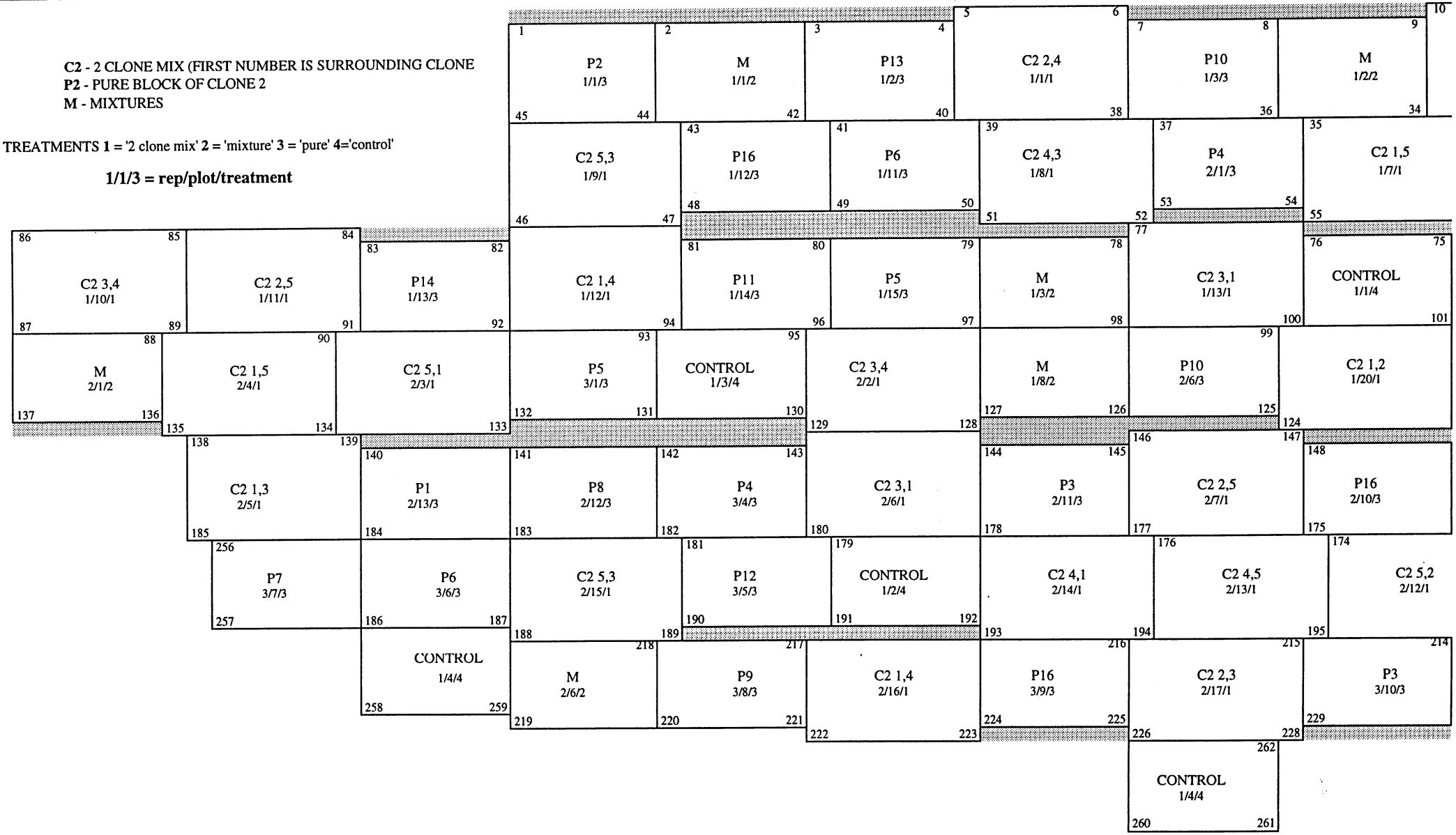
TARAWERA RD

TARAWERA RD

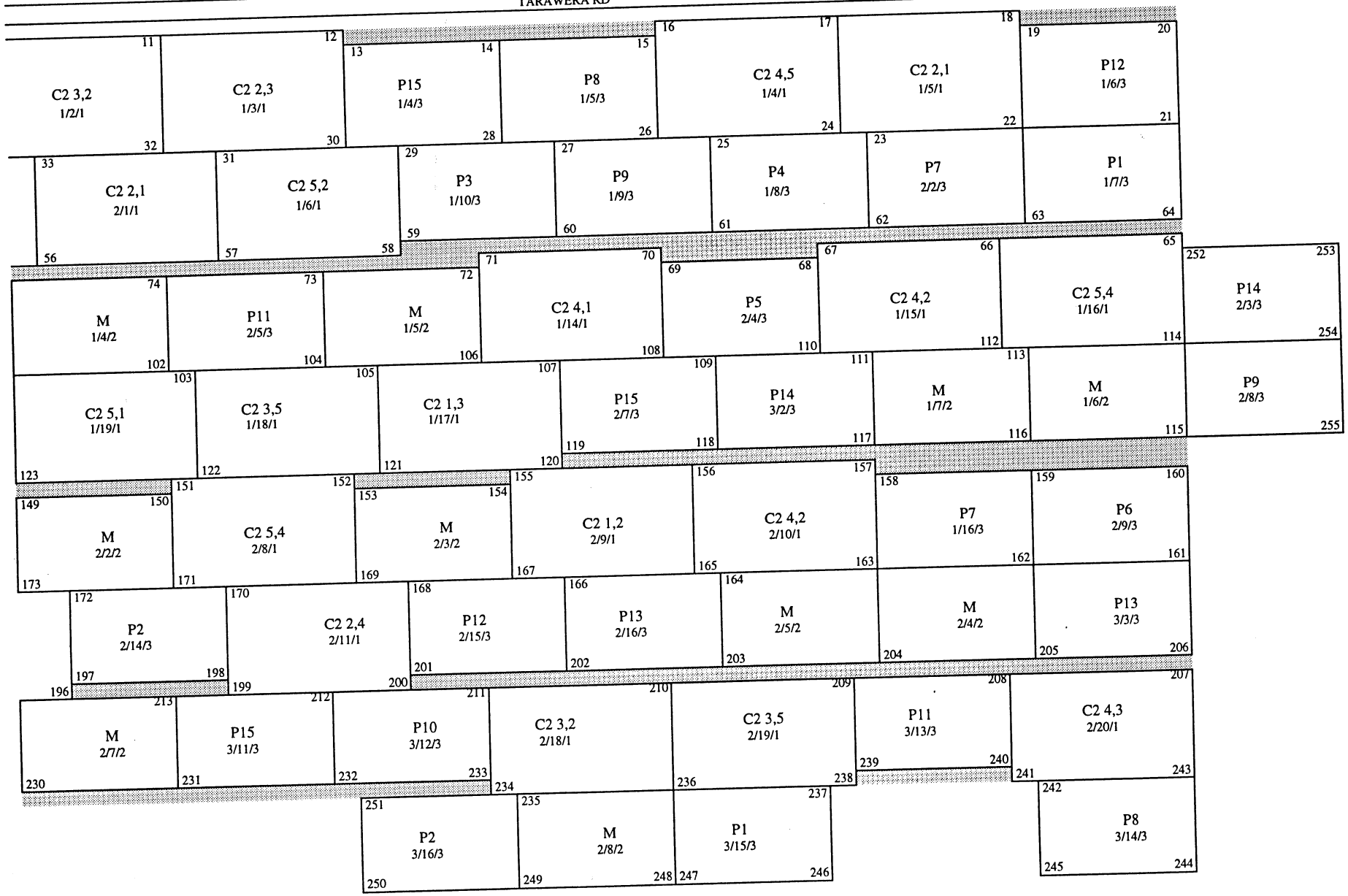
C2 - 2 CLONE MIX (FIRST NUMBER IS SURROUNDING CLONE
P2 - PURE BLOCK OF CLONE 2
M - MIXTURES

TREATMENTS **1** = '2 clone mix' **2** = 'mixture' **3** = 'pure' **4**='control'

1/1/3 = rep/plot/treatment



PLOT LAYOUT FOR CLONAL MIXTURES TRIAL - TARAWERA FOREST



LAYOUT OF CLONES FOR MIXTURES PLOTS

1/1/2

7	15	3	16	1	13
14	5	10	6	11	9
11	1	7	3	9	8
5	4	15	8	14	6
5	2	12	16	13	7
8	10	9	12	13	2

1/2/2

3	4	6	14	5	1
2	8	11	5	7	4
2	4	1	2	3	7
8	14	12	6	13	1
9	16	9	10	15	16
3	12	13	11	10	15

1/3/2

12	9	16	8	15	10
11	7	12	16	14	1
2	10	13	15	2	9
6	8	4	3	6	13
12	11	5	1	10	5
3	14	7	9	4	11

1/4/2

15	12	4	7	2	1
3	16	5	13	9	9
10	1	7	12	3	1
11	2	14	15	11	8
13	4	6	8	10	14
2	5	6	3	16	4

1/5/2

13	10	12	13	7	14
16	2	14	13	1	14
2	11	15	3	16	1
6	5	8	7	6	3
5	12	4	10	9	16
15	11	9	4	8	15

1/6/2

1	16	5	4	11	8
9	8	14	7	11	10
11	12	13	10	6	7
9	2	4	1	3	2
12	9	5	15	16	12
10	15	6	3	14	13

1/7/2

14	2	11	11?	4	10
5	11	3	10	9	9
6	6	14	7	15	3
8	16	13	8	1	10
7	12	2	5	4	7
8	9	12	3	1	5

1/8/2

14	13	14	7	4	15
10	3	4	12	14	16
11	16	5	7	11	15
8	6	13	2	15	3
1	10	8	9	1	9
16	2	5	6	12	13

2/1/2

4	10	1	16	7	3
12	9	1	3	15	15
4	6	7	12	5	1
2	14	13	4	10	11
2	8	2	11	16	3
8	6	9	13	14	5

2/2/2

2	14	4	6	10	5
7	9	2	10	16	5
7	7	8	15	5	1
15	13	12	1	4	12
13	6	11	3	14	16
9	8	3	11	6	8

2/3/2

12	6	3	4	8	15
5	12	7	9	6	13
9	13	1	4	2	16
11	5	10	11	8	11
10	3	16	14	15	10
1	6	7	12	2	14

2/4/2

12	11	2	4	3	11
10	4	5	3	10	9
5	15	16	11	13	13
7	12	9	2	1	14
16	8	7	6	14	6
10	12	8	9	15	1

2/5/2

9	4	16	16	13	5
14	12	1	16	9	2
12	7	5	14	10	13
15	11	13	4	2	3
6	8	15	3	6	14
15	1	11	8	10	7

2/6/2

5	3	10	4	4	12
1	5	11	1	6	8
11	7	15	10	12	2
15	9	3	2	8	2
3	13	16	14	4	16
1	7	13	14	9	6

2/7/2

1	4	13	5	16	7
10	7	5	15	3	11
2	2	10	1	6	14
8	4	9	8	12	6
5	11	14	16	13	3
7	9	15	6	12	8

2/8/2

13	2	7	3	15	16
15	13	4	7	12	14
13	14	16	10	9	14
12	8	2	35	1	9
5	11	15	5	6	11
1	6	8	4	14	16

PLOT NUMBERING

X	X	X	X	X	X
X	4	3	2	1	X
X	5	6	7	8	X
X	12	11	10	9	X
X	13	14	15	16	X
X	X	X	X	X	X

TARAWERA RD

APPENDIX V: MIXTURES PLOTS LAYOUT