Project Record No. 3220

KEY POINTS FROM TECHNICAL SESSIONS AND FIELD DAY OF THE N.Z. FOREST SITE MANAGEMENT COOPERATIVE HELD IN DUNEDIN 26-27 MAY 1992

Compiled by

J.A.C. Hunter

Report No. 57 June 1992

MAMAKU MULTI-NUTRIENT TRIAL
(N,P, B, Mg AND WEED CONTROL)

MALCOLM SKINNER

FR90 N, P, B, Mg and Weed Control Trial, Mamaku

INTRODUCTION

The soils of most of the Mamaku Plateau are classed as either primary podzolic soils or steepland skeletal soils. At the northern end of the plateau the dominating soil types are Mangowera sand, derived from Kaharoa ash, and Otanewainuku sand and sandy silt, derived from rhyolite and rhyolitic ash.

Phosphorus (P) reserves in these soils are recognised as being low and subsequent foliage sampling of established radiata pine has revealed marginal concentrations of P, nitrogen (N), and magnesium (Mg). Also, the boron (B) levels were low enough to cause concern should the trees suffer a summer drought.

The practice, in the late 70's and early 80's, of burning the slash from native bush felling, then blading the debris into windrows has caused a maldistribution of higher grade soil. Resulting patchiness in stand growth has been exacerbated at times by periodic waterlogging.

A trial was instigated to test the growth responses to added P and N with an insurance factor of added B as well. Because these additions could tax the soil's ability to supply Mg, extra plots were added to the original balanced design.

At some sites weeds are known to compete strongly with a young tree crop for moisture (unlikely in this case) and nutrients. The chosen trial site provided a good opportunity to test the importance of this competition factor.

METHODS AND MATERIALS

FR90 was established over the winter and spring of 1989 in a seven year old stand of *P. radiata*.

The basic design is a 2^4 factorial in N (0 and 200kg/ha), P (0 and 100kg/ha), B (0 and 8kg/ha) and weed control (yes/no). Magnesium (100kg/ha in the presence of N, P, and B) is tested with and without weeds, as is also a half rate of P (plus N and B).There are two replicates of every treatment giving a total of 40 plots.
Measurement plots are 18*12 metres (0.0216ha) plus a 4m treated surround on all sides.

The required number of plot trees to give a stocking of 600-650 stems/ha were selected and pruned to 2.5m and the remaining stems (about 1000s/ha) were thinned to waste.Within the weed control plots the understorey of hardwood shrubs, bush lawyer, and toetoe was cleared with a chainsaw. Regrowth has been sprayed twice with Roundup.

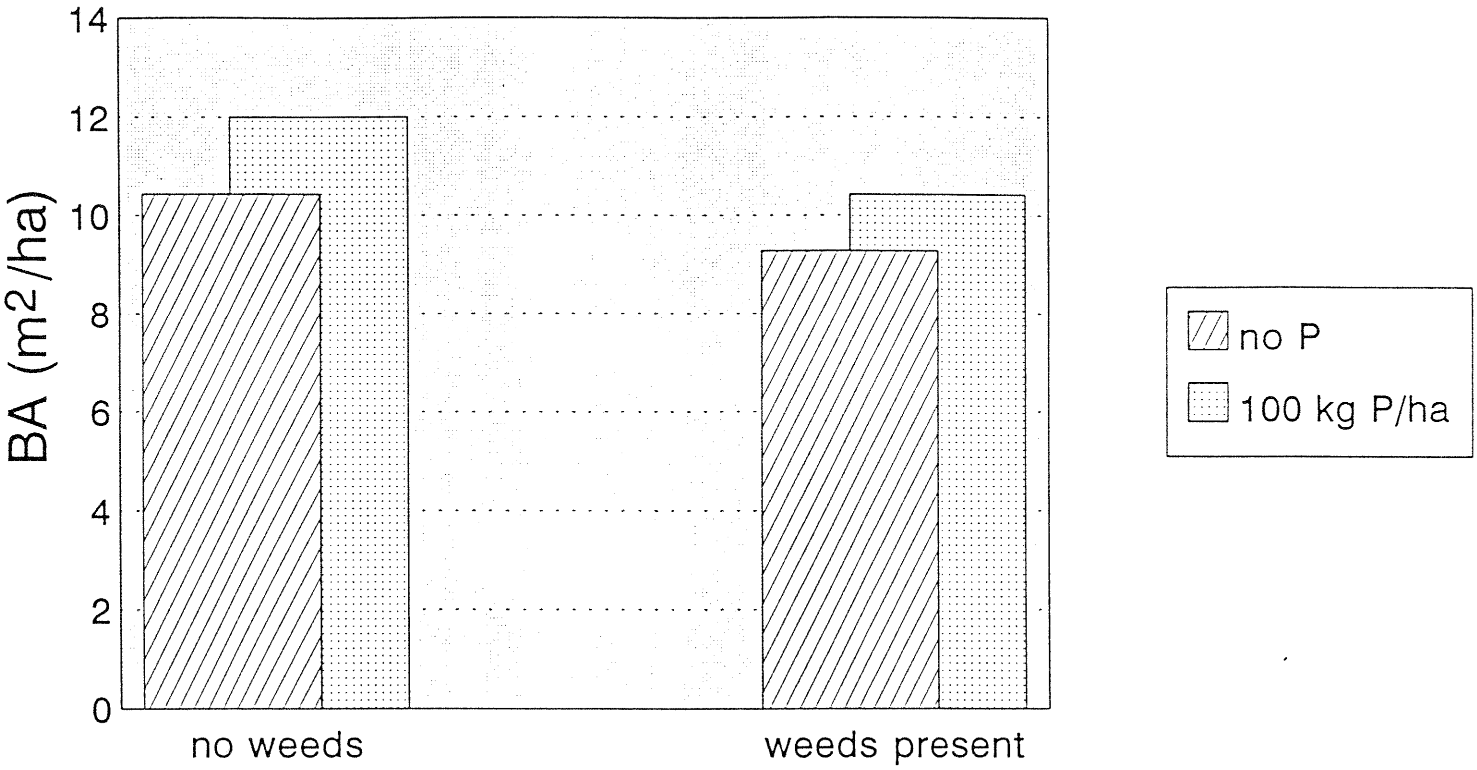
Fertilisers were broadcast applied by hand in October. Nitrogen as urea, P as PAPR, B as ulexite and Mg as medium ground magnesite.

The trees were measured at the time of fertilising and again in the winter of 1990 and 1991. All diameters and heights were recorded and processed through the FRI PSP system. Standard foliage samples were collected from every plot in late summer 4 and 16 months after establishment.

Statistical analysis of the growth data and foliage elemental concentrations was performed in the program SAS with the initial measurement used as a covariate.

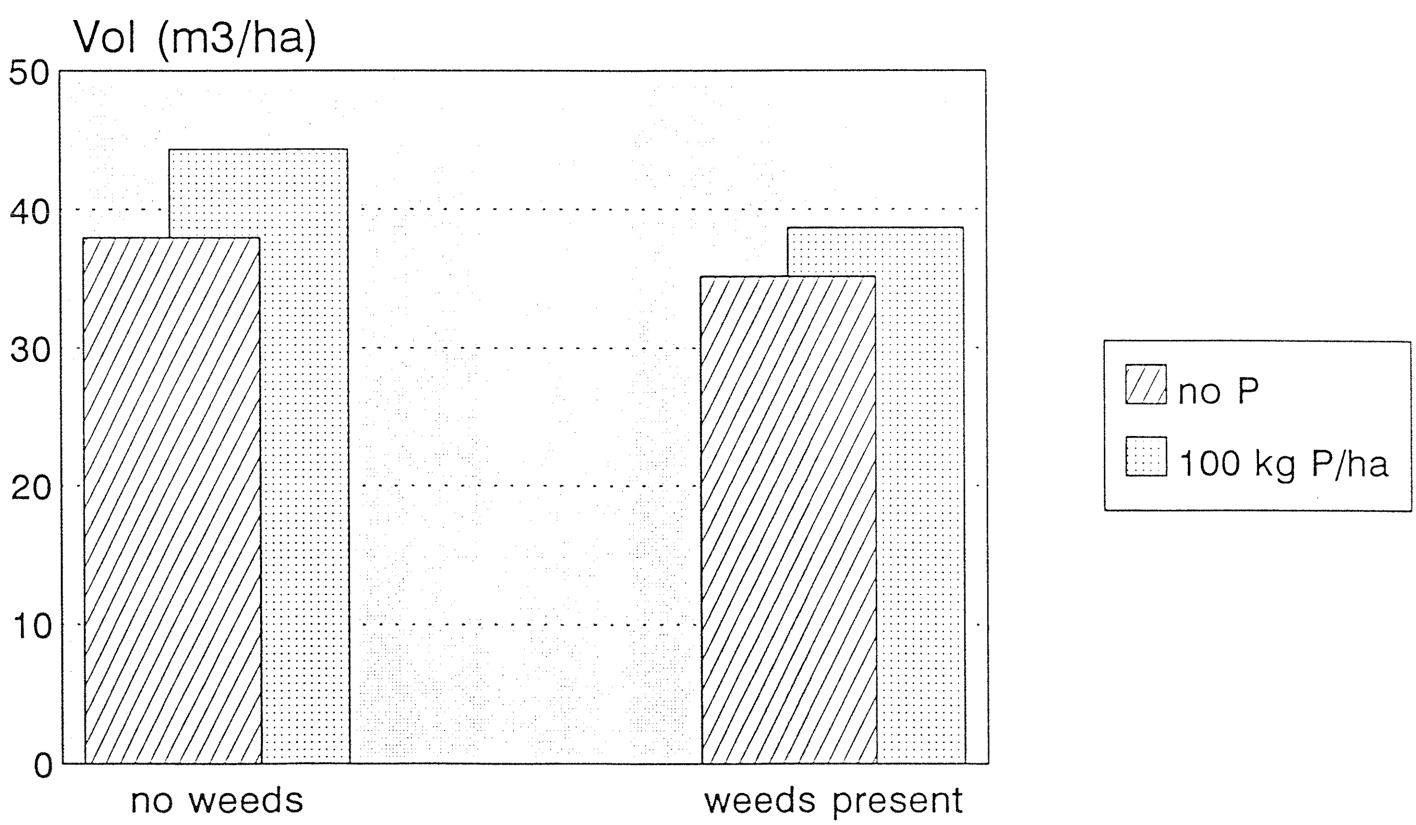
Mamaku multi-nutrient trial (N P B and Mg)

Effect of P and weeds on BA after 2 yrs



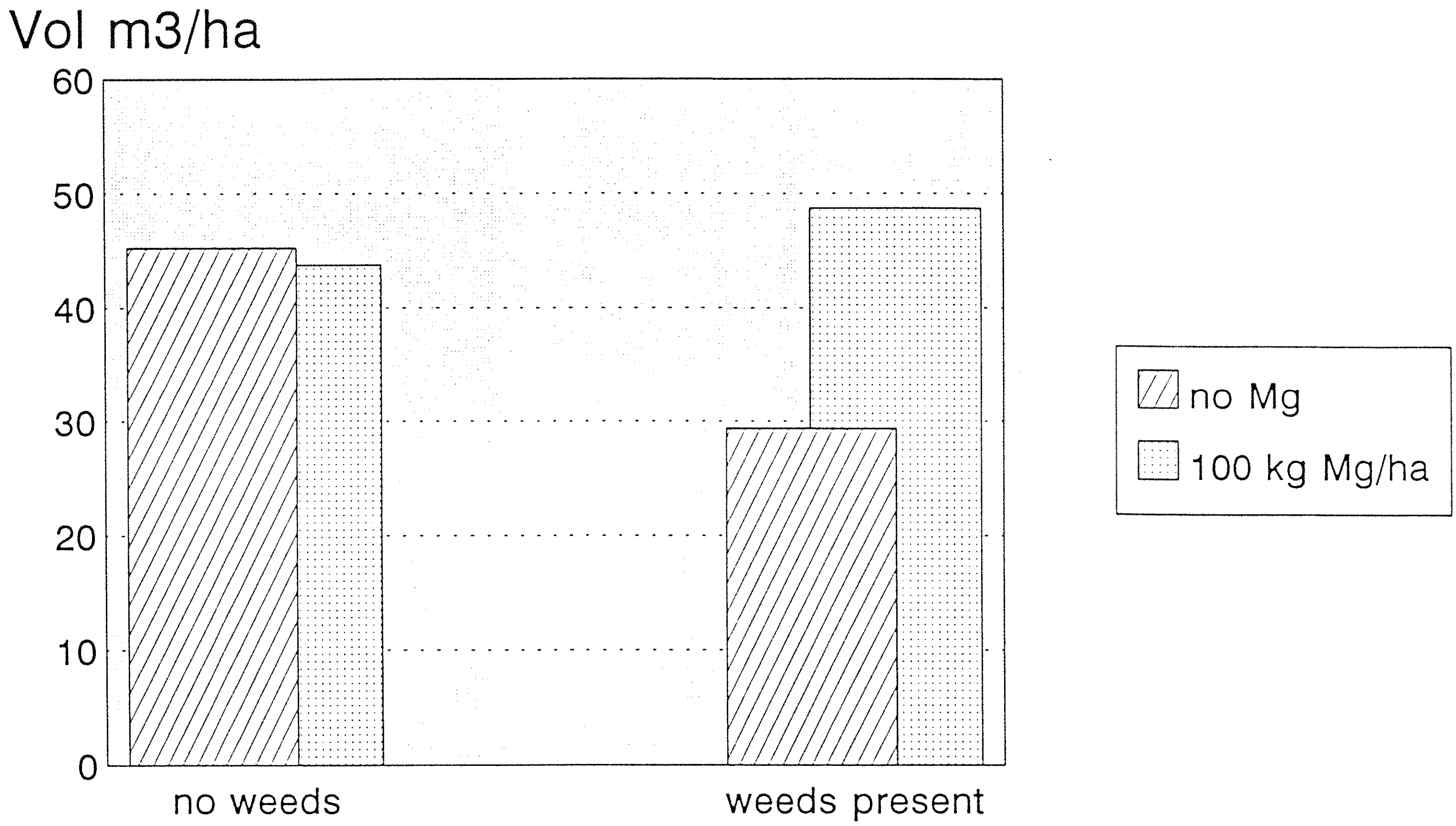
Mamaku multi-nutrient trial (N P B and Mg)

Effect of P and weeds on VOLUME after 2 yrs



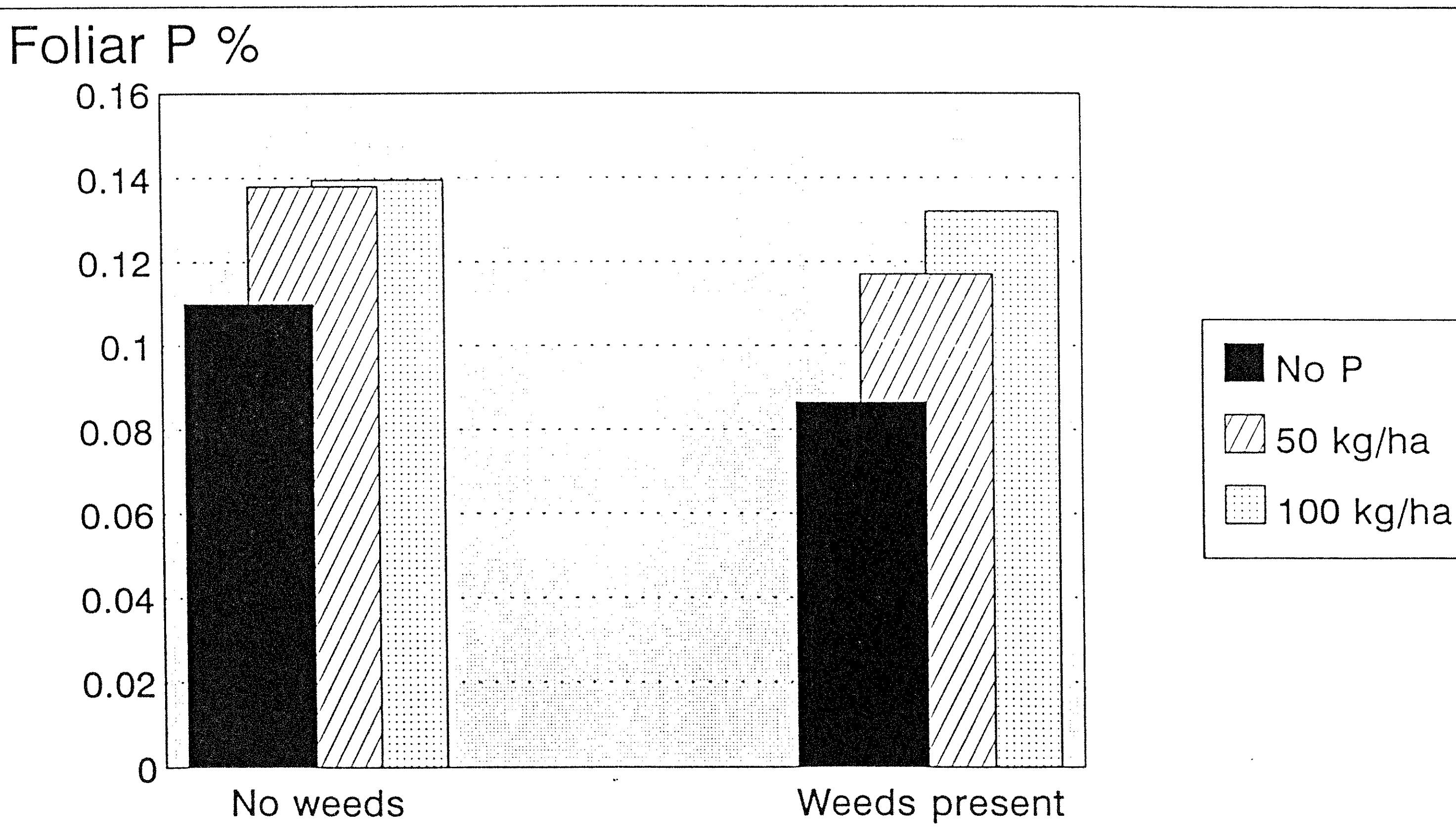
Mamaku multi-nutrient trial (N P B and Mg)

Effect of Mg and weeds on volume after 2 yrs



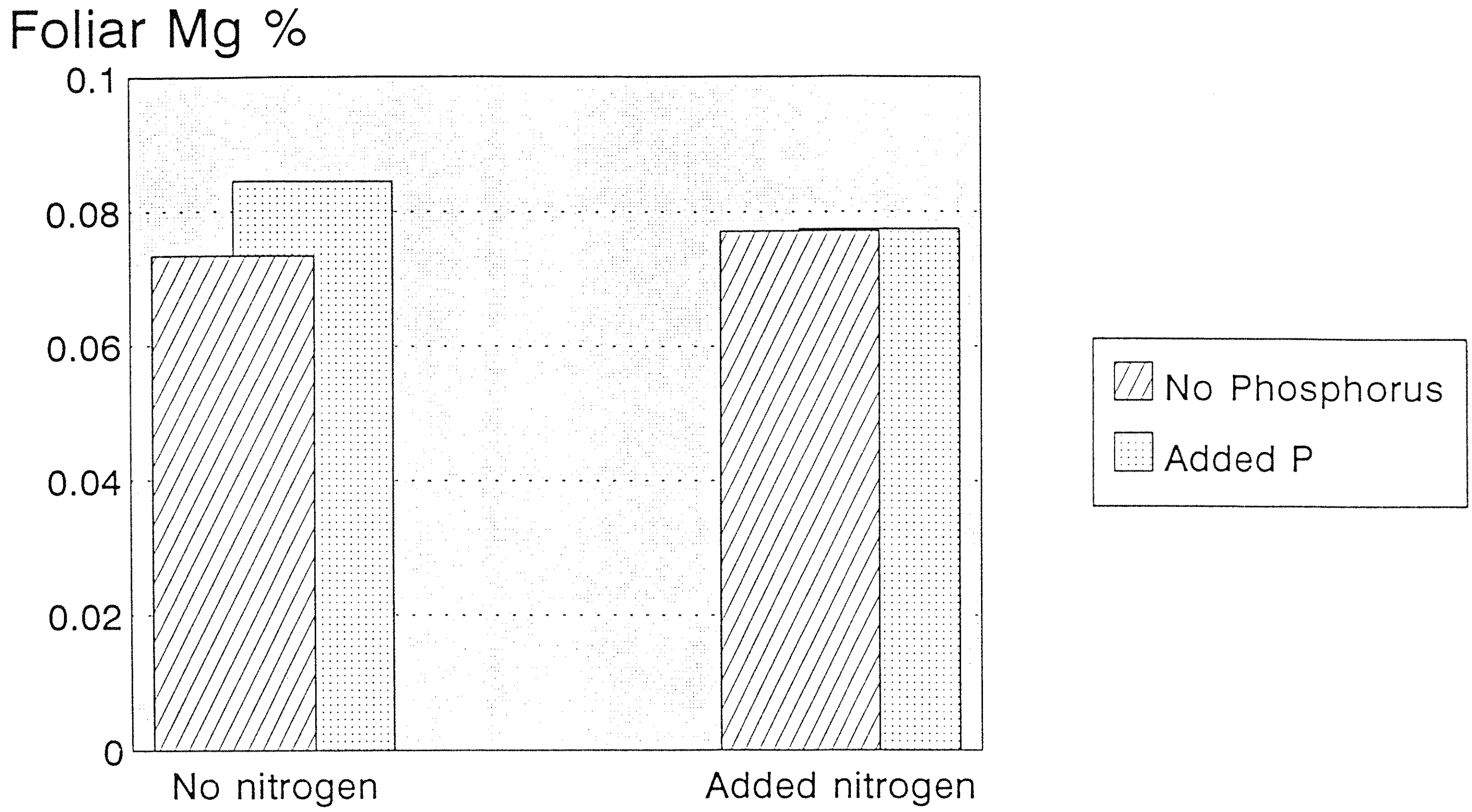
Mamaku multi-nutrient trial (N P B Mg)

Effect of weed control and P fertiliser on foliar P levels



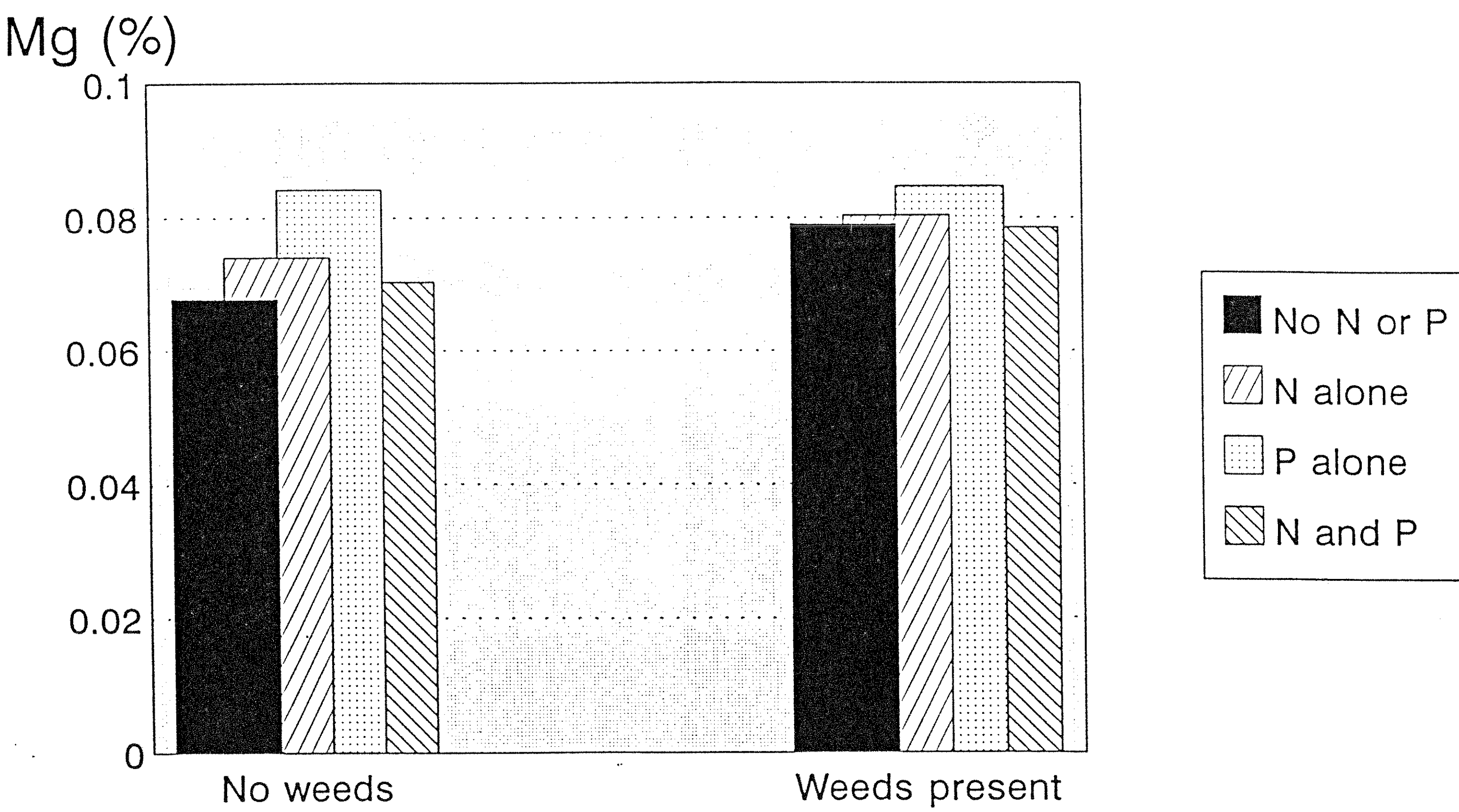
Mamaku multi-nutrient trial (N P B Mg)

Effect of N and P fertiliser on foliar Mg levels



Mamaku multi-nutrient trial (N P B Mg)

Effect of weeds, N and P on foliar Mg after 2 years



FOLIAGE NUTRIENT MAPPING

TIM PAYN

Foliage Nutrient Mapping

- Nutrition Atlas based on foliar means within Soil Groups
- No feel for spatial variation within Soil Groups
- This is not sensitive enough

Research Proposal

- To investigate the spatial variation of foliar nutrient concentrations within Soil Groups

Methods

- Foliage Data from FRI database
- Spatially locate sample points (Compartment centres)
- Analyse spatial pattern using geostatistics
- Identify spatial dependence per element
- Determine further sampling requirements

Methods

- Re run spatial analysis
- Use variogram model parameters in prediction phase
- Predict foliage concs on fine grid over Soil Group
- Plot contour maps of concs of foliar nutrients
- Plot contour maps of prediction errors for nutrient concs

Spatial Analysis

Variograms

- Describe the spatial dependence of a variable in terms of distance and direction

Spatial Analysis

Kriging

- Kriging predicts values of a variable at unsampled points
- Estimates have minimum and known variance
- Variogram parameters are used in kriging process

Output

- Evaluation of usefulness of technique
- Standard variogram parameters for pumice soils
- Spatial pattern of foliar nutrients for pumice soils

Mg AND B SOILS TESTS

TIM PAYN

Mg and B Soil Tests

- Mg and B deficiencies widespread
- No soil tests available for predicting susceptible sites
- Such tests would be valuable

Research Proposal

- To investigate soil and foliar relationships for Mg and B
- To develop a useable soil test for predicting deficient sites

Methods

- Sites - Nationwide, range of foliar concs
- Sampling - 15 trees per 0.04 ha plot Current and 1 year needles.
  Needle weight. Unpruned trees. 25 Hoffer soil cores, topsoil depth and bulk density

Methods

- Analytical - Foliar Mg and B concs, weight 50 fascicles
- Analytical - Soil Mg fractionation (soln, exch, acid extract)
- Analytical - Soil B (hot water)
- Statistical - Regression analysis

Outputs

- Scientific article on Mg soil/foliar relationships
- Scientific article on B soil/foliar relationships

COMPETITION DATABASE

BRIAN RICHARDSON

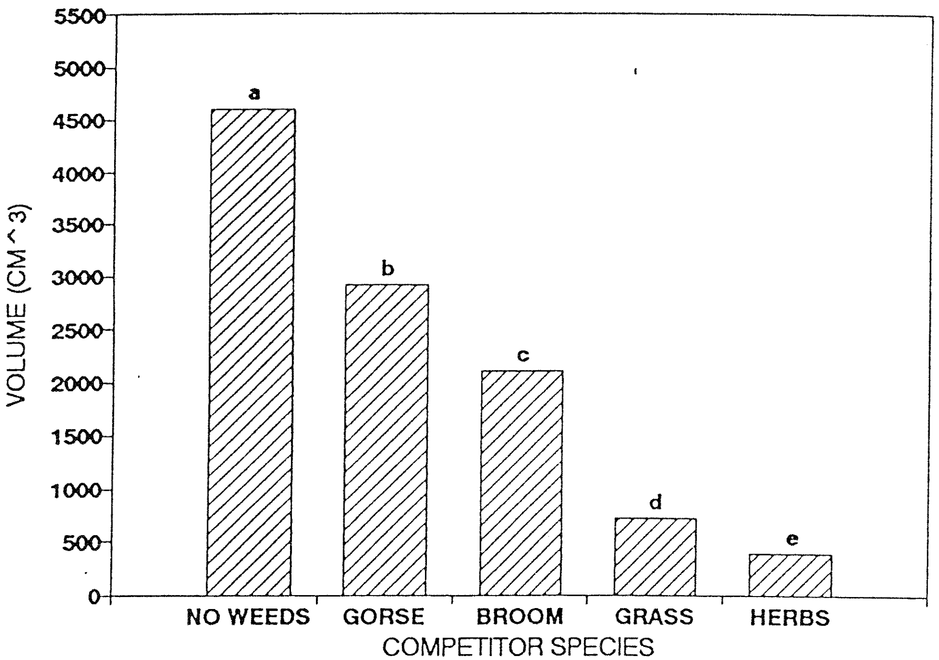
COMPETITION DATABASE ACHIEVED TO DATE:

- DB STRUCTURE COMPLETED
- COMPATIBLE WITH PSP
- DATA ENTRY UNDERWAY

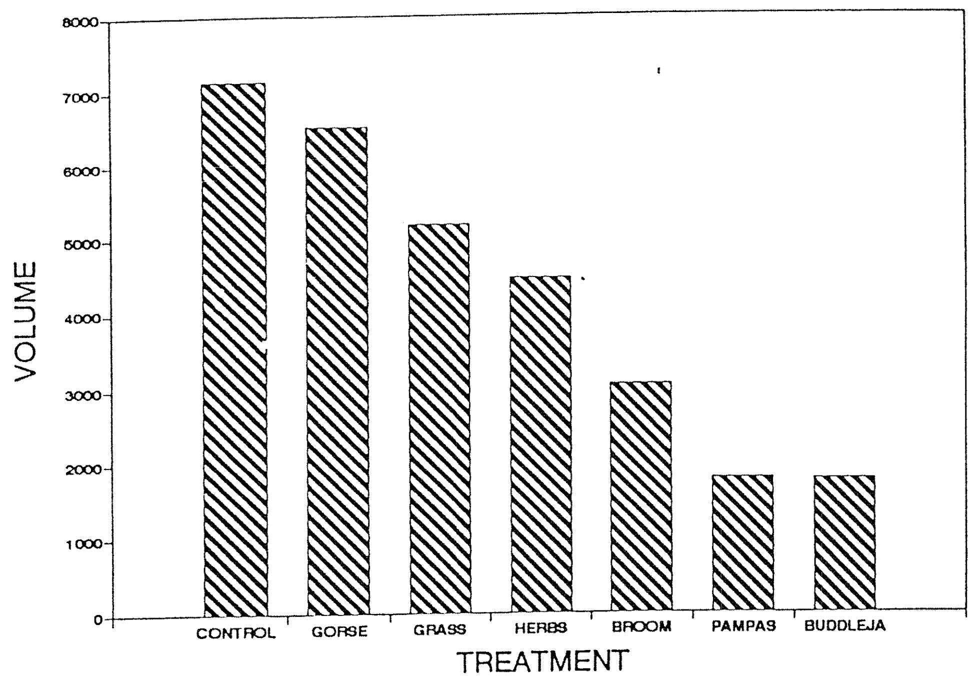
COMPETITION DATABASE NEW WORK PROPOSED

- LONG-TERM TRIALS TO DEFINE COST-BENEFIT OF WEED CONTROL
- \- COMPETITION
+ COMPETITION
OPERATIONAL
FERTILISER INTERACTIONS
- TRIAL LOCATION?
- SUSTAINABILITY TRIALS

EFFECT OF COMPETITION ON RADIATA PINE VOLUME GROWTH



RADIATA MEAN VOLUME AFTER 22 MONTHS BLOCK A



DURATION OF WEED CONTROL

BRIAN RICHARDSON

NEW PROPOSALS
DURATION OF WEED CONTROL

OBJECTIVES:

- OPTIMAL DURATION OF CONTROL
- GROWTH RESPONSE AFTER RELEASE
- MAXIMUM GROWTH RATES
- FERTILISER INTERACTIONS

WEED CONTROL DURATION

EXPERIMENTAL DESIGN

Treatment number	TIME INTERVAL (YEARS) 0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-3.0	Fertiliser
1	0^1	0	0	0	0	No
2	0	0	0	0	x^2	No
3	0	0	0	x	x	No
4	0	0	x	x	x	No
5	0	x	x	x	x	No
6	x	x	x	x	x	No
7	x	x	x	x	0	No
8	x	x	x	0	0	No
9	x	x	0	0	0	No
10	x	0	0	0	0	No
11	0	0	0	0	0	Yes
12	0	0	0	0	x	Yes
13	0	0	0	x	x	Yes
14	0	0	x	x	x	Yes
15	0	x	x	x	x	Yes
16	x	x	x	x	x	Yes
17	x	x	x	x	0	Yes
18	x	x	x	0	0	Yes
19	x	x	0	0	0	Yes
20	x	0	0	0	0	Yes

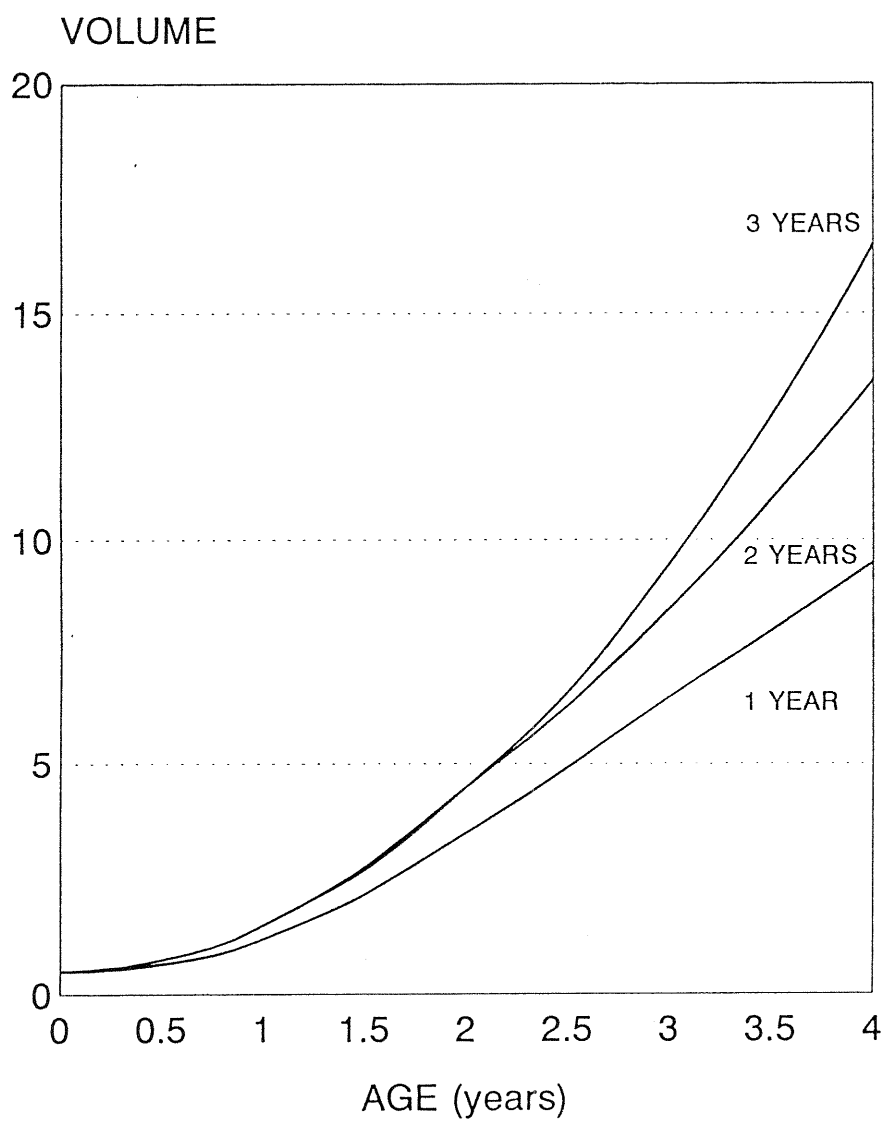
0^1 - represents weed control i.e. no competition
x^2 - represents no weed control i.e. competition

- SINGLE TREE PLOTS

- 20 REPLICATIONS

- RANDOMISED BLOCK, SPLIT PLOT

DURATION OF WEED CONTROL



WEED FREE ZONE

BRIAN RICHARDSON

NEW PROPOSALS
WEED FREE ZONE

OBJECTIVES:

- OPTIMAL WEED FREE ZONE
- CHANGES OVER TIME
- MAXIMUM GROWTH RATES
- FERTILISER INTERACTIONS

WEED FREE ZONE

EXPERIMENTAL DESIGN

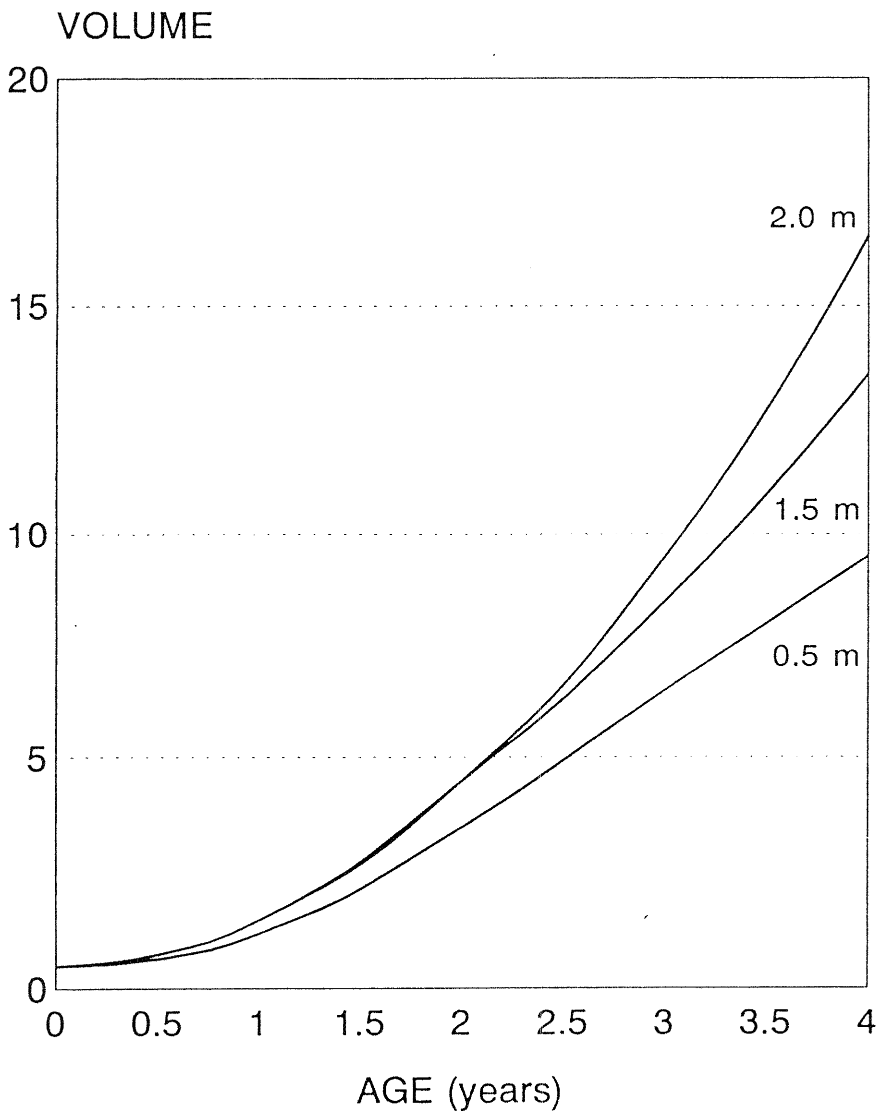
TREATMENT NUMBER	SPOT RADIUS (m) FOR YRS 0-1	1-2	2-3	FERTILISER
1	0.0	0.0	0.0	Yes
2	0.5	0.5	0.5	Yes
3	0.75	0.75	0.75	Yes
4	1.5	1.5	1.5	Yes
5	2.0	2.0	2.0	Yes
6	0.0	0.0	0.0	No
7	0.5	0.5	0.5	No
8	0.75	0.75	0.75	No
9	1.5	1.5	1.5	No
10	2.0	2.0	2.0	No

- SINGLE TREE PLOTS

- 20 REPLICATIONS

- RANDOMISED BLOCK, SPLIT PLOT

WEED FREE ZONE

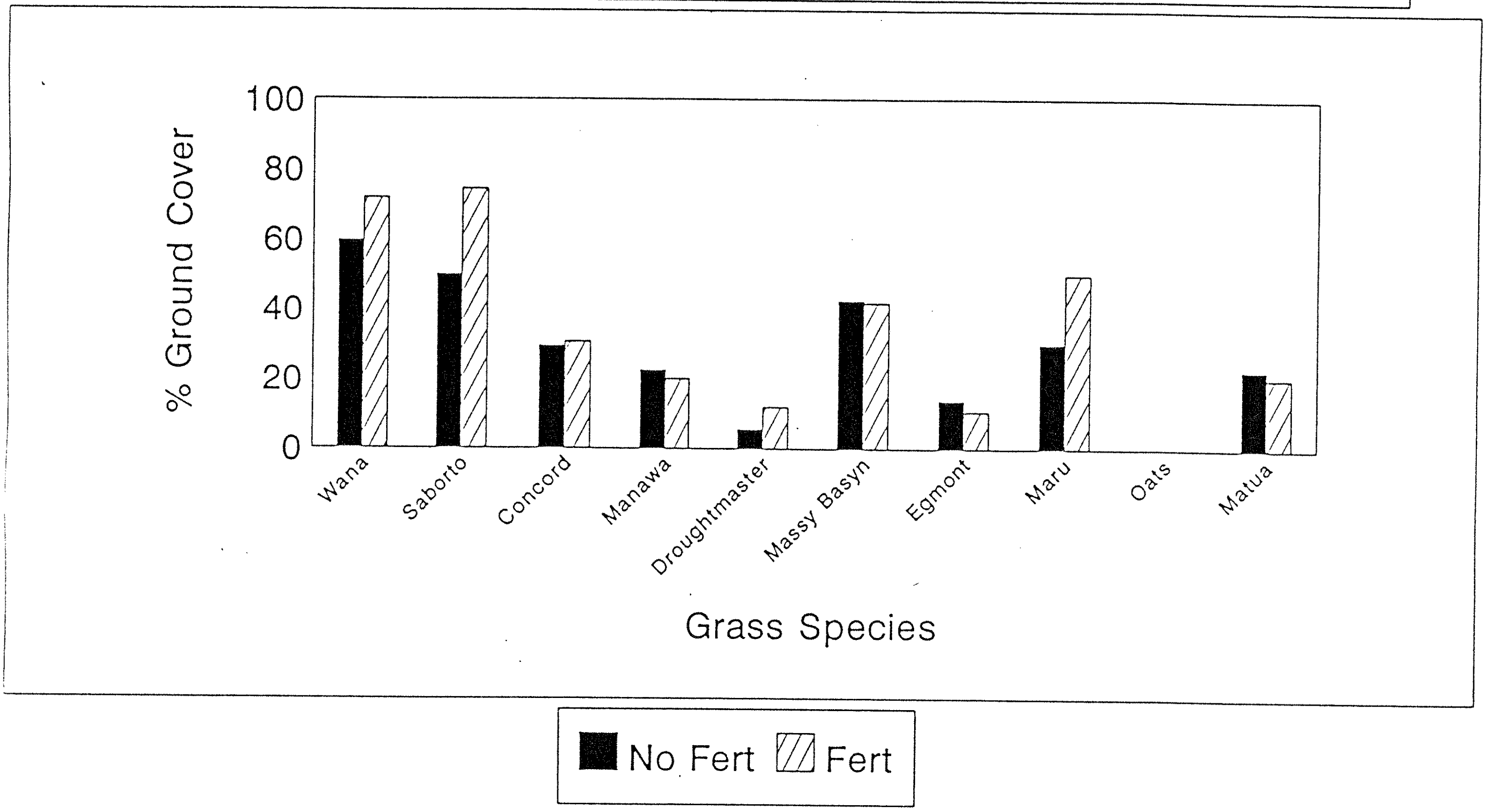


FIELD SCREENING OF GRASS SPECIES

GRAHAM WEST

Whaka Grass Screening Trial

assessed Jan 1992 - 16 months after sowing



Field Screening

Grass species

Objective :

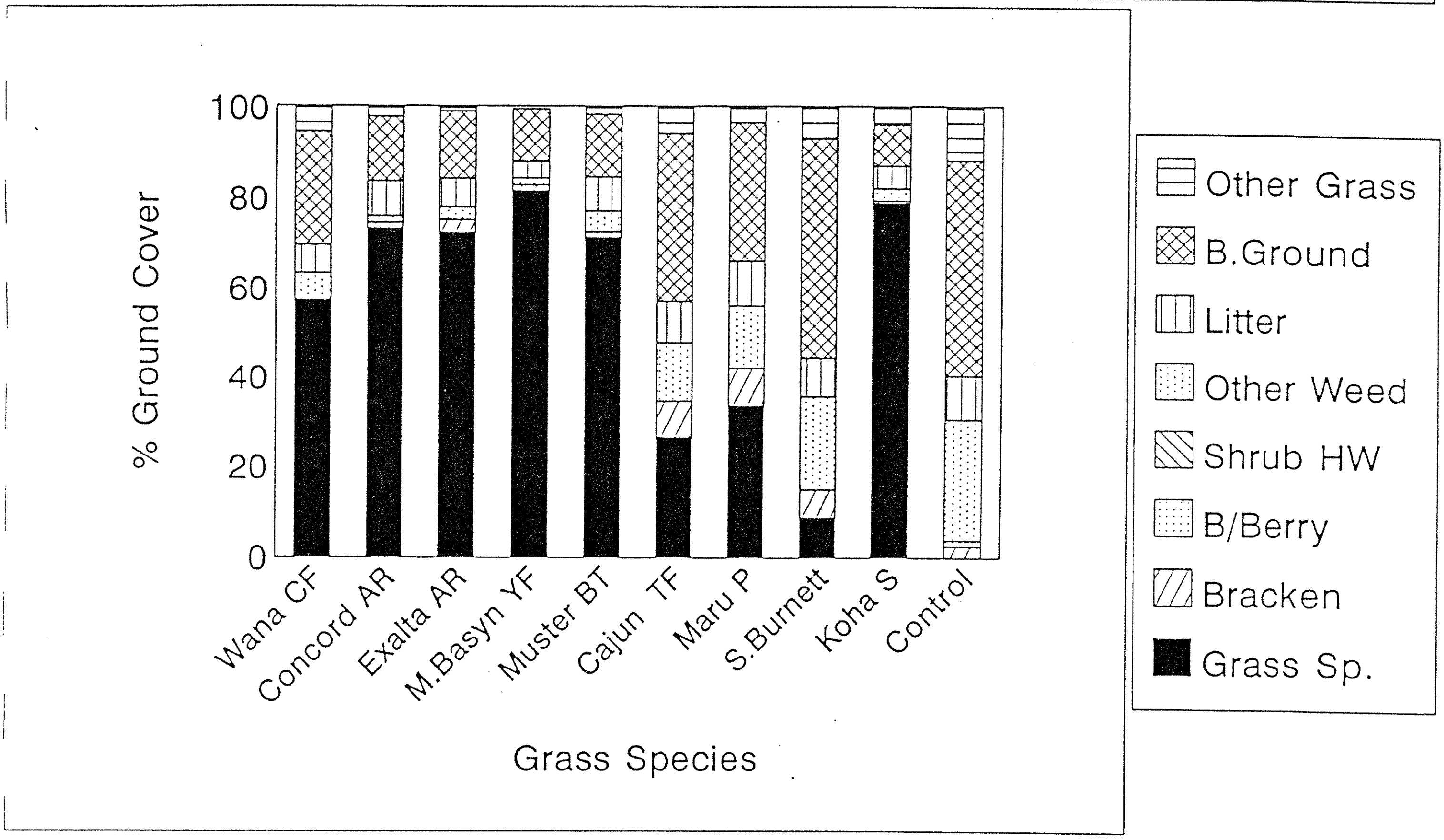
Develop cover crop

to compete

against weeds

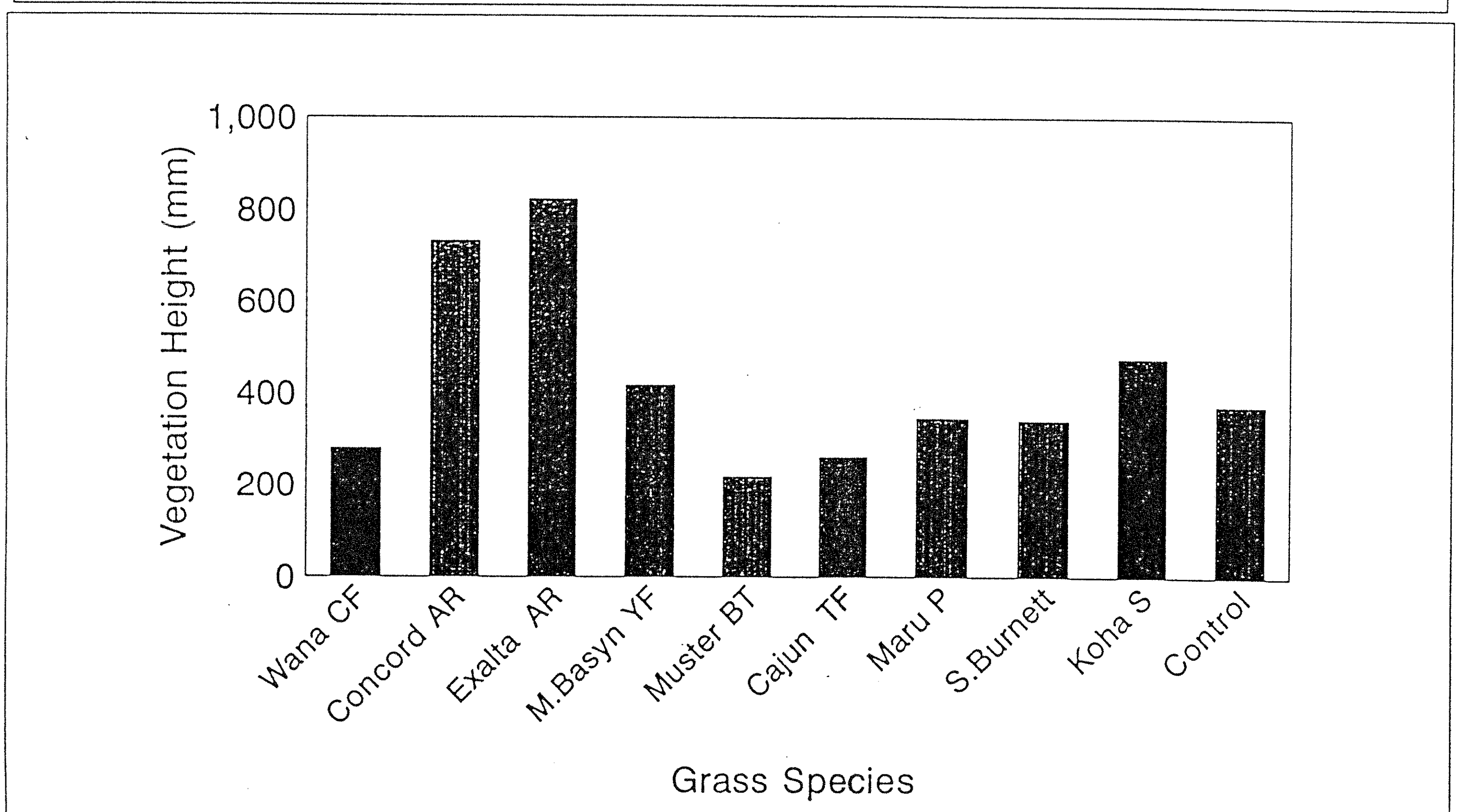
Longmile Grass Oversowing Trial

Sown April 1991 - assessed Dec 1991- 8 months after sowing



Longmile Grass Oversowing Trial

Sown April 1991 - assessed Dec 1991 -8 months after sowing



LOTUS TREE GROWTH - STEP OUTS

GRAHAM WEST

Lotus tree growth step outs

Control	Lotus
Lotus + P	Lotus & Grass

Treatments:

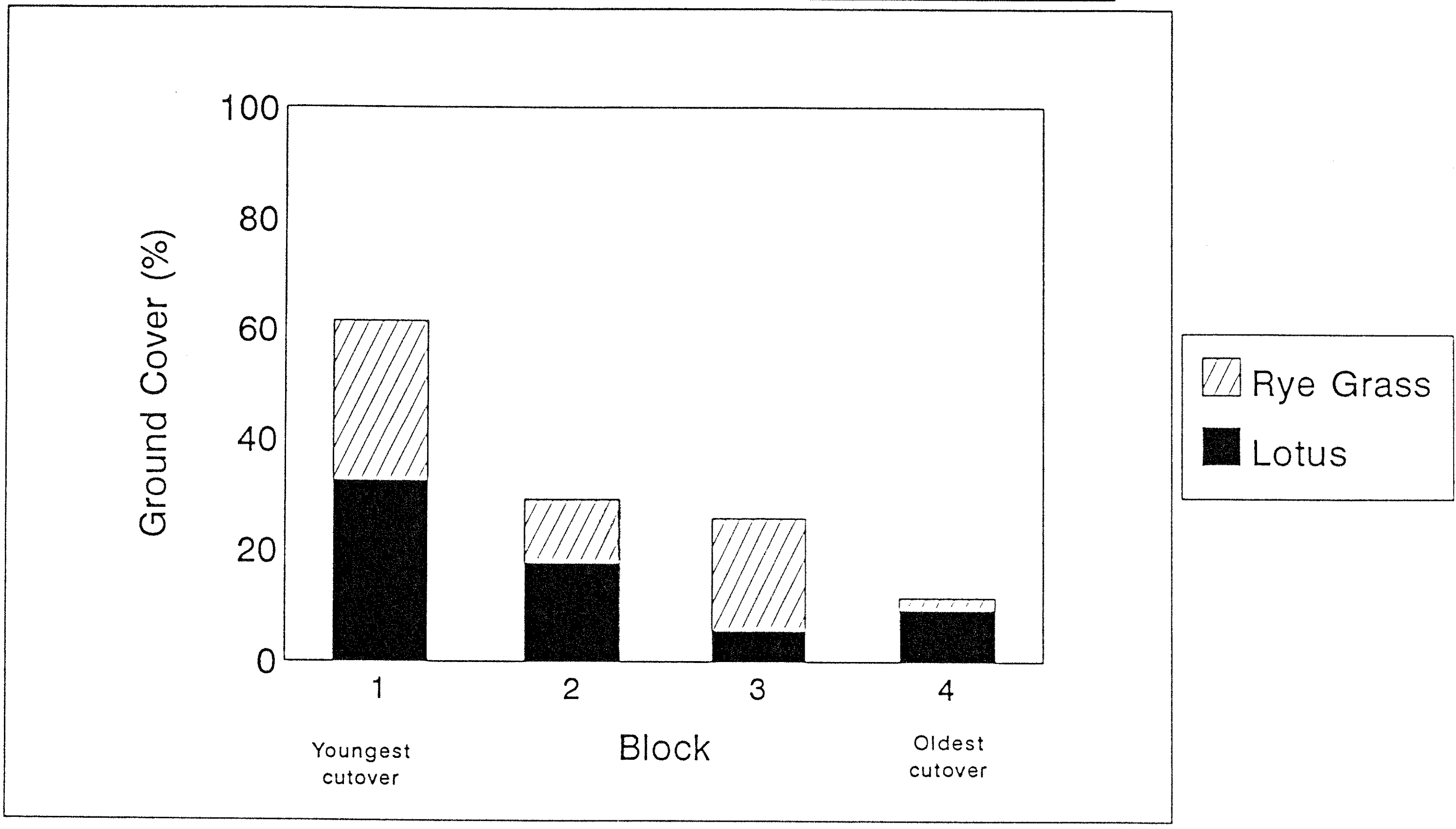
Lotus = Maku Lotus @ 5kg/ha

Grass = Annual ryegrass @ 14kg/ha
Yorkshire Fog @ 7 kg/ha

P = Superphosphate @ 400 kg/ha

Lotus Stepouts

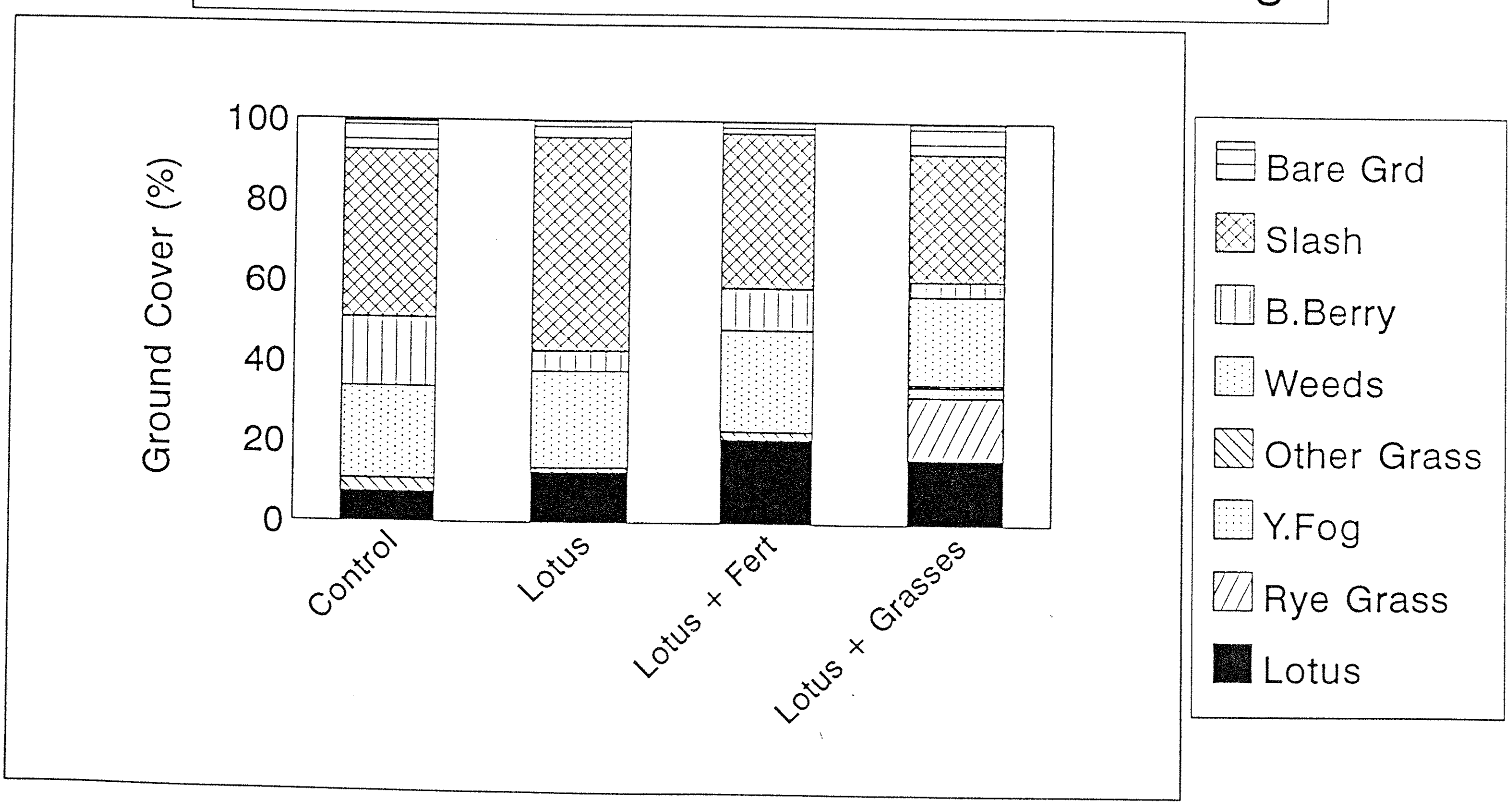
as distributed within the compartment



Effect of Lotus on tree growth

Step out 1 -CHH Tokoroa

March 1992 - 5 months after oversowing



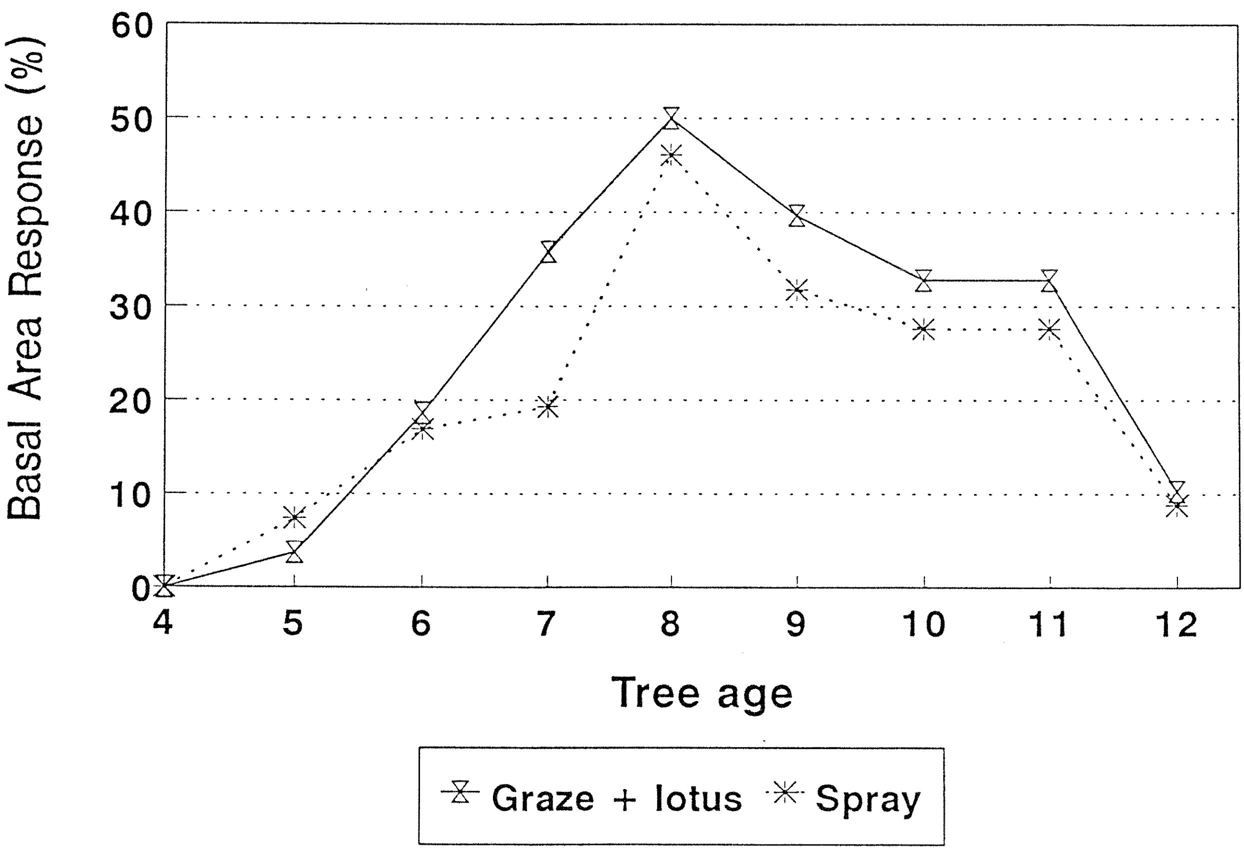
FOREST GRAZING TRIALS

GRAHAM WEST

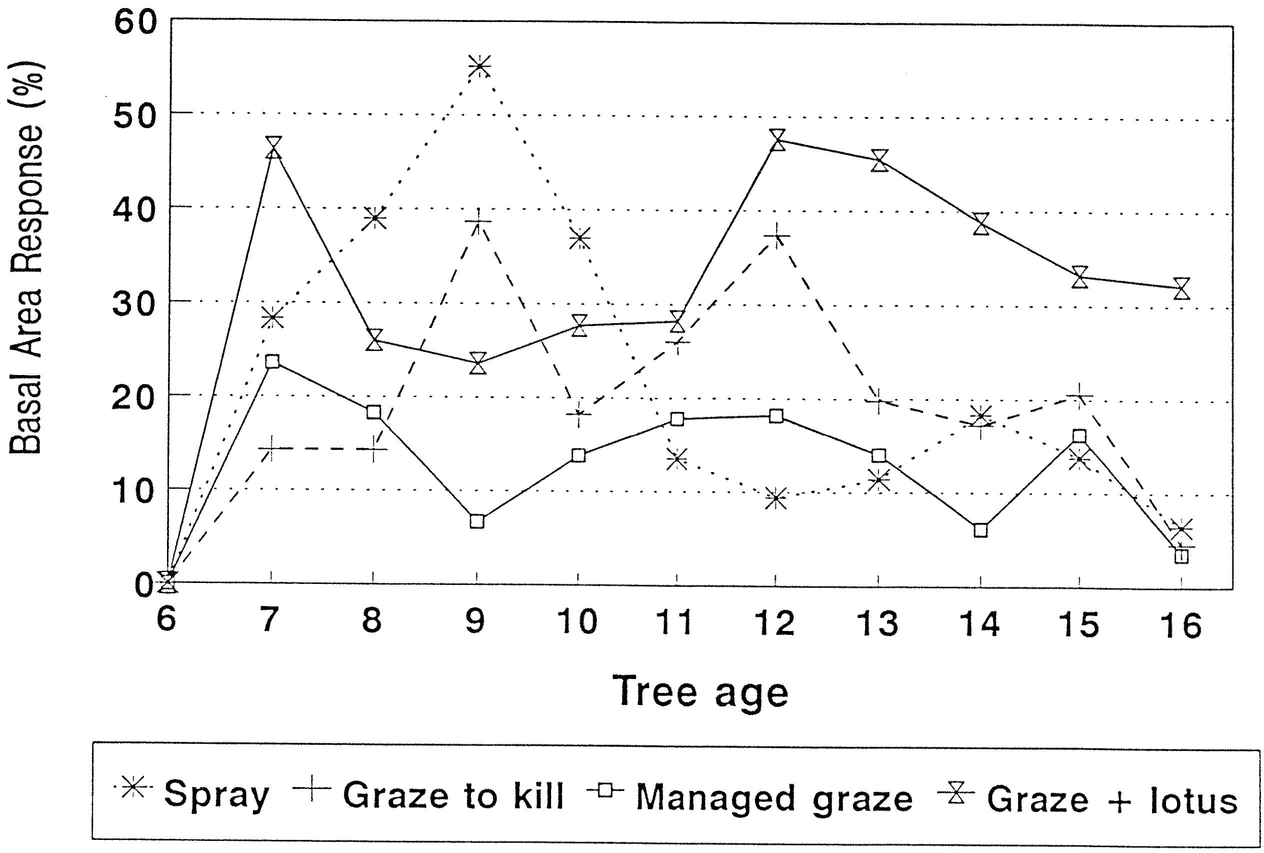
FOREST GRAZING TRIALS

Treatment	Waiuku (1981)	Maramarua (1984)	Kaharoa (1984)	Kaingaroa (1983)	Aupouri (1985)
1. Control	*	*	*	*	*
2. Herbicide	*	*			
3. Graze to kill	*				
4. Manage graze	*				
5. Lotus graze	*	*	*	*	*
6. Lotus			*	*	
7. Lupin					*
8. N Fertiliser					*

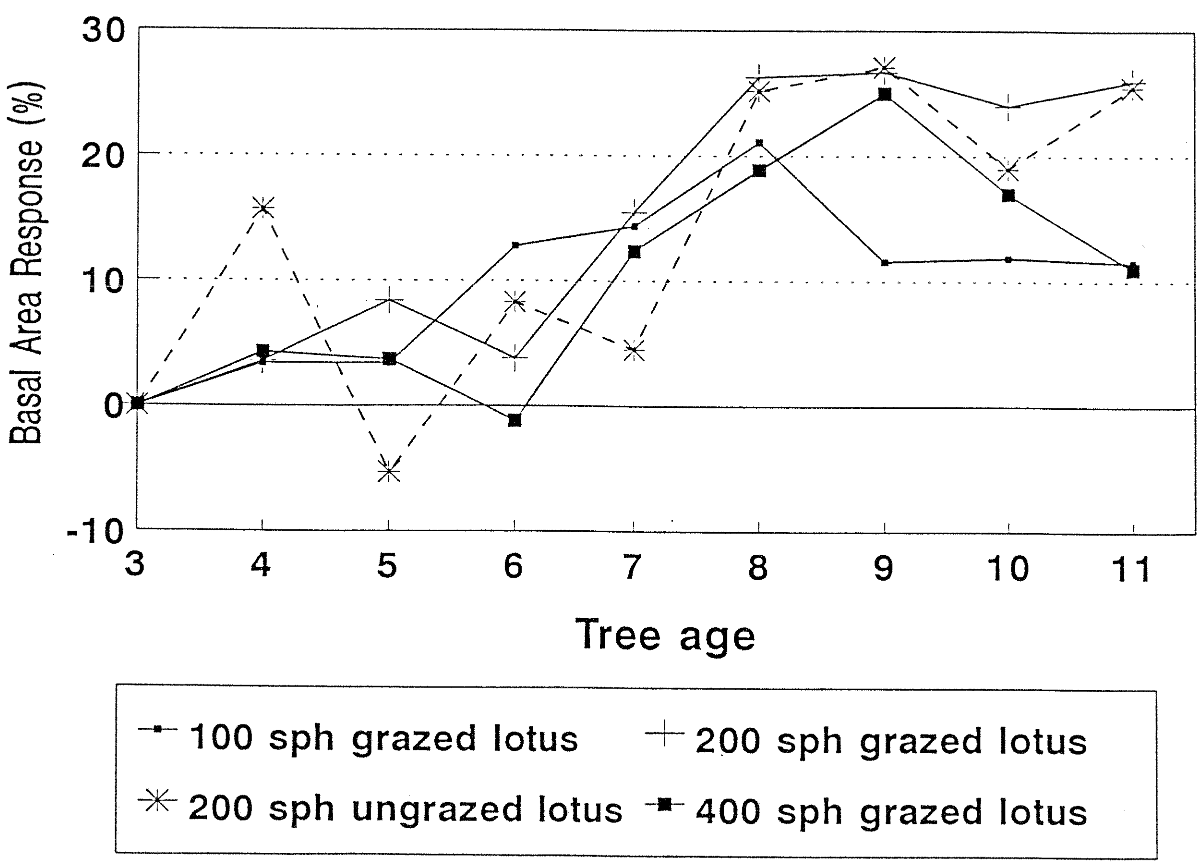
Effect of Pampas treatments at Maramarua AK1005



Effect of Pampas control treatments at Waiuku AK847



Effect of lotus oversowing at Kaingaroa RO1891

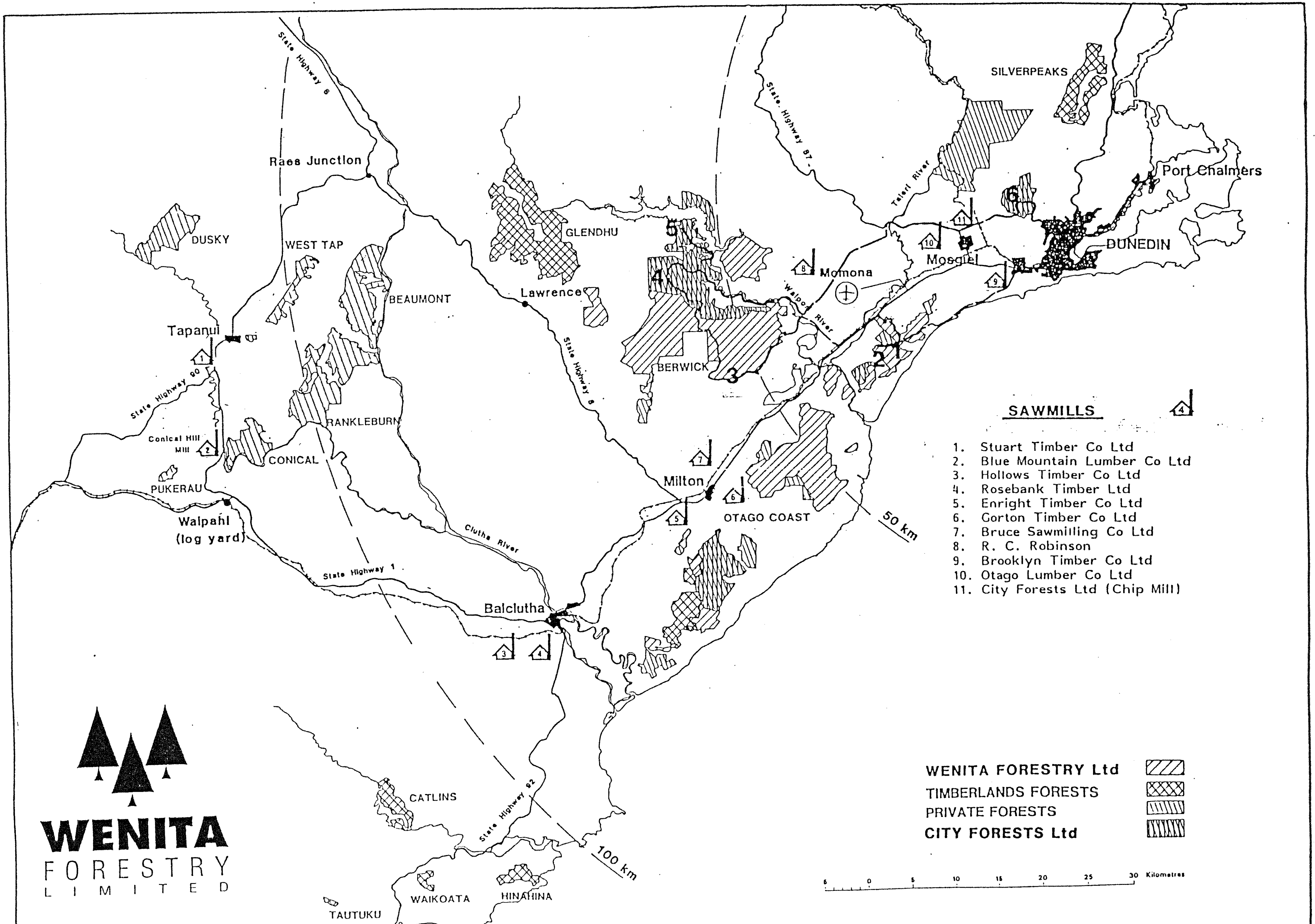


FIELD DAY TOUR NOTES

PHIL TAYLOR/ JOHN BALNEAVES/ WAYNE LINDSAY

SITE MANAGEMENT CO-OPERATIVE FIELD DAY DUNEDIN - 27 MAY 1992

	Arrival Time	Departure Time
Depart, Farrys' Motel, Dunedin 9:00am		
STOP 1 **Harvesting & Site Preparation Implications** *Wayne Lindsay* [Allanton, Wenita Forestry]	9:30am	9:55am
STOP 2 **Excavator site preperation & Oversowing** *Wayne Lindsay* [Allanton, Wenita Forestry]	10:00am	10:25am
STOP 3 **Sustainable forestry trial** *John Balneaves* [Berwick Forest, Wenita Forestry]	11.00am	11:30am
STOP 4 **Severe Magnesium deficiency.** *Phil Taylor/Tim Payne* [Waipori Forest, City Forests]	12:00am	12:30am
STOP 5 **Managing P.radiata/D.fir regeneration** *Phil Taylor* [Waipori Forest, City Forests]	12:50am	1:10pm
LUNCH, Lake Mahinerangi/Waipori Falls Hall	1.10 pm	2:00pm
STOP 6 **Harvesting and site impacts** *Phil Taylor* [Flagstaff Forest, City Forests)	3:00pm	3:30pm
Return, The Octagon, Dunedin	4:00pm	


State Highway 8
Raes Junction
DUSKY
WEST TAP
BEAUMONT
Tapanui
State Highway 90
Conical Hill Mill
RANKLEBURN
CONICAL
PUKERAU
Waipahi (log yard)
Lawrence
GLENDHU
BERWICK
State Highway 87
Taieri River
SILVERPEAKS
Port Chalmers
DUNEDIN
Mosgiel
Momona
Waipori River
Milton
OTAGO COAST
50 km
Clutha River
State Highway 1
Balclutha
CATLINS
State Highway 92
100 km
WAIKOATA
HINAHINA
TAUTUKU
SAWMILLS
1. Stuart Timber Co Ltd
2. Blue Mountain Lumber Co Ltd
3. Hollows Timber Co Ltd
4. Rosebank Timber Ltd
5. Enright Timber Co Ltd
6. Gorton Timber Co Ltd
7. Bruce Sawmilling Co Ltd
8. R. C. Robinson
9. Brooklyn Timber Co Ltd
10. Otago Lumber Co Ltd
11. City Forests Ltd (Chip Mill)
WENITA FORESTRY Ltd
TIMBERLANDS FORESTS
PRIVATE FORESTS
CITY FORESTS Ltd
5 0 5 10 15 20 25 30 Kilometres
WENITA FORESTRY LIMITED

Stop 1 **Isobel Road, Allanton Block, Otago Coast Forest**

Harvesting and Site Preparation Implications

Hauler Logging:

Stand History - P. radiata planted 1963, 2000 spha, thinned to waste 1975, 830 spha residual stocking, harvested 1991 - 1992, total volume 700m^3/ha, recoverable volume 576m^3/ha.

Area A:
Logged May - August 1991
Planted August 1991
Site Prep - nil
Spot Spray - Velpar 4kg/ha equivalent.
Aerial Release Spray - Tordon 1.5 litres/ha (50% of area) target weeds gorse and honeysuckle.

Area B:
Logged September - December 1991
Pre Plant broadcast spray Roundup 6 litres/ha plus Escort 50gm/ha - April 1992
Plant July 1992
Oversow September 1992
Spot Spray October 1992 and 1993 if required.

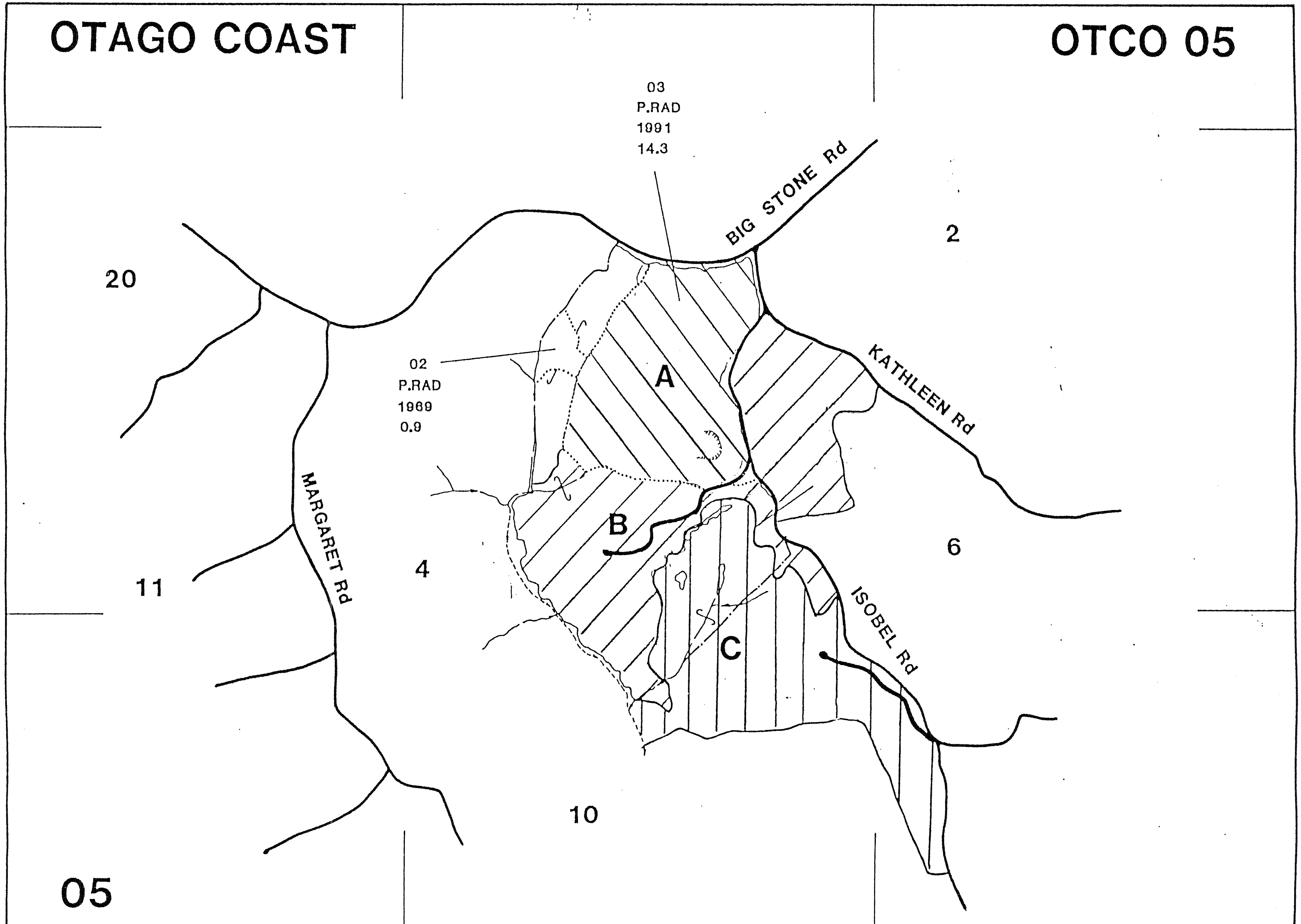
Area C:
Logged January - March 1992
Oversown April 1992
Plant July 1992
Spot spray October 1992 and 1993 if required.
Aerial release if required for honeysuckle or gorse.

Stop 2 Margaret Road, Allanton Block, Otago Coast Forest

Ground Based Logging

Oversowing:
Logged April - July 1991.
Linedozed July 1991; Liebherr 731C with bullblade, 1.7 machine hrs/ha.
Planted August 1991
Oversown September 1991; 7kg/ha White, Montgomery and Alsike Clovers plus 2kg/ha Fog grass.
Spot sprayed October 1991 - Velpar 4kg/ha equivalent.
Spot sprayed September 1992 - Velpar.

Excavator Windrowing:
Logged July - November 1991.
Windrowed April 1992; Hitachi Ex 200 with modified root rake, 2.1 machine hrs/ha.
Aerial sprayed April 1992; 6 litres Roundup plus 50gms Escort per ha.
Plant July 1992
Oversow September 1992
Spot Spray October 1992
Spot Spray September 1993.



OTAGO COAST
OTCO 05
03
P.RAD
1991
14.3
BIG STONE Rd
2
20
KATHLEEN Rd
02
P.RAD
1969
0.9
A
B
MARGARET Rd
6
4
11
ISOBEL Rd
C
10
05

STOP 3. SUSTAINABLE FORESTRY TRIAL - CPT. 79 BERWICK FOREST

OBJECTIVES:

1. To determine the effects of harvesting and site preparation on a major soil type in Berwick Forest on short- and long-term productivity.

2. To determine if harvesting intensity is negatively correlated with succeeding forest growth.

3. To determine if the reasons for negative correlation are nutritional.

4. To determine to what extent soil compaction has a negative effect on tree growth.

5. To determine if fertiliser application can fully compensate for nutrient removal in forest floor and soil organic matter.

6. To determine the impact of understorey vegetation on crop productivity.

7. To provide information to forest management before large areas of mature forest are clearfelled.

TRIAL DESIGN:

Treatments:

WT Whole tree removal, minimal site preparation
SO Stem only harvest, minimal site preparation

In addition to the above main treatments, an extra 30 X 30 m area will be whole tree harvested and 4 X 4 m subplots will be treated:

i) no further disturbance
ii) Litter removal - to litter/topsoil interface
iii) Litter and topsoil removal to 5 cm
iv) Litter and top soil removal to 10 cm

For the two main treatments WT and SO there will be four replications, and for the small 4 X 4 subplot treatments six replications. Additionally, and immediately adjacent to the main treatment area, there will be four Berwick Forest (BF) management plot (see map).

Biomass and nutrient removal effects:

The interaction between harvesting treatments, nutrition, and weed competition will be investigated by splitting the main treatment plots as follows:

i) No fertiliser - no weed control (**-F -C**)
ii) Fertiliser - no weed control (**+F -C**)
iii) No fertiliser - weed control (**-F +C**)
iv) Fertiliser - weed control (**+F +C**)

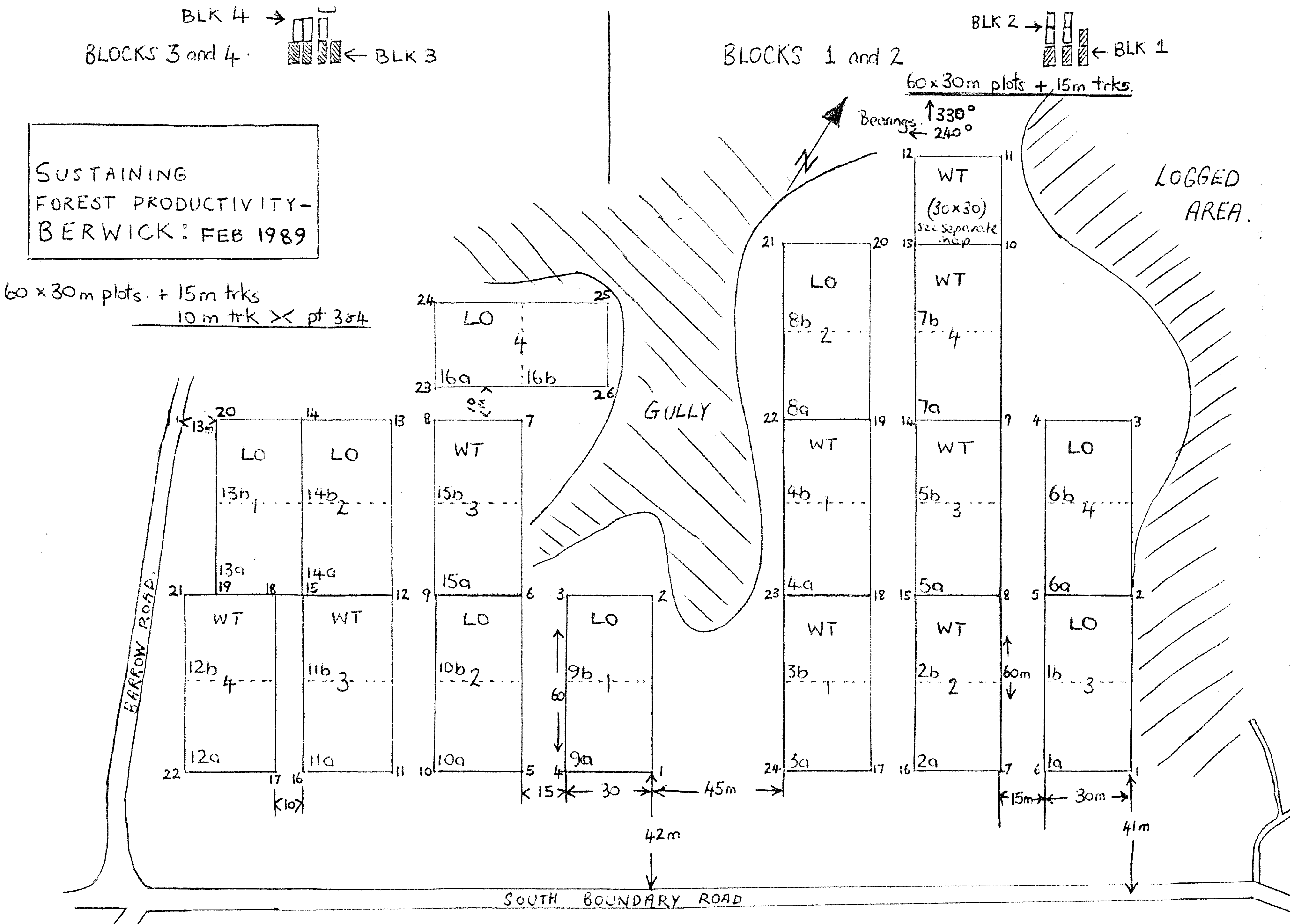
Fertiliser will be added at a rate to ensure optimum nutrition in F plots. the need for nutrient additions will be determined by annual foliar nutrient analysis. By adding fertiliser to half the plots, it should be possible to account for non-nutritional effects on growth.

Soils Compaction effects:

In the main trial area, soil disturbance during harvesting and site preparation will be kept to a minimum to avoid any possible negative effects of compaction on tree growth. Although soil compaction is a normal part of harvesting operations, the variability across a logged site would likely override the main effects being studied. To test the effect of harvesting on soil compaction and subsequent site preparation, BF plots will be established outside the main trial area and soil compaction will be assessed and tree growth compared to those in the main trial area.

Forest Floor and Soil Removal Effects:

The purpose of the subplots is to determine if fertiliser application can fully compensate for nutrient removal in forest floor and soil organic matter. Soil removal often occurs during mechanical site preparation operations, as well as during harvesting, however, the effects on tree growth are poorly documented. To address this objective half the subplots will receive fertiliser to maintain adequate foliar nutrient levels and all subplots will receive weed control so that weed growth is uniform on all treatments.



BLK 4
BLOCKS 3 and 4.
BLK 3
SUSTAINING
FOREST PRODUCTIVITY-
BERWICK: FEB 1989
60 x 30m plots. + 15m trks
10 m trk >< pt 3&4
BLOCKS 1 and 2
BLK 2
BLK 1
60 x 30m plots + 15m trks.
Bearings. 330° 240°
LOGGED AREA.
GULLY
(30x30) see separate map
LO
WT
15m
30m
41m
60m
45m
42m
15
30
60
13m
10
BARROW ROAD.
SOUTH BOUNDARY ROAD

BERWICK FOREST SUSTAINABLE FORESTRY TRIAL

30 X 30 m AREA => 5 X 5 m PLOTS X 36

36 D	35 F	34 C	33 D	32 B	31 A
25 C	26 B	27 A	28 E	29 D	30 F
24 F	23 D	22 E	21 A	20 B	19 C
13 A	14 E	15 D	16 C	17 E	18 B
12 A	11 E	10 D	9 E	8 C	7 F
1 F	2 B	3 C	4 A	5 F	6 B

KEY : LAND PREPARATION OPTIONS

A = Slash remains

B = Removed logging slash only

C = Raked off litter to expose topsoil

D = Removed 10 cm topsoil

E = Spare plots

F = Removed 5 cm topsoil

Stop 4 - Severe Magnesium deficiency

Waipori Forest Cpt 34/04 planted P.radiata 1984 demonstrates severe nutrient/tree health symptoms typical of P.radiata stands at Waipori Forest. Variation amongst individual trees within the stand is apparent.

The obvious visual problems are magnesium/mid crown yellowing.

A limited foliage sampling of 5 individual trees from each classification; 'Visually healthy trees' and 'Visually severe Mg deficiency' was carried out and the results are attached.

Table 1 - MAGNESIUM FOLIAGE ANALYSIS Cpt 34/04 Waipori

Species: P.radiata

Age: 8 years

Sampled: Apr-92

Marginal | Low

Visually healthy trees

Ref #	N(%)	P(%)	K(%)	Ca(%)	Mg(%)	B(ppm)
B1	1.49	0.23	1.03	0.18	0.09	12
B2	1.42	0.19	0.77	0.09	0.06	13
B3	1.48	0.22	0.96	0.17	0.08	9
B4	1.40	0.23	0.86	0.21	0.12	11
B5	1.36	0.24	0.92	0.09	0.05	13
B Mix	1.44	0.22	0.89	0.12	0.07	12

Visually severe Mg deficiency

Ref #	N(%)	P(%)	K(%)	Ca(%)	Mg(%)	B(ppm)
A1	1.15	0.17	0.77	0.19	0.10	14
A2	1.24	0.20	0.73	0.14	0.09	16
A3	1.17	0.18	0.67	0.14	0.11	15
A4	1.35	0.19	0.83	0.13	0.08	12
A5	1.57	0.22	0.91	0.16	0.08	12
A Mix	1.36	0.19	0.77	0.15	0.09	14

The unexpected results from the sampling raised more questions than they answer, e.g.

- what sample size is required in using foliage analysis to make this type of comparison?
- how accurate an indicator are visual symptoms of a nutrient problem?
- do genetics mask visual symptoms?

FOLIAGE ANALYSIS SUMMARY FOR CITY FORESTS LTD

Element Levels

M - Marginal   L - Low

SOIL TYPE CLASSIFICATION 27b

FOREST	CPT/STD	YR	AGE	TY	N	P	K	Ca	Mg	Zn	Fe	Mn	B	Cu	S	Al	Na	Cl	REF.
					%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	%	%	%	NO.
WAIPORI	59.01	1987	5	T	1.55	0.15	1.00	0.18	0.07	35	80	394	9	4	0.121	0.043	0.017	0.129	RO73
WAIPORI	4.01	1987	10	C	1.60	0.17	1.22	0.16	0.08	27	45	599	14	4	0.114	0.038	0.008	0.082	RO73
WAIPORI	32.01	1987	4	T	1.56	0.15	0.96	0.18	0.08	29	61	177	9	3	0.114	0.047	0.020	0.105	RO73
WAIPORI	7.01	1988	8	C	1.80	0.26	1.31	0.13	0.07	36	135	601	12	4	0.120	0.050			RO87
WAIPORI	34.01	1988	4	T	1.62	0.19	0.81	0.14	0.09	30	69	239	8	5	0.120	0.050			RO82
WAIPORI	10.02	1988	9	C	1.62	0.21	1.07	0.14	0.10	26	74	614	15	4	0.110	0.050			RO82
WAIPORI	46.01	1988	15	T	1.72	0.17	0.71	0.20	0.10	26	78	770	9	4	0.120	0.050			RO82
WAIPORI	11.01	1988	12	C	1.81	0.30	1.47	0.15	0.09	39	97	520	18	4	0.150	0.060			RO87
WAIPORI	9.02	1989	4	C	1.45	0.18	0.97	0.17	0.10	35		468	13	5					RO96
WAIPORI	20.03	1989	16	T	1.34	0.28	1.19	0.10	0.10	25		161	11	3					RO96
WAIPORI	37.02	1989	9	T	1.40	0.22	1.02	0.11	0.08	33		160	16	5					RO96
WAIPORI	(?)	1990	6	T	1.40	0.16	0.85	0.17	0.07	33		243	10	4					R114
WAIPORI	37.02	1990	10	T	1.49	0.15	0.81	0.11	0.09	26		325	11	4					R114
WAIPORI	24.01	1990	9	T	1.56	0.18	0.81	0.11	0.09	26		215	9	5					R114
WAIPORI	20.03	1990	17	TY	1.55	0.24	1.06	0.05	0.08	26		114	15	5					R114
WAIPORI	35.01	1991	9	T	1.52	0.22	0.91	0.19	0.10	33		260	13	5					R125
WAIPORI	14.04	1991	5	R	1.36	0.15	0.84	0.11	0.08	22		412	16	4					R125
WAIPORI	27.01	1991	4	T	1.60	0.18	0.79	0.13	0.09	27		267	15	5					R125
WAIPORI	58.01	1991	9	T	1.23	0.11	0.55	0.16	0.07	13		216	10	3					R125
WAIPORI	28.01	1992	4	T	1.71	0.19	0.61	0.15	0.09	26		372	9	6					R147
WAIPORI	22.04	1992	4	T	1.60	0.19	0.88	0.17	0.09	42		542	11	5					R147
WAIPORI	38.01	1992	9	T	1.53	0.20	0.92	0.19	0.11	32		548	12	5					R147
	AVERAGES				1.55	0.19	0.94	0.15	0.09	29	80	374	12	4	0.121	0.049	0.015	0.105	
	STD DEV.				0.15	0.05	0.22	0.04	0.01	6.3	26.9	184.8	2.9	0.8	0.012	0.006	0.006	0.024	

SOIL TYPE CLASSIFICATION 68a

FOREST	CPT/STD	YR	AGE		N	P	K	Ca	Mg	Zn	Fe	Mn	B	Cu	S	Al	Na	Cl	REF.
					%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	%	%	%	NO.
FLAGSTAFF	8.18	1987	4	C	1.36	0.14	1.14	0.28	0.09	41	33	722	12	3	0.099	0.034	0.013	0.141	RO75
FLAGSTAFF	4.10	1987	9	C	1.28	0.14	1.27	0.23	0.10	36	59	573	12	2	0.102	0.030	0.013	0.160	RO75
FLAGSTAFF	1.03	1988	11	C	1.26	0.14	0.65	0.30	0.13	27	94	806	9	2	0.110	0.090			RO87
FLAGSTAFF	3.12	1989	9	C	1.18	0.15	0.82	0.20	0.14	30		458	8	4					RO96
FLAGSTAFF	2.11	1989	4	C	1.45	0.13	0.79	0.17	0.10	35		465	9	4					RO96
FLAGSTAFF	3.12	1990	10	C	1.34	0.13	0.90	0.19	0.11	32		142	10	4					R114
FLAGSTAFF	7.15	1990	7	C	1.23	0.12	0.64	0.20	0.10	29		547	9	4					R116
FLAGSTAFF	3.25	1990	4	C	1.32	0.11	0.75	0.19	0.12	36		436	13	4					R116
FLAGSTAFF	(?)	1990	4	C	1.56	0.18	0.86	0.18	0.07	35		436	12	4					R114
FLAGSTAFF	4.14	1991	9	C	1.29	0.10	0.75	0.16	0.09	22		298	9	4					R125
FLAGSTAFF	3.23	1991	5	C	1.51	0.11	0.72	0.24	0.11	31		509	9	4					R125
FLAGSTAFF	4.15	1992	4	C	1.49	0.15	0.80	0.20	0.10	43		449	10	5					R147
FLAGSTAFF	1.06	1992	9	C	1.51	0.12	0.85	0.15	0.09	36		414	10	4					R147
	AVERAGES				1.37	0.13	0.84	0.21	0.10	33	62	481	10	4	0.104	0.051	0.013	0.151	
	STD DEV.				0.12	0.02	0.18	0.04	0.02	5.7	30.6	167.3	1.6	0.9	0.006	0.034	0.000	0.013	

SOIL TYPE CLASSIFICATION 63a

FOREST	CPT/STD	YR	AGE		N	P	K	Ca	Mg	Zn	Fe	Mn	B	Cu	S	Al	Na	Cl	REF.
					%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	%	%	%	NO.
TOKOITI	6.01	1988	9	P	1.42	0.14	0.84	0.34	0.16	30	86	157	13	4	0.100	0.050			RO87
TOKOITI	9.01	1989	9	P	1.47	0.12	0.74	0.37	0.11	21		235	10	4					R100
TOKOITI	8.01	1989	4	P	1.23	0.12	0.74	0.29	0.09	23		203	10	4					R100
TOKOITI	8.01	1990	5	P	1.34	0.11	0.73	0.18	0.11	24		130	6	2					R106
TOKOITI	14.01	1990	8	P	1.42	0.15	0.92	0.16	0.11	27		231	9	2					R106
TOKOITI	19.01	1991	4	P	1.37	0.13	0.71	0.22	0.11	32		166	11	5					R125
TOKOITI	16.01	1991	4	P	1.48	0.16	0.96	0.16	0.10	25		164	11	4					R130
TOKOITI	14.01	1991	9	P	1.41	0.17	1.12	0.20	0.12	26		213	16	4					R130
	AVERAGES				1.39	0.14	0.85	0.24	0.11	26	86	187	11	4	0.10	0.05			
	STD DEV.				0.08	0.02	0.15	0.08	0.02	3.63		38.3	2.9	1.1					

SOIL TYPE CLASSIFICATION 68a

FOREST	CPT/STD	YR	AGE		N	P	K	Ca	Mg	Zn	Fe	Mn	B	Cu	S	Al	Na	Cl	REF.
					%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	%	%	%	NO.
TOKOITI	22.01	1988	4	P	1.68	0.18	0.90	0.22	0.11	35	87	297	9	5	0.130	0.040			R087

SOIL TYPE CLASSIFICATION ?

FOREST	CPT/STD	YR	AGE		N	P	K	Ca	Mg	Zn	Fe	Mn	B	Cu	S	Al	Na	Cl	REF.
					%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	%	%	%	NO.
F. HILL	1.01	1991	9	T	1.67	0.16	0.94	0.26	0.13	26		207	13	5					R130
F. HILL	5.01	1991	6	T	1.35	0.13	0.81	0.18	0.10	29		246	9	4					R130
F. HILL	4.01	1990	5	T	1.49	0.15	0.78	0.24	0.13	40		349	9	2					R106
F. HILL	3.01	1989	4	T	1.24	0.14	0.87	0.22	0.13	28		219	9	4					R096
	AVERAGES				1.44	0.15	0.85	0.23	0.12	31		255	10	4					
	STD DEV.				0.19	0.01	0.07	0.03	0.02	6.3		64.6	2.0	1.3					

TY Land/crop Type   C = 2nd Rotation cutover/ R = 2nd Rotation Regen/ P = 1st Rotation Ex pasture/ T 1st Rotation Unimproved

Stop 5 - Managing Regeneration

Forest Managers are increasingly facing the problem of natural regeneration on cutover forest sites. Current harvesting levels are resulting in increasing areas of cutover re-establishment. Significantly, steeper terrain is becoming a larger part of these cutover re-establishment programs.

The recent LIRO workshop on cutover management reinforced a strong industry message that control of natural regeneration is rapidly becoming a major re-establishment issue.

Natural regeneration manifests itself at different levels within the country, and indeed within discrete areas of forest. Individual forest managers have and are developing land preparation practices to overcome this problem.

The fact

- Natural regeneration is a significant and increasing problem in modern forest plantation silviculture.

The issues

Firstly, to see instances where natural regeneration is an opportunity not a problem.

- Describe the range of options available to manage natural regeneration.
- Objectively quantify and qualify the issues relating to managing natural regeneration, e.g.
  - Genetic gain vrs genetic dilution
  - Increased tending costs vrs reduced establishment and preparation costs
  - Uniformity of stand and products
- Objectively evaluate the options

Case Study - Managing regeneration Cpt 7/01 Waipori

Compartment 7/01 Waipori is a managed stand of natural regeneration. Current age is estimated at 12 years at a site index of 22m.

Current estimates:

Stocking:	293 stems ha-1
Basal Area:	14.1ha-1
Height:	11.6m

Pruning History

Pruned to 4.9m with a DOS of 18.7 at age 9.

Financial analysis

The financial analysis attached evaluated pre tax IRRs for five management options:

- Area 100% covered in natural regeneration and managed as natural regen.
- Area 85% covered in natural regeneration and managed as natural regen.
- Area 60% natural regen, with supplementary planting of 40% of the area.
- Natural regeneration cleared and re-established in genetically improved P.radiata.
- 5 years advanced regeneration cleared and then re-establishment in genetically improved P.radiata.

The analysis is presented as a basic concept. The fundamental approach (with development) is a method whereby forest managers can make objective decisions on managing regeneration.

Variables that have been considered in this analysis include:

- increased cost of tending natural regeneration
- increased volume and form of genetically improved stock (through adjustments to STANDPAK i.e Site Index, BA, Steep, Branch Index etc)
- additional cost of establishing genetically improved stock.

Areas that have not been addressed and will require incorporation into the analysis include:

- Non uniformity of natural regeneration as if effects tending
- Genetic dilution in planted areas
- Additional stability of natural regen (?)
- Site impacts of mechanical land preparation as it effects ongoing productivity
- Modified silvicultural techniques (and their costs) for managing regeneration, e.g. aerial strip desiccation of D.Fir.

Results

The level of sophistication of this approach at present makes it only possible to deal in generalities.

(1) The financial returns of managing regen vrs re-establishing genetically improved stock would not appear to be significantly different in the case studied.

(2) However, the more advanced regen becomes then the more appropriate it is to manage it rather than clear and re-establish it.

(3) Economies of scale suggest that on small areas of steeper terrain (where land preparation is difficult and establishment cost high), managing regeneration could be the preferred option.

CITY FORESTS LTD - Regeneration Vrs Planting financial analysis

Prepared by: Phil Taylor (Technical Forester) | **Regime: 3 prune 2thin 300 stemsha-1**

Date: 20/05/92

Administration costs($ha-1) **$70**

Year	REGENERATION OPTIONS (SI 22m)						PLANTING OPTIONS (SI +2m, BA +15%)			
of	Regeneration 100%		Regeneration 85%		Regen 60% /Plnt 40%		Planting at C/F		Planting 5yrs + C/F	
operation	Operation	($ha-1)	Operation	($ha-1)	Operation	($ha-1)	Operation	($ha-1)	Operation	($ha-1)
0							Land prep	$145		
1							Plant/Releas	$620		
2					Blank/Rels	$400				
3							Regen pull	$150		
4	Regen Thin	$300	Regen Thin	$255	Regen Thin	$255				
5									Land prep	$400
6									Plant/Releas	$570
7	Prn1/Thn1	$710	Prn1/Thn1	$603	Prn1/Thn1	$684	Prn1/Thn1	$645		
8									Regen pull	$150
9	Prn 2	$523	Prn 2	$444	Prn 2	$504	Prn 2	$475		
10										
11	Prn3/Thn2	$479	Prn3/Thn2	$407	Prn3/Thn2	$461	Prn3/Thn2	$435		
12									Prn1/Thn1	$645
13										
14									Prn 2	$475
15										
16									Prn3/Thn2	$435
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31	Clearfell	($20,667)	Clearfell	($17,567)	Clearfell	($21,947)	Clearfell	($23,868)		
32										
33										
34										
35										
36									Clearfell	($23,86
IRR(Pre tax)		8.0%		7.7%		7.7%		7.4%		6.5

Stop 6 - Harvesting and site impact

Forest managers are increasingly becoming aware of the issues of sustainable management. This is in part a process of the evolution of forestry over time (viz European Forestry), the increasing environmental awareness and legislative requirements (Resource Management Act).

A significant part of the sustainability issue is that of harvesting impact on the long term forest site productivity. Research in this area is by definition long term however forest managers are increasingly asking for short term answers.

Given recent organisational and structural changes in the areas of forest research it is appropriate to review "where we are at" and "who is doing what" into research in this area.

By definition, site management suggests this work is in part the domain of this the new site management co-operative. LIRO, recently restructured, held a seminar on cutover management and have historically directed areas of research into impacts of harvesting.

Given that priorities are being decided on the future work programme for the cooperative the main purpose of this stop is to discuss these issues and others -

- what role does the site management co-op fill in this area?
- are there gaps in research, particularly research yielding short term results that this co-op could fill?
- are there opportunities for joint research with this Co-op and other research bodies e.g. LIRO, University of Canterbury etc.?
- Is there a place for a comprehensive review of the literature and trials currently in place?