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PROJECT RECORD COVER SHEET

PROJECT RECORD NO.: 4404

DIVISION: FOREST TECHNOLOGY

RESOURCE CENTRE: SOILS AND SITE PRODUCTIVITY

CODE:

94 / 95	120	0194	01	4413	7
Financial Year	Resource Centre No.	Project	Sub-project	FRST Output	Prog.

WORK PLAN NO.: N/A **EXPERIMENT NO.:** FR68 AK917

TITLE: KEY POINTS FROM TECHNICAL SESSIONS OF THE NZ FOREST SITE MANAGEMENT COOPERATIVE, HELD AT OAKWOOD MANOR, AUCKLAND - 26 AND 27 JULY 1994

AUTHOR(S): J.A.C. HUNTER-SMITH (COMP) **DATE:** 11 OCT 94

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AUTHOR(S): J.A.C. HUNTER-SMITH (COMP) **DATE:** 11 OCT 1994

KEYWORDS: PHOSPHORUS, PHOSPHATE RETENTION, WEED COMPETITION, PINUS RADIATA, SOIL DISTURBANCE

ABSTRACT*

This report covers the key points from Technical sessions of the NZ Forest Site Management Cooperative. This includes:

- Summary of weed competition results
- Impacts of understorey species on the growth and nutrition of radiata pine at Eyrewell Forest - irrigation trial
- Phosphate retention capacity - What is it and how does it effect the choice of P fertiliser?.
- An update on the P uptake series of trials.

and - Notes from the soil disturbance trial at Maramarua forest.

The report is copies of the overheads presented during the technical sessions and are interim results only. Full reports will be written up and forwarded to Cooperative members at a later date.

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* **Note: This material is unpublished and must not be cited as a literature reference.**

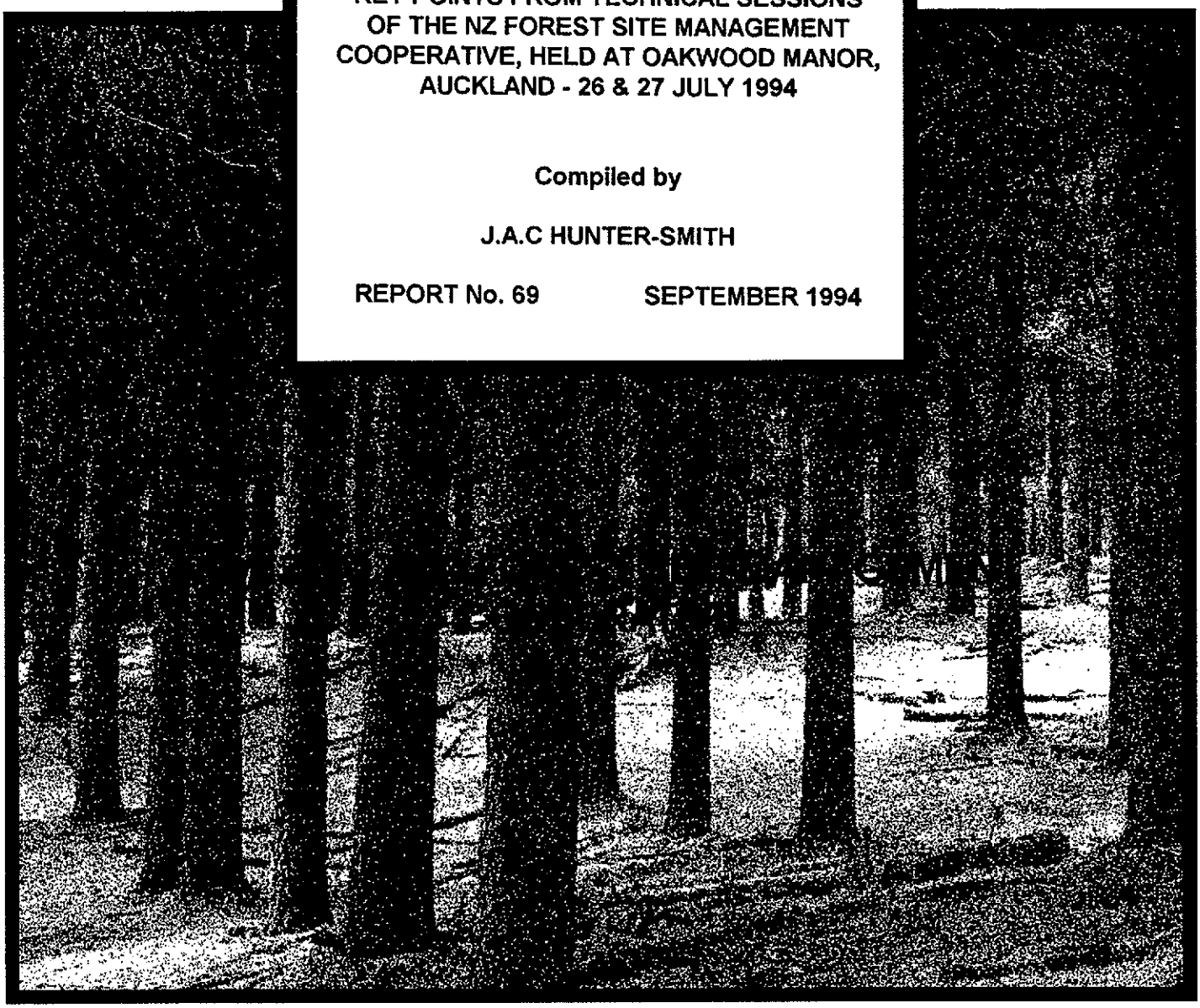
NZ FRI/INDUSTRY
RESEARCH COOPERATIVES

KEY POINTS FROM TECHNICAL SESSIONS OF THE NZ FOREST SITE MANAGEMENT COOPERATIVE, HELD AT OAKWOOD MANOR, AUCKLAND - 26 & 27 JULY 1994

Compiled by

J.A.C HUNTER-SMITH

REPORT No. 69 SEPTEMBER 1994



NEW ZEALAND
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NZ FOREST SITE

MANAGEMENT COOPERATIVE

TECHNICAL PRESENTATION NOTES

26 JULY 1994

1. SUMMARY OF WEED COMPETITION RESULTS - BRIAN RICHARDSON

2. IMPACTS OF UNDERSTOREY SPECIES ON THE GROWTH AND NUTRITION OF RADIATA PINE : EYREWELL FOREST - PETER CLINTON

3. PHOSPHATE RETENTION CAPACITY - WHAT IS IT AND HOW DOES IT EFFECT THE CHOICE OF P FERTILISER? - JESSICA HUNTER-SMITH

4. P UPTAKE SERIES OF TRIALS: AN UPDATE - MALCOLM SKINNER

5. NOTES FROM SOIL DISTURBANCE TRIAL AT MARAMARUA FOREST - MALCOLM SKINNER

The following notes are copies of the overheads presented during the technical sessions. These are only interim results. Full reports will be written up and forwarded to Cooperative members at a later date.

SUMMARY OF WEED COMPETITION RESULTS

BRIAN RICHARDSON

SUMMARY OF WEED COMPETITION RESEARCH

Brian Richardson

The purpose of this talk was to discuss aspects of research into competition between radiata pine and herbaceous vegetation, with particular emphasis on moist North Island sites. Preliminary results from a number of trials were presented, and discussion focussed on the practical application of these findings.

The main points presented in this talk have been summarised below.

1. Specific scientific goals of this research are to:

- Quantify the effects of different weed species on radiata pine growth and survival
- Understand mechanisms of competition so that we can predict the effect on crop growth of interaction between weed species and site type (different sp., fertility, rainfall, temperature, aspect etc.).
- Predict long-term effects of competition from results of short-term trials.
- Provide empirical evidence of long-term effects to validate conclusions from short term trials.

2. Specific management outcomes

- Define optimum area and duration of weed control.
- Decide when weed control is required -define thresholds of competition.
- Prioritise weed control operations (where is money best spent).
- Calculation of long-term economic benefits from weed control. How much can you afford to spend?

3. Effect on growth and survival based on results from the Rotorua nursery competition trial Block A

- There are no huge mortality effects.
- Slight effect on height growth after 3 years - height poor indicator of competition.
- Species which compete for light are having very significant effect.
- No statistically significant effect of herbaceous species, but only 1 replication - still an economically significant growth loss.

- initially, herbaceous broadleaf competitors most significant; but by first year fast growing tall species are overtopping pines - competition for light severely reduces pine growth.

- After 3 years, the trees growing with buddleia are almost 18 months behind the growth of weed free trees.

4. Interactions with site/mechanisms of competition.

- To understand how different sites will interact with competitors in influencing tree growth, mechanisms of competition must be understood.

- No evidence of moisture stress at Rotorua; no effect of irrigation; competition for water not likely to be significant.

- All competition trials to date have been on moderately fertile to very fertile sites, consequently there have been no statistically significant fertiliser effects.

- The major observation at Rotorua has been a stimulation of growth with radiata pine on weed free plots and a reduction of crop growth rate on plots where competition for light has been a factor.

5. Competition for light

- As soon as competition for light is a factor, trees slow right down.

- There has been significant competition for light from pampas and buddleia; also broom, but the growth and development of broom has been hampered by *Pleiochaeta* (a pathogen).

- Grasses also can compete for light, however the duration of this competition is relatively short lived.

6. Application of results to oversowing/spot spraying

- With spot weed control, we assume that there is a certain area or "neighbourhood or zone of competition" around a tree, outside of which there is no effect of the competitor.

- If this assumption is correct, we can fill a site with a large quantity of competitors and have no effect on crop growth.

- So, from a practical point of view, it is important to know the zone of competition around the crop and how this changes with site, competitor species, and time.

- An initial analysis of 8 month growth data from the Kaingaroa area/duration spot control has been undertaken. A plot of degree of weed control versus growth shows the expected negative hyperbolic growth curve.

- There has been a significant diameter growth benefit from spot weed control. The size of the growth gain continues to increase to almost total weed control but the rate of growth increase maximised at around a 1.5-1.75 m diameter spot.

- Thus, the zone of "competition" extended to almost complete weed control (equivalent to crop spacing) i.e. total area around each tree. Most likely mechanisms was early competition for light or effect on temperature.

7. Economics of spot spraying

- The key question is whether each additional bit if chemical required to increase spot diameter or area is economically justified.

- The maximum return per unit of chemical occurs with the first bit of spot control - as expected the greatest benefit is from weed control closer to the tree.

- The question though is what is the most economical return? More measurements over time are required before the true growth benefit can be calculated.

- There are three general categories of growth response which are likely following weed control, which can be described as parallel, converging, or diverging growth responses..

- The shape of the growth curve obviously has profound implications for the cost benefit of weed control.

- Mason proposed 5 conditions or assumptions or constraints that must be met for a parallel growth response to occur. These can also be modified and applied to converging or diverging growth responses.

- With herbaceous competition on moist Central North Island sites, we can be confident of meeting all of these constraints relating to a parallel growth trajectory, with the exception of assumption 4, relating to growth efficiency and carbon allocation patterns.

- This is in many ways the key assumption, and the one that we know least about. The biomass work in the Rotorua nursery trial helps to address this issue.

8. Carbon allocation and growth efficiency

- The key question is whether there are any effects of competition at Rotorua on carbon allocation that are not simply a function of tree size.

- The relationship between above- and below-ground biomass was consistent across all tree sizes and competition treatments. This meets the constraint that requires no effects of competition on growth efficiency or allocation patterns.

- However, it raises an interesting question regarding tree stability. It is often said that trees growing with good weed control or on fertile farm sites are most prone to toppling because of greater top height in proportion to root growth. While it may be true that such trees are prone to toppling, there is no evidence from this study that this is due to any change in total biomass allocation.

9. Conclusion

- All of the indications from our studies to date suggest that spot weed control on moist, moderately fertile Central N Island sites will lead to a parallel growth response. Once we know the duration of effective competition, we can simply calculate growth benefit by using the time advantage concept.

IMPACTS OF UNDERSTOREY SPECIES ON THE GROWTH AND NUTRITION OF RADIATA PINE: EYREWELL FOREST

PETER CLINTON

The trial objectives are:

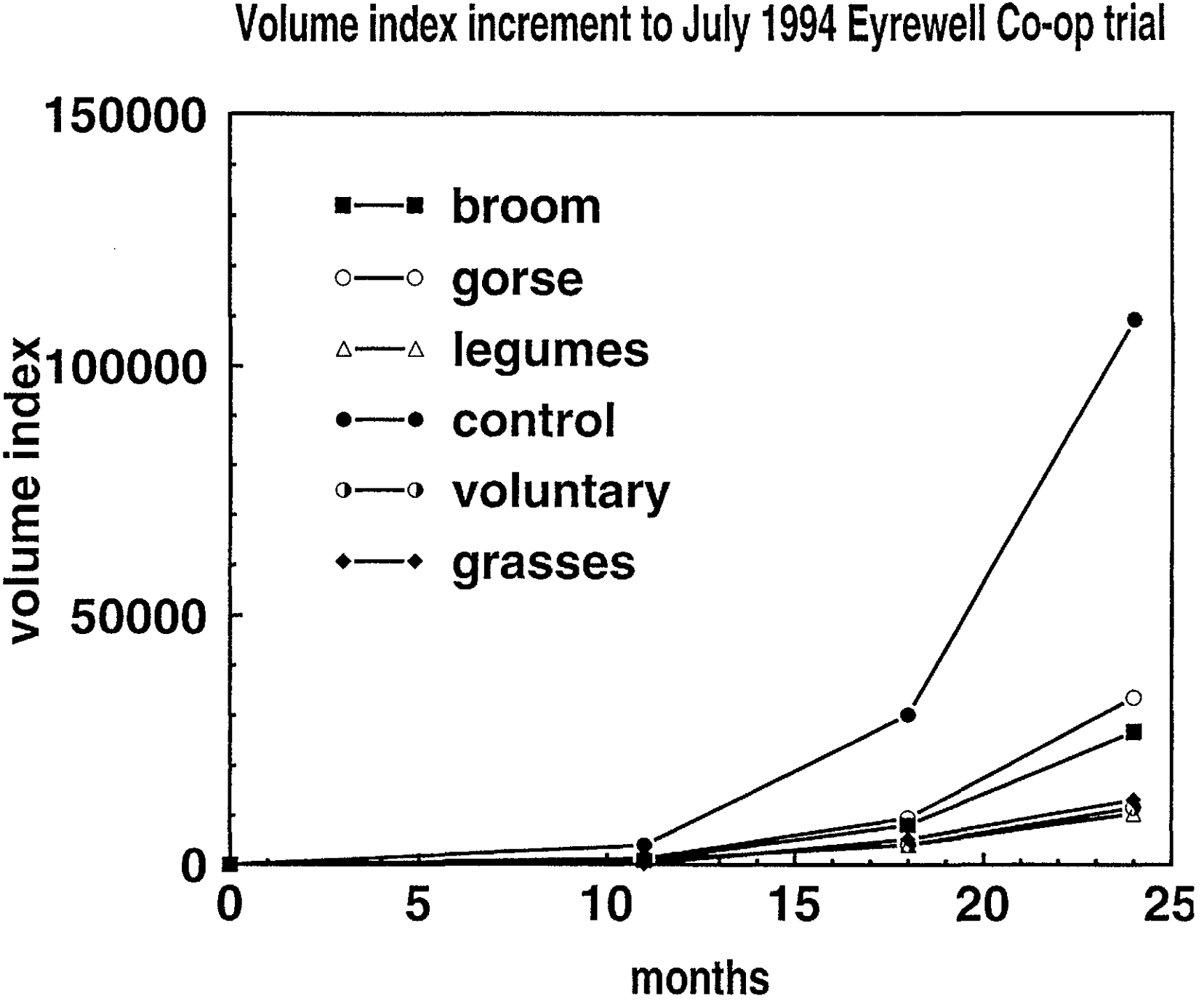
- **to quantify the interaction of weed control, fertilisers and legumes on the growth and productivity of radiata pine in wet and dry conditions.**

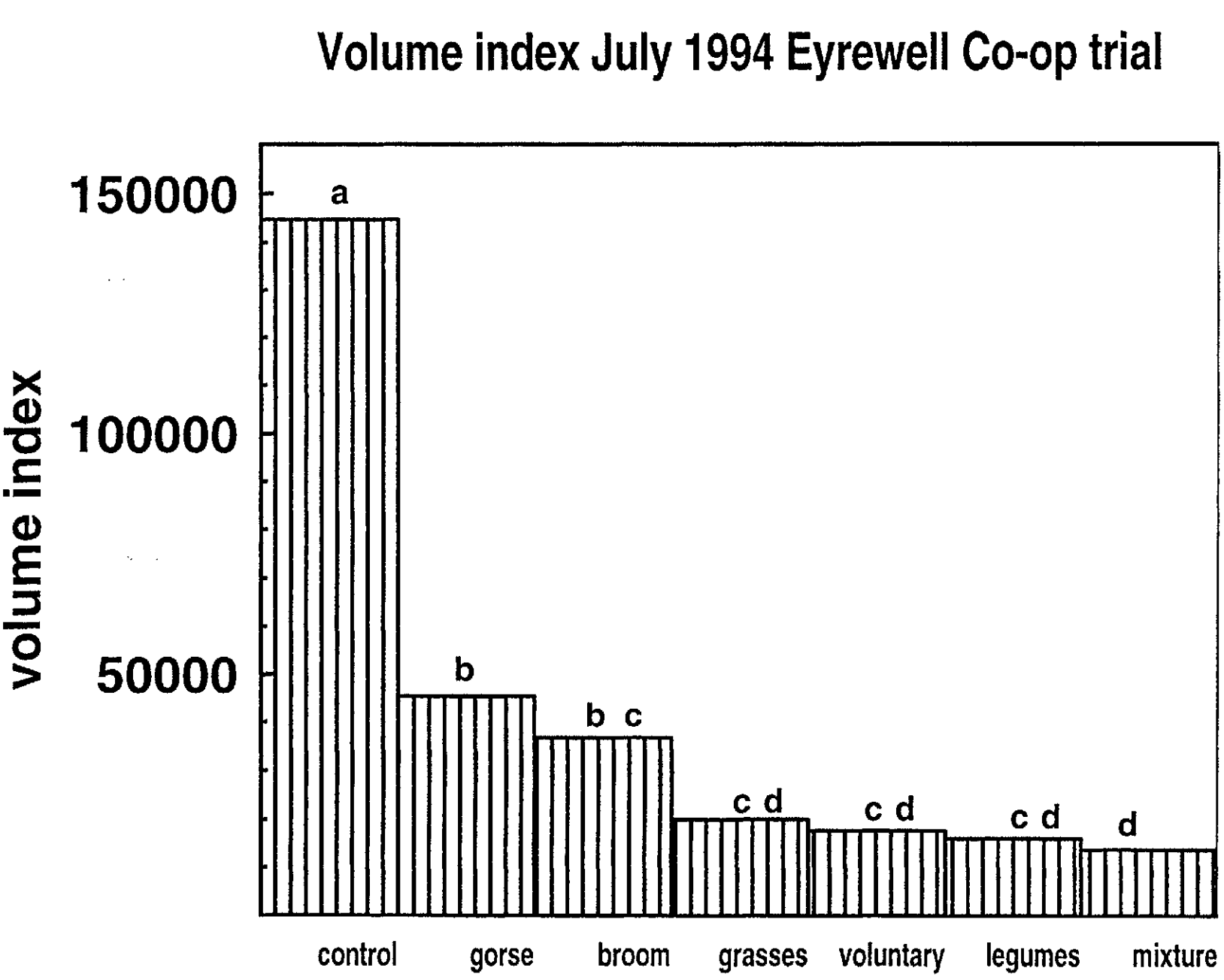
- **to study mechanisms of competition between radiata pine and competing vegetation for water and nutrients.**

- **to provide a demonstration trial illustrating the effects of specific weeds on the growth of radiata pine seedlings under varying conditions of fertility and soil moisture.**

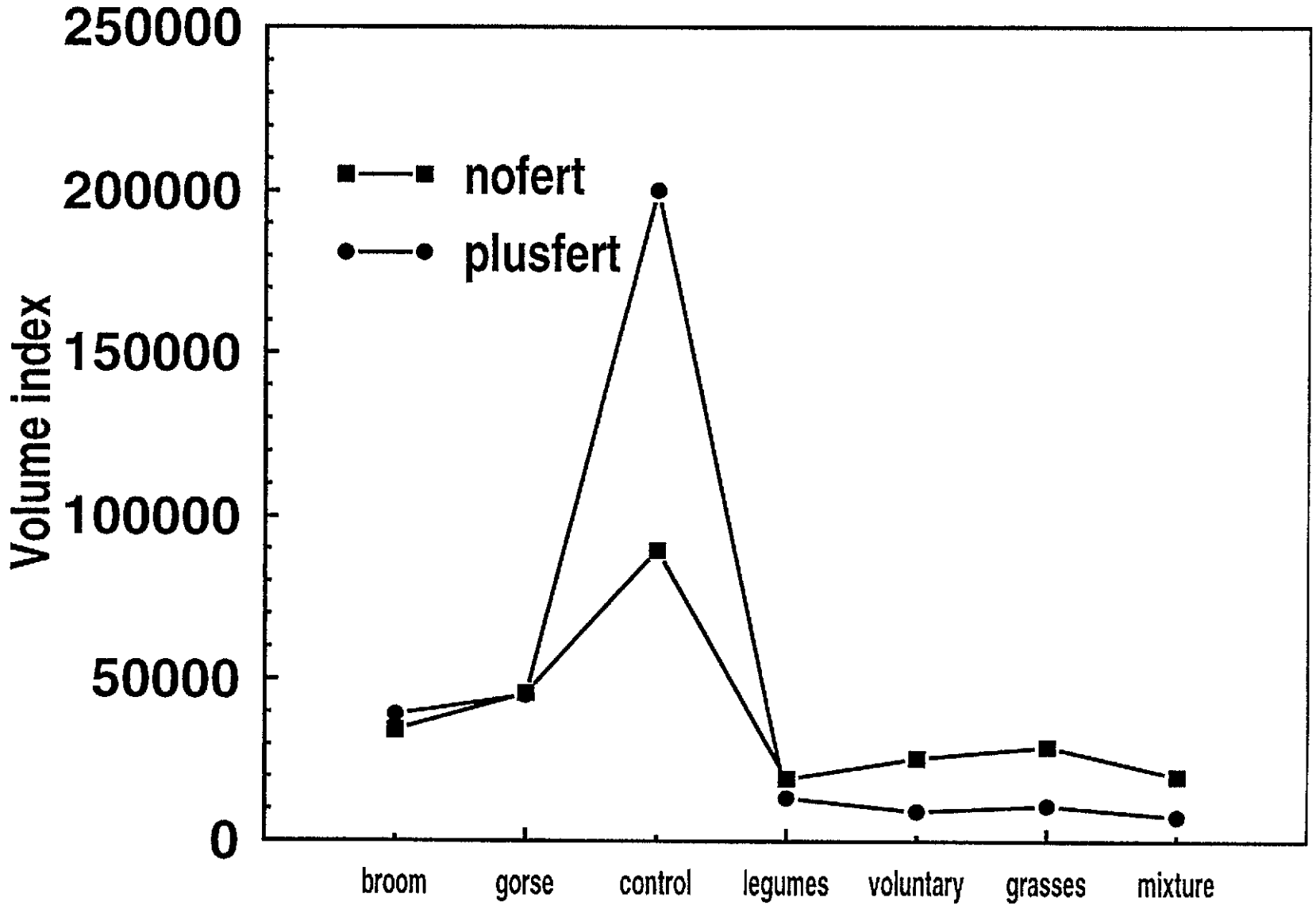
Tree growth and increment

July 1994	irrigation	ns	
	fertiliser	**	16% I
	vegetation	***	
	veg x fert	***	


Volume index increment to July 1994 Eyrewell Co-op trial
150000
100000
50000
0
volume index
broom
gorse
legumes
control
voluntary
grasses
0
5
10
15
20
25
months


Volume index July 1994 Eyrewell Co-op trial
volume index
150000
100000
50000
a
b
b c
c d
c d
c d
d
control
gorse
broom
grasses
voluntary
legumes
mixture

Summary tree growth until July 1994 Eyrewell Co-op trial



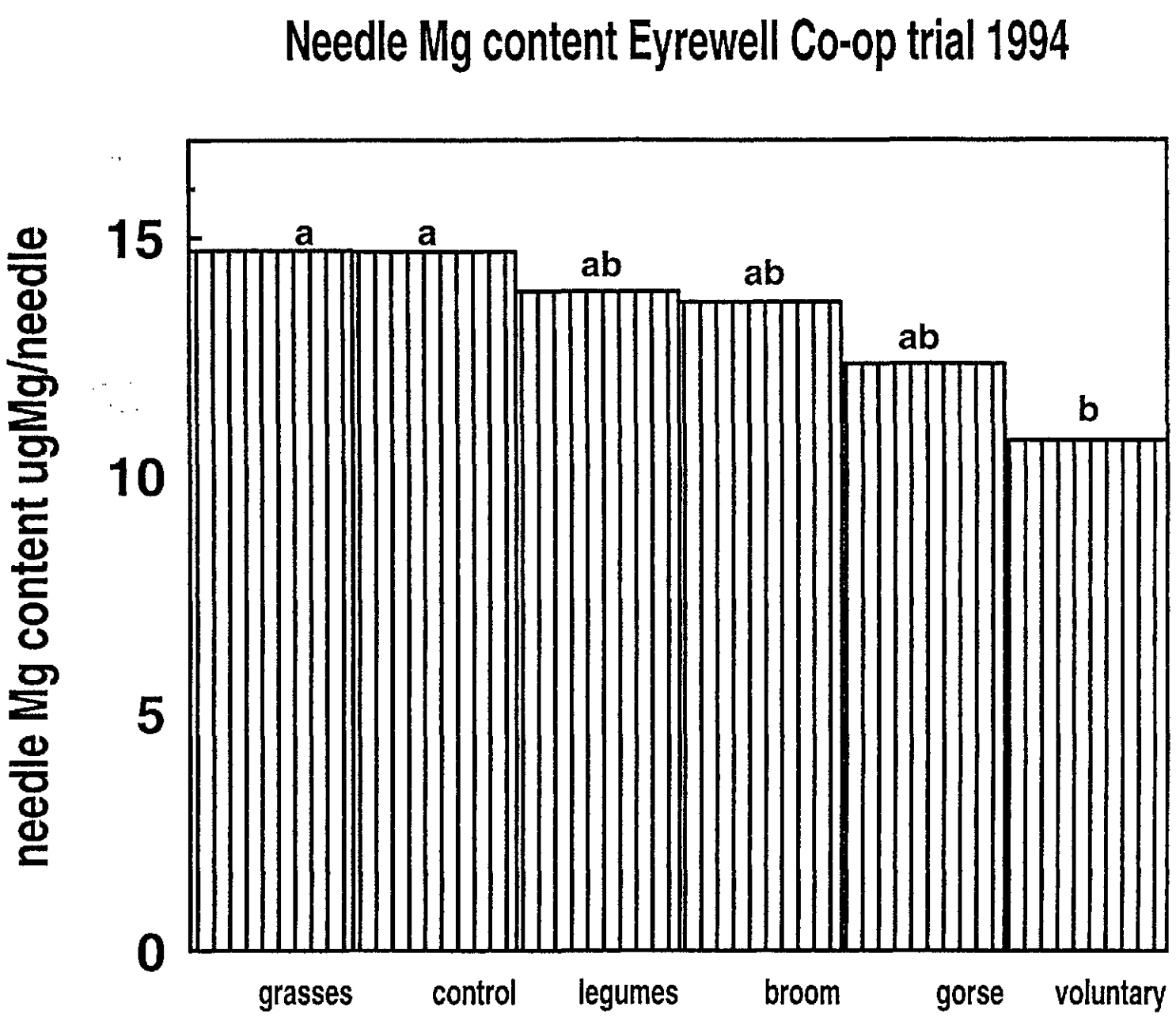
Tree nutrition

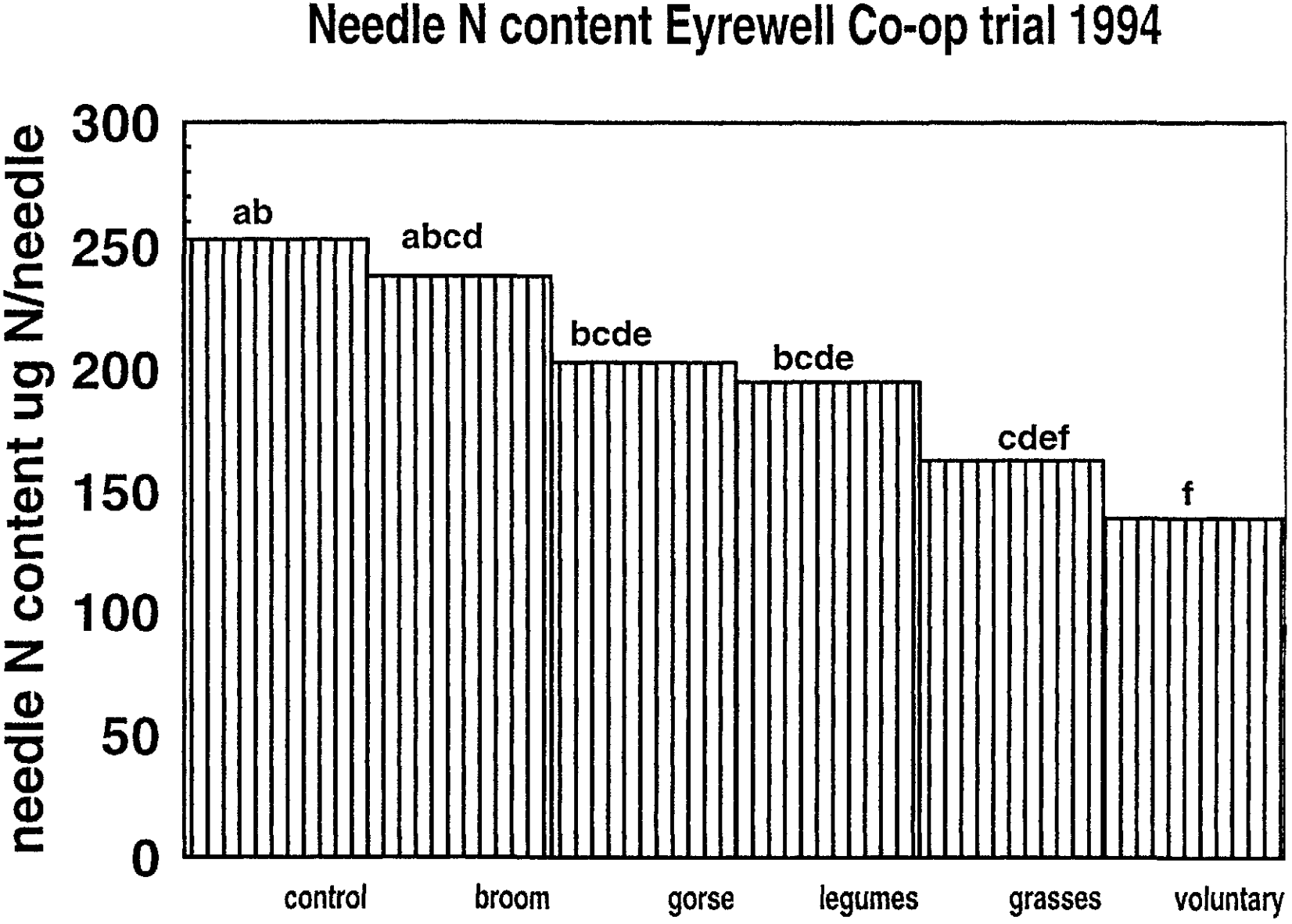
	needle nutrient concentration					
	N	P	K	Ca	Mg	B
irrigation	ns	ns	ns	ns	ns	ns
fertiliser	**	ns	***	ns	***	***
vegetation	***	**	***	***	***	*
fert x veg	*	**	*	ns	*	ns

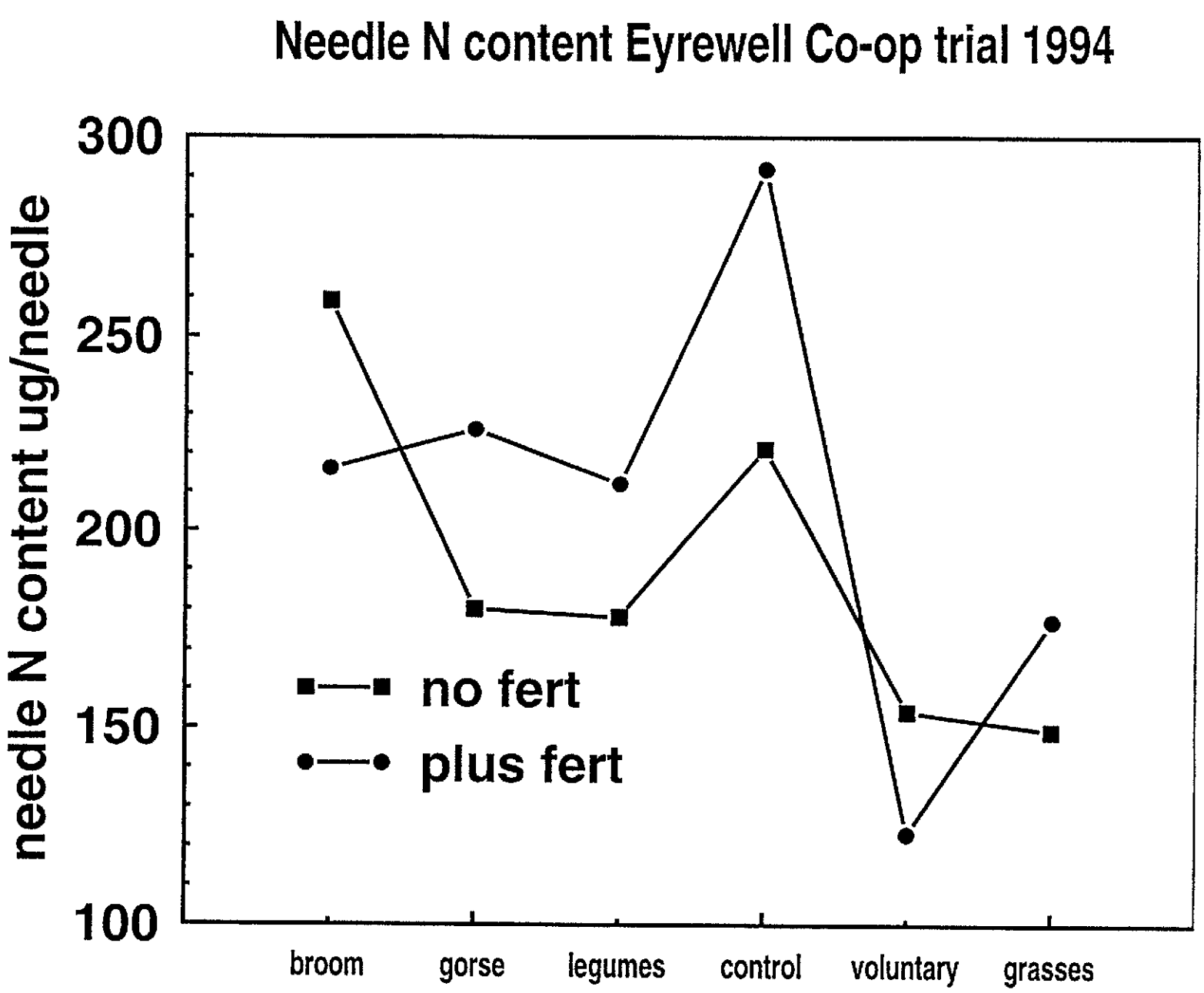
* P<0.05
** P<0.01
*** P<0.001
ns non significant

	needle nutrient content					
	N	P	K	Ca	Mg	B
irrigation	ns	ns	ns	ns	ns	ns
fertiliser	*	ns	***	ns	***	***
vegetation	***	***	***	***	***	**
fert x veg	***	**	***	*	***	**

* P<0.05
** P<0.01
*** P<0.001
ns non significant

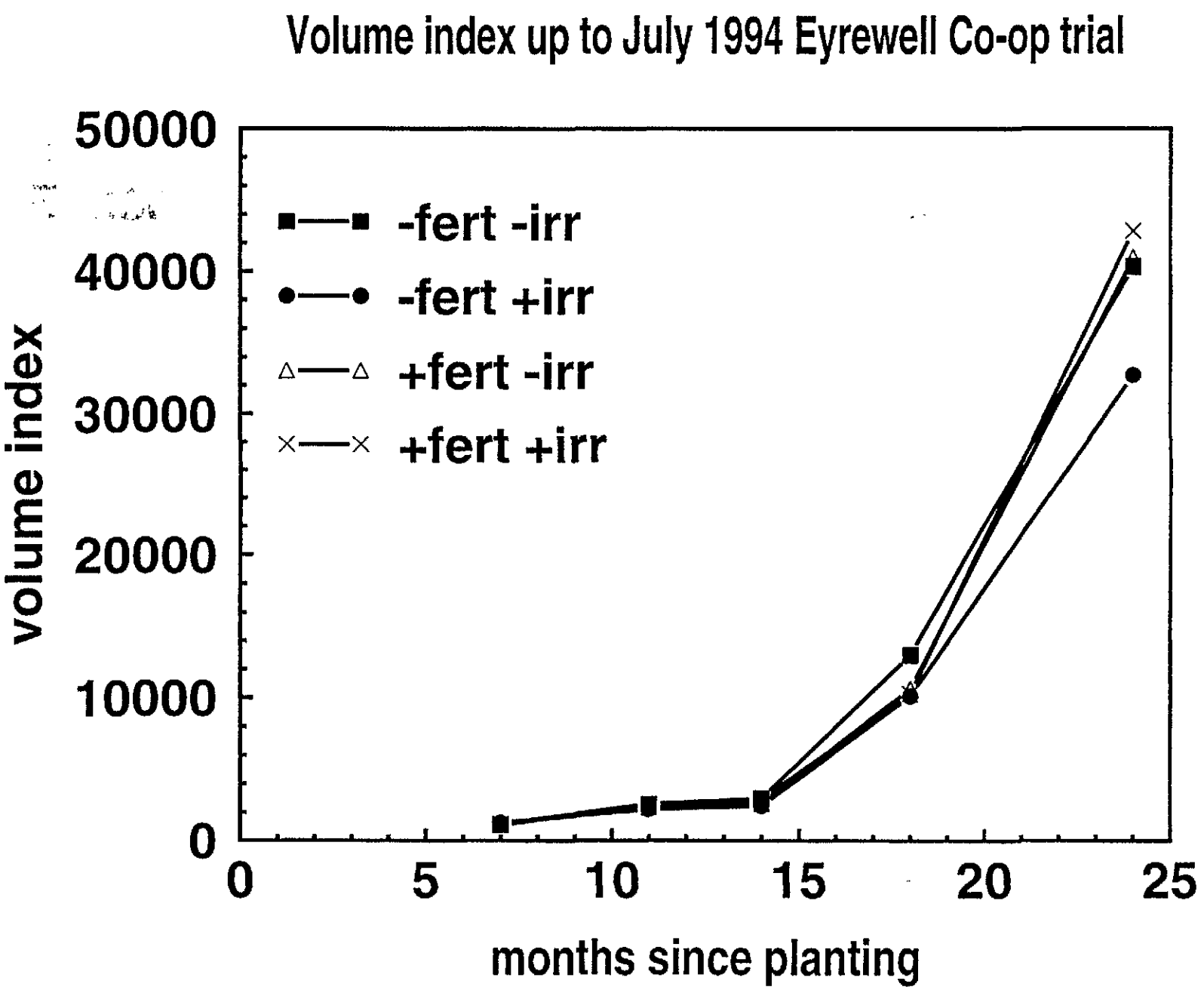

Needle Mg content Eyrewell Co-op trial 1994
needle Mg content ugMg/needle
15
10
5
0
a
a
ab
ab
ab
b
grasses
control
legumes
broom
gorse
voluntary

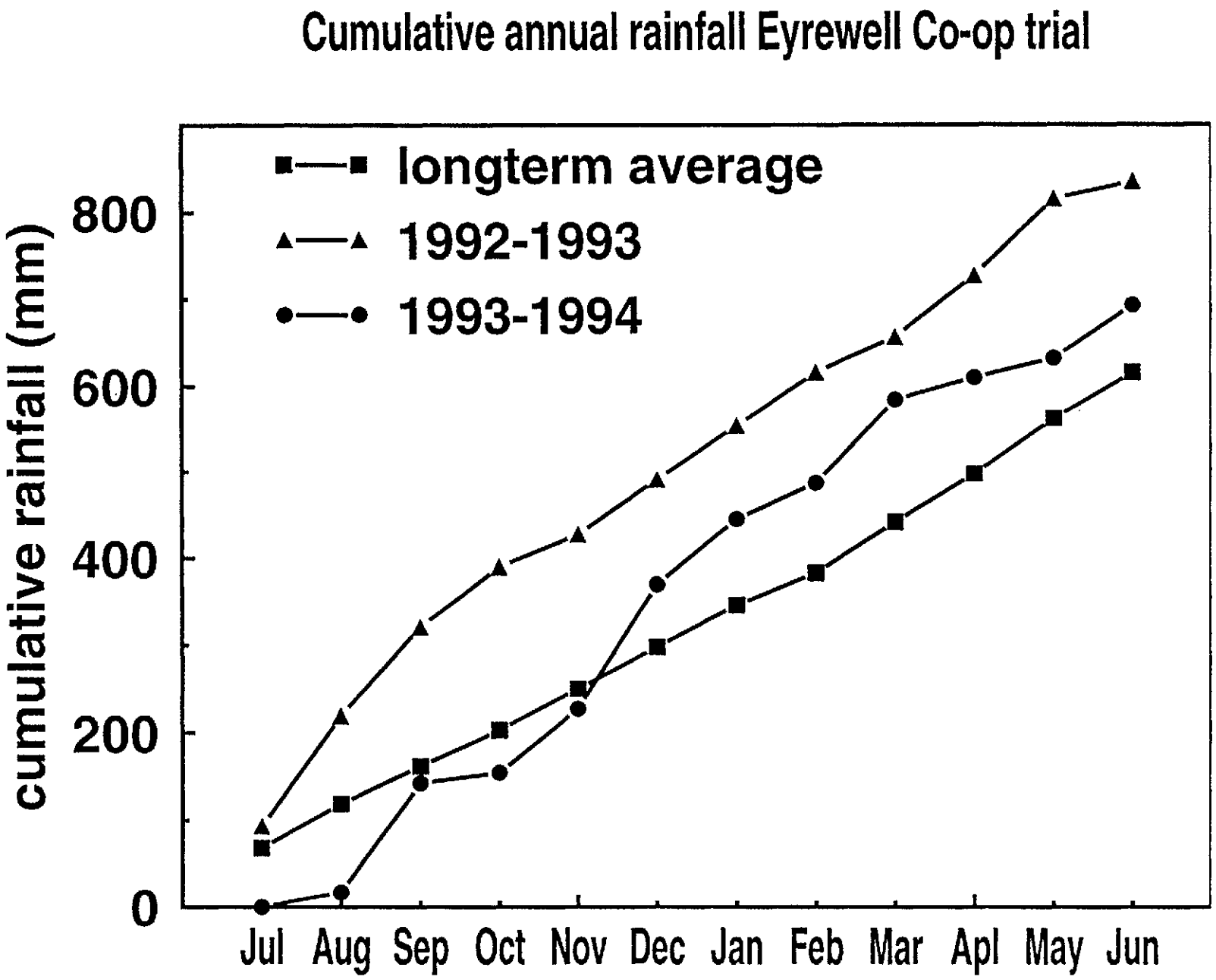

Needle N content Eyrewell Co-op trial 1994
needle N content ug N/needle
300
250
200
150
100
50
0
ab
abcd
bcde
bcde
cdef
f
control
broom
gorse
legumes
grasses
voluntary


Needle N content Eyrewell Co-op trial 1994
needle N content ug/needle
300
250
200
150
100
no fert
plus fert
broom
gorse
legumes
control
voluntary
grasses

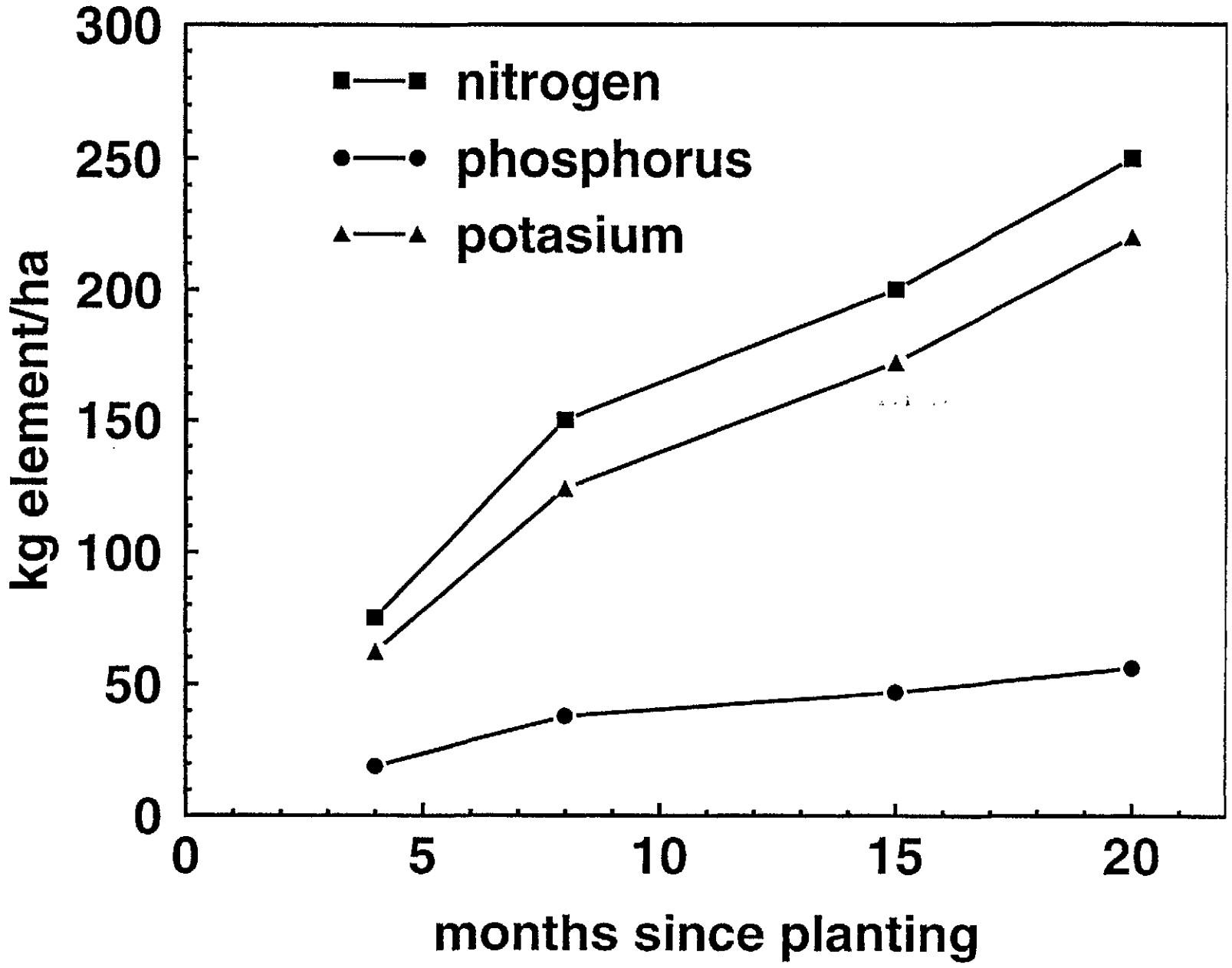
site vegetation productivity

irrigation	**	**55% I**
fertiliser	***	**116% I**
veg type ns	**grass > voluntary > legume**	


Volume index up to July 1994 Eyrewell Co-op trial
50000
40000
30000
20000
10000
0
volume index
-fert -irr
-fert +irr
+fert -irr
+fert +irr
0
5
10
15
20
25
months since planting


Cumulative annual rainfall Eyrewell Co-op trial
longterm average
1992-1993
1993-1994
cumulative rainfall (mm)
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apl
May
Jun

cumulative fertiliser additions up to July 1994 Eyrewell Co-op tri



Conclusions

- growth of radiata pine greatly reduced by herbaceous weeds with,
- grasses and legumes reducing tree growth to the same extend as invasive weeds
- even at the low densities used in this study, broom and gorse are reducing tree growth
- herbaceous weeds respond more strongly to increased nutrient availability and,
- in the absence of moisture stress, competition between trees and herbaceous understorey vegetation for nutrients would appear to be limiting radiata pine growth
- competition between trees and broom and gorse for light may be limiting radiata pine growthy

PGSF objectives 1994-1995

- follow seasonal changes in root growth and longevity for both tree and understorey roots in relation to soil water content
- determining effects of understorey vegetation on nutrient uptake into expanding needles of radiata pine
- continue monitoring soil temperature
- present aspects of PGSF work at two international meetings

Dissertation topics 1994-1995

- changes in understorey vegetation composition after oversowing
- changes in soil chemical characteristics and plant nutrition with an emphasis on Mg
- water use efficiency of radiata pine and legumes

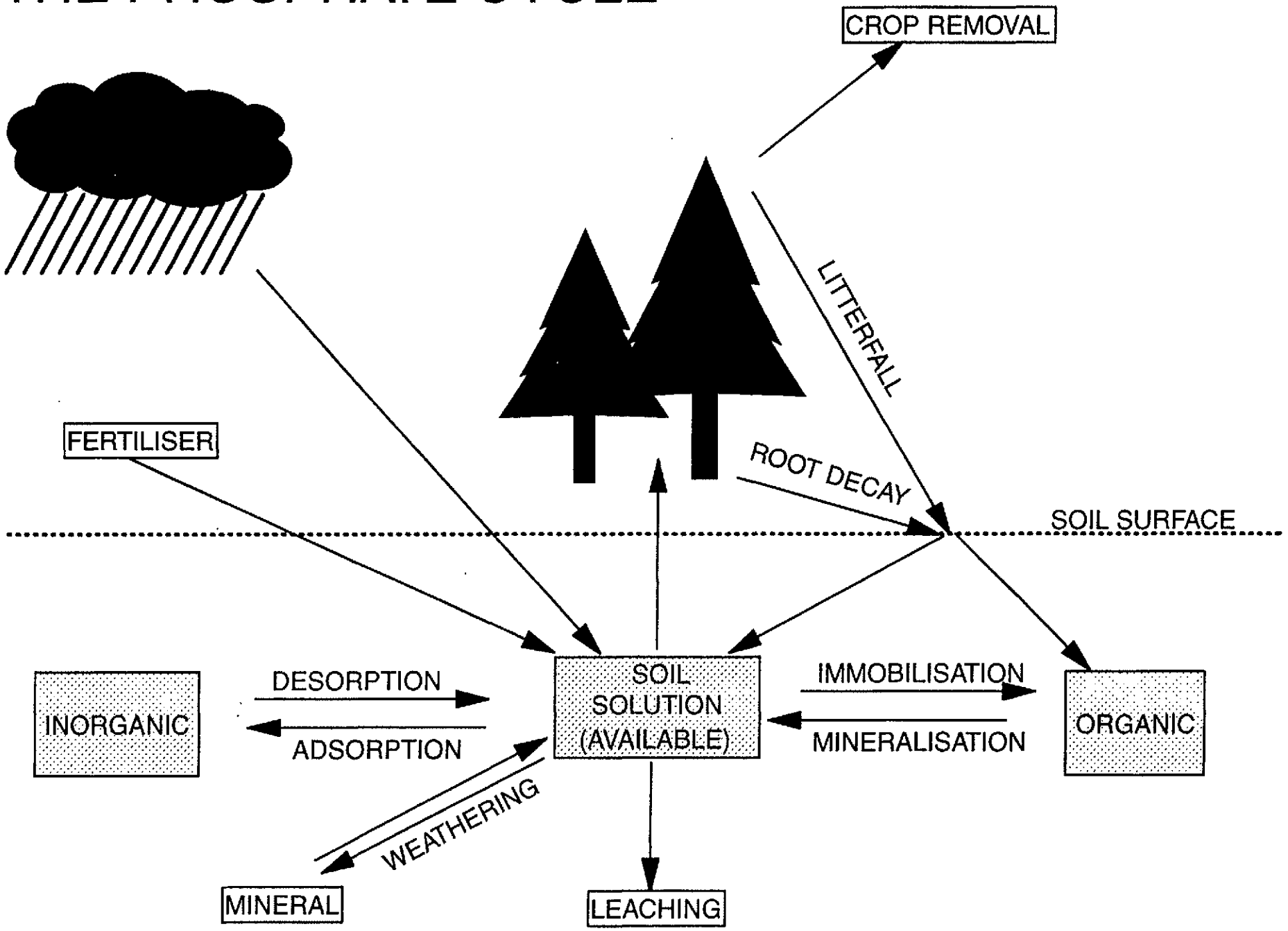
MSc projects 1994-1995

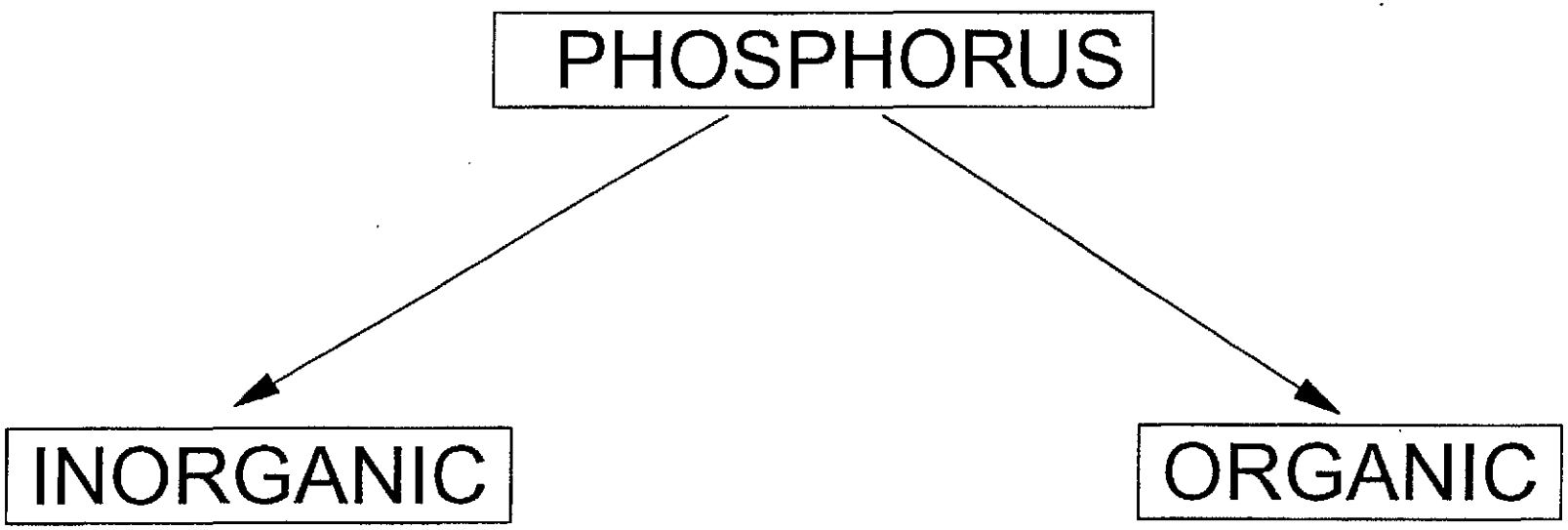
- water use efficiency of radiata pine and legumes
- describing radiata pine root growth and turnover

PHOSPHATE RETENTION CAPACITY WHAT IS IT AND HOW DOES IT EFFECT THE CHOICE OF P FERTILISER?

JESSICA HUNTER-SMITH

THE PHOSPHATE CYCLE





Young soils
Heavily leached soils

Peaty soils
Soils under long-established pasture

CONCENTRATION OF P IN SOIL SOLUTION USUALLY VERY LOW.

P IN SOLUTION EXISTS AS PHOSPHATE ION
- FORM DEPENDS ON SOLUTION pH.

MOST FOREST SOILS pH= 5.5
TAKEN UP BY PLANTS IN $H_2PO_4^-$ FORM

INORGANIC P.

Primary - derived from minerals in rocks of parent material => calcium phosphate mineral (apatite)

Weathers slowly to release phosphate ions.

Secondary - usually associated with compounds of Fe, Al, Ca and clay minerals

Adsorbed from soil solution

ORGANIC P.

The way it either accumulates or mineralises similiar to organic N.

- organic matter
- immobilised from soil solution

LOSSES:

- Inorganic immobilisation (adsorption)
- Organic immobilisation
- Leaching
- Plant uptake

GAINS:

- Desorption
- Mineralisation of organic matter
- Fertiliser additions

P RETENTION CAPACITY

"The ability to adsorb P out of the soil solution and bind it tightly onto the soil surface thus making it unavailable to plants"

The strength which adsorbed P is held can vary a lot
- which affects availability of this P to plants

- Strongest adsorbtion on sites that are usually filled first
i.e. have high P retention

P RETENTION CAPACITY - Experiment

A measured amount soil is added to a solution of orthophosphate and shaken for 24 hours, then centrifuged. The supernatent is diluted and a solution of molybdate is added. The method is based on the reaction between the phosphate in solution and the molybdate in the reagent.

HIGH P RETENTION - all the P is adsorbed from the solution (Clear colour)

MEDIUM P RETENTION - around half of the P is adsorbed (Light blue)

LOW P RETENTION - almost all of the added P stays in solution (Dark blue)

P RETENTION CAPACITY

How does it affect your choice of phosphate fertiliser ?

- Superphosphate
- Triple super
- Phosphate rock
- PAPR

P UPTAKE SERIES OF TRIALS: AN UPDATE

MALCOLM SKINNER

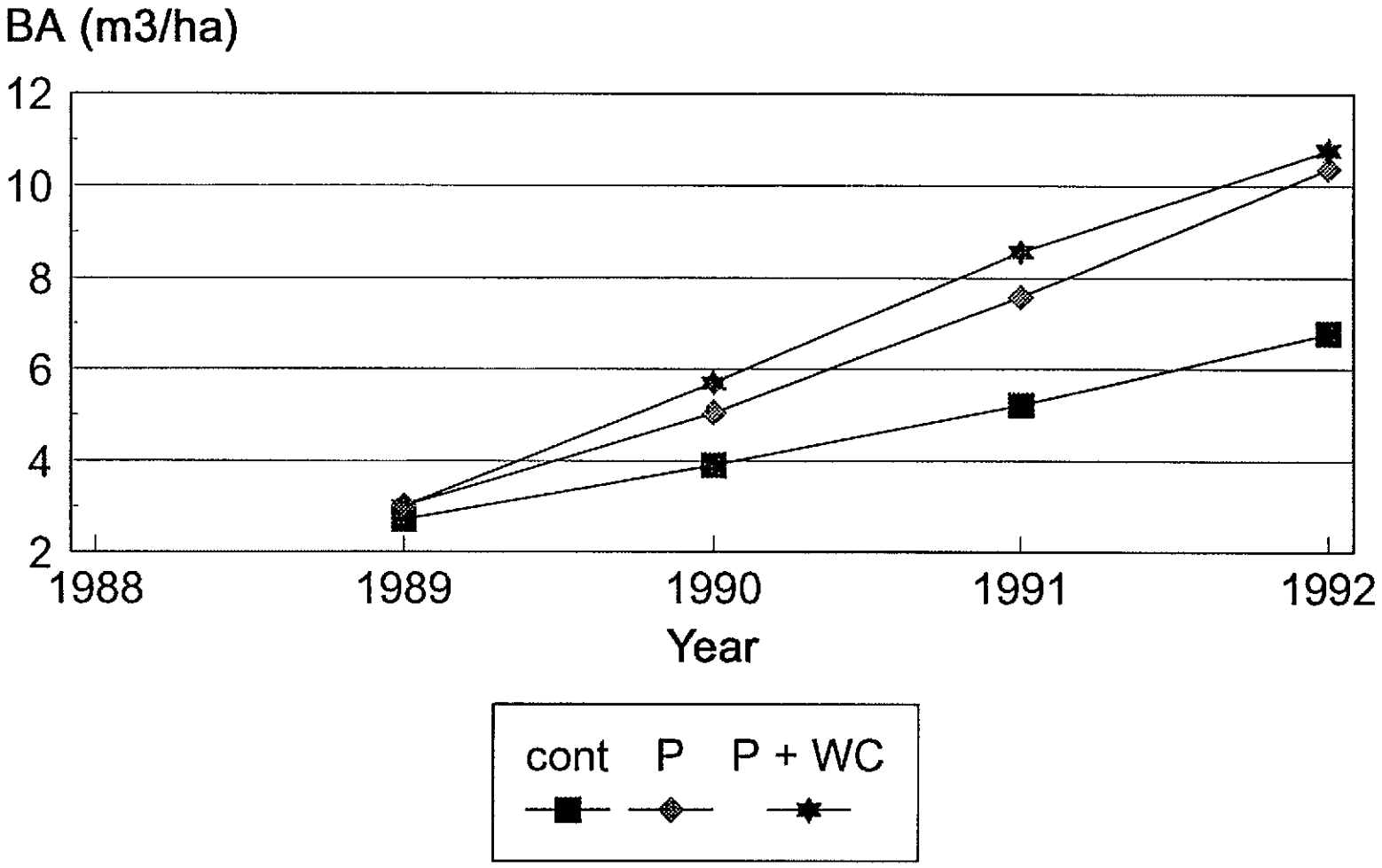
The P uptake, weed control series - Industry organised and maintained

FR68/1 at Harakeke
B, B+P, B+P+WC, B+P+N

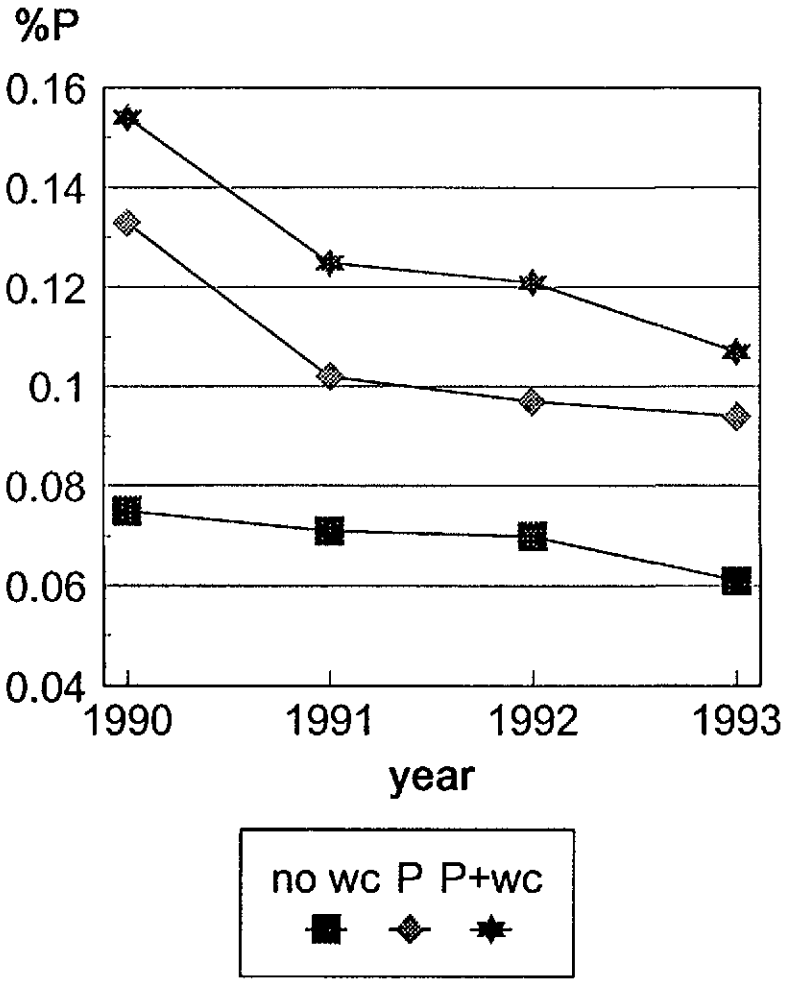
FR68/2 at Tairua
+/- WC; +/- super or PAPR

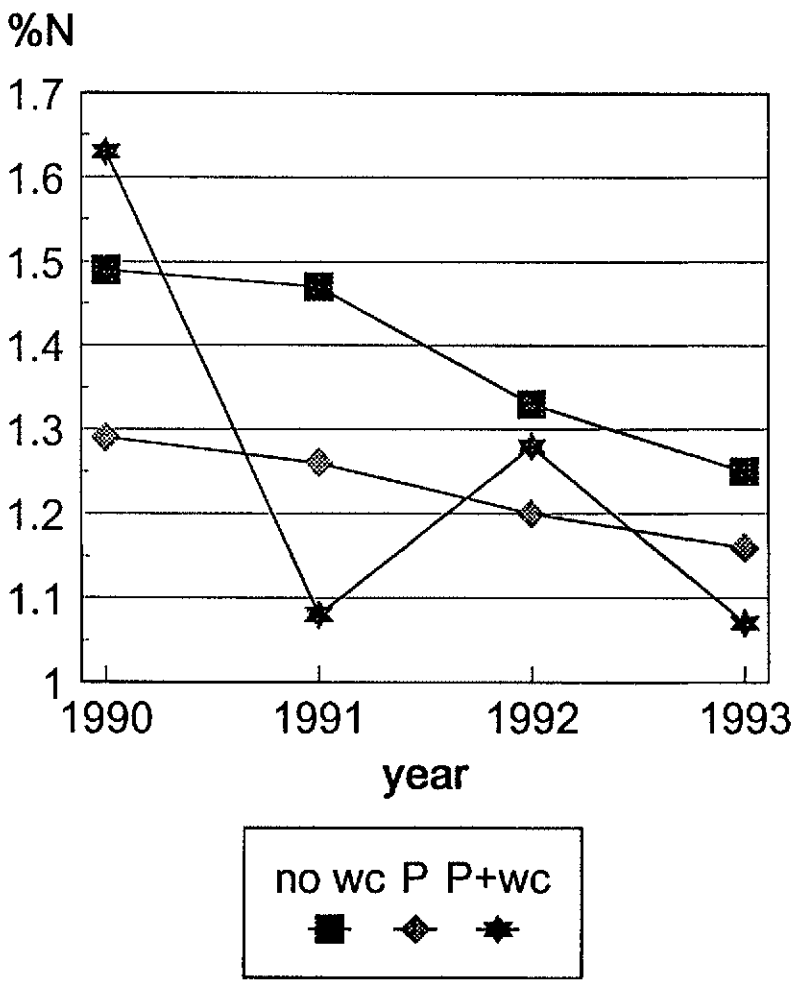
FR68/3 at Mangakahia
control, triple, triple+WC, rock, PAPR

FR68/1 at Harakeke - effect of P and WC on basal area

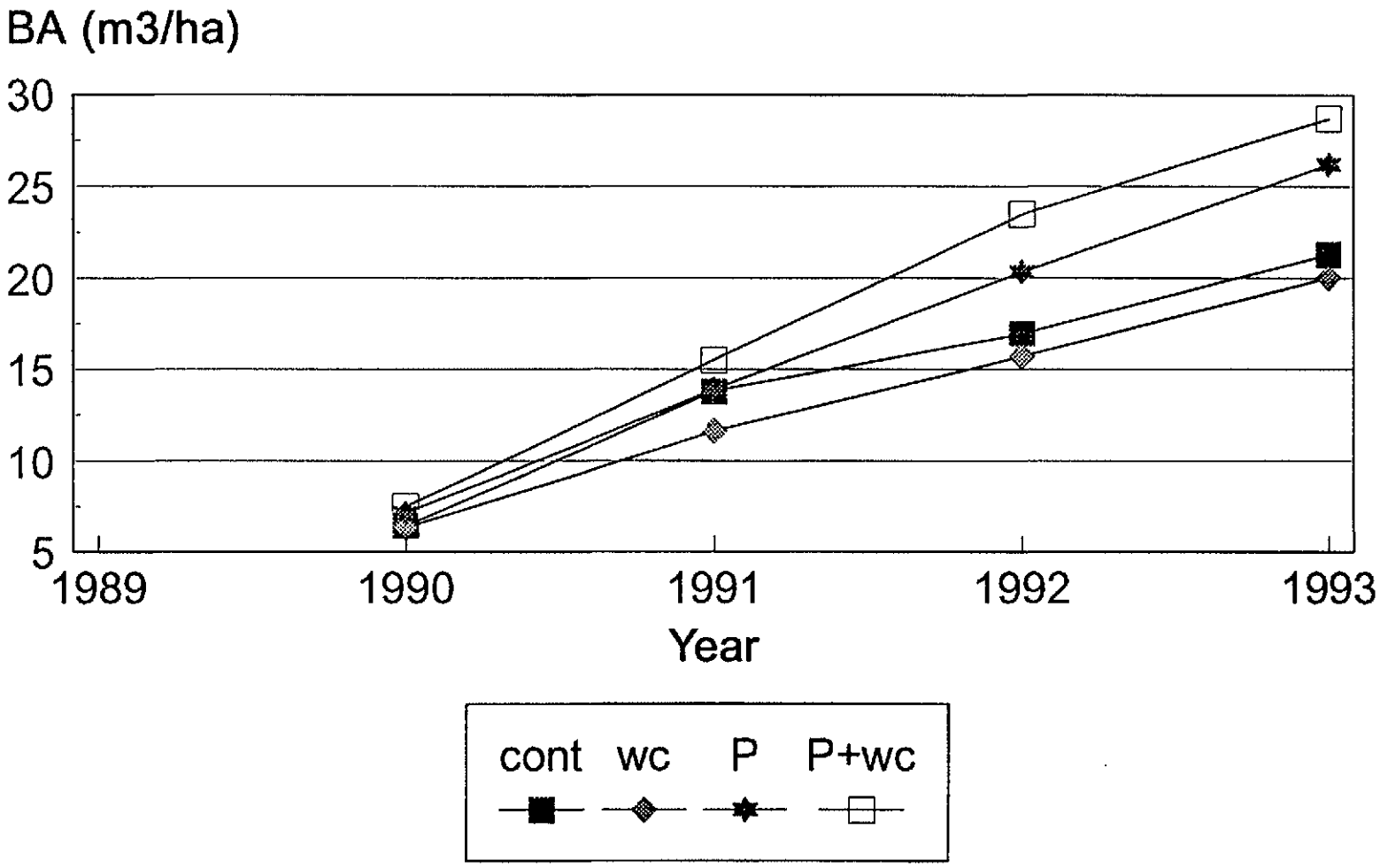


FR68/1 at Harakeke - effect of P and WC on foliar P and N

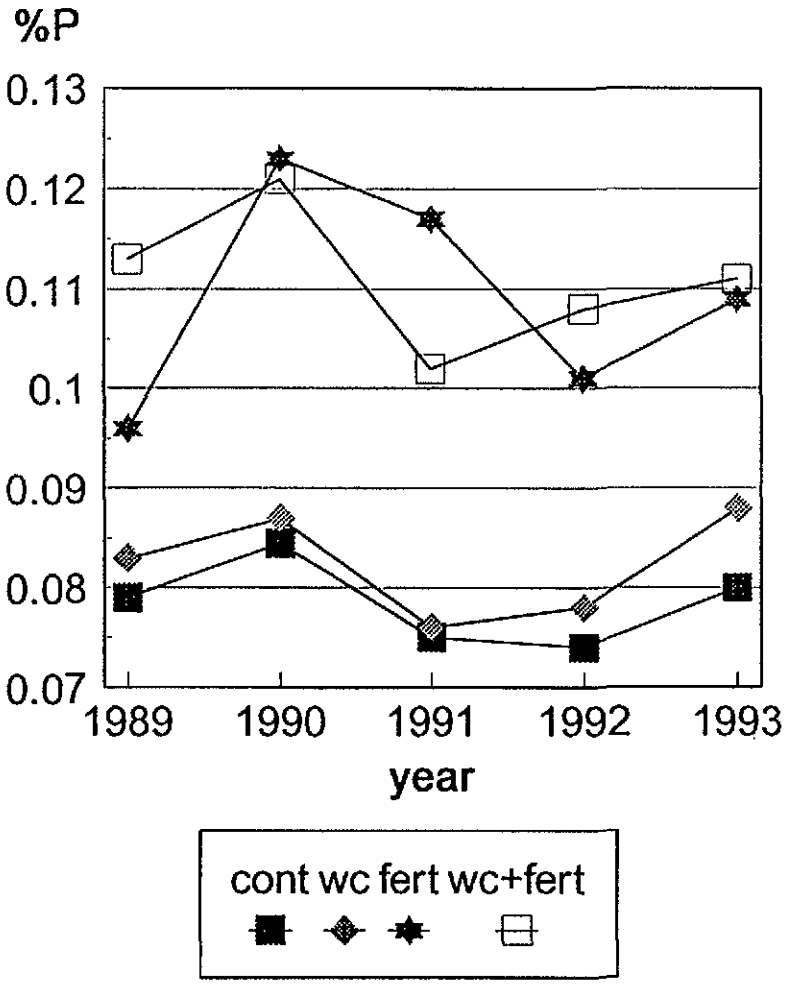


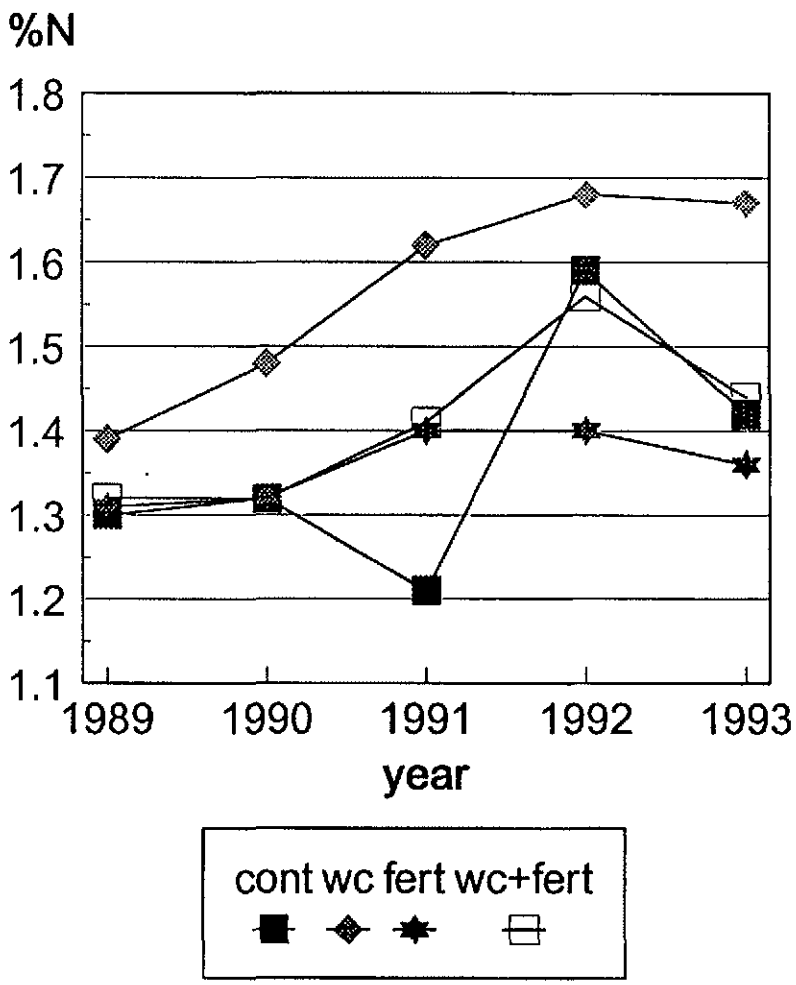


FR68/2 at Tairua - effect of P and WC on basal area

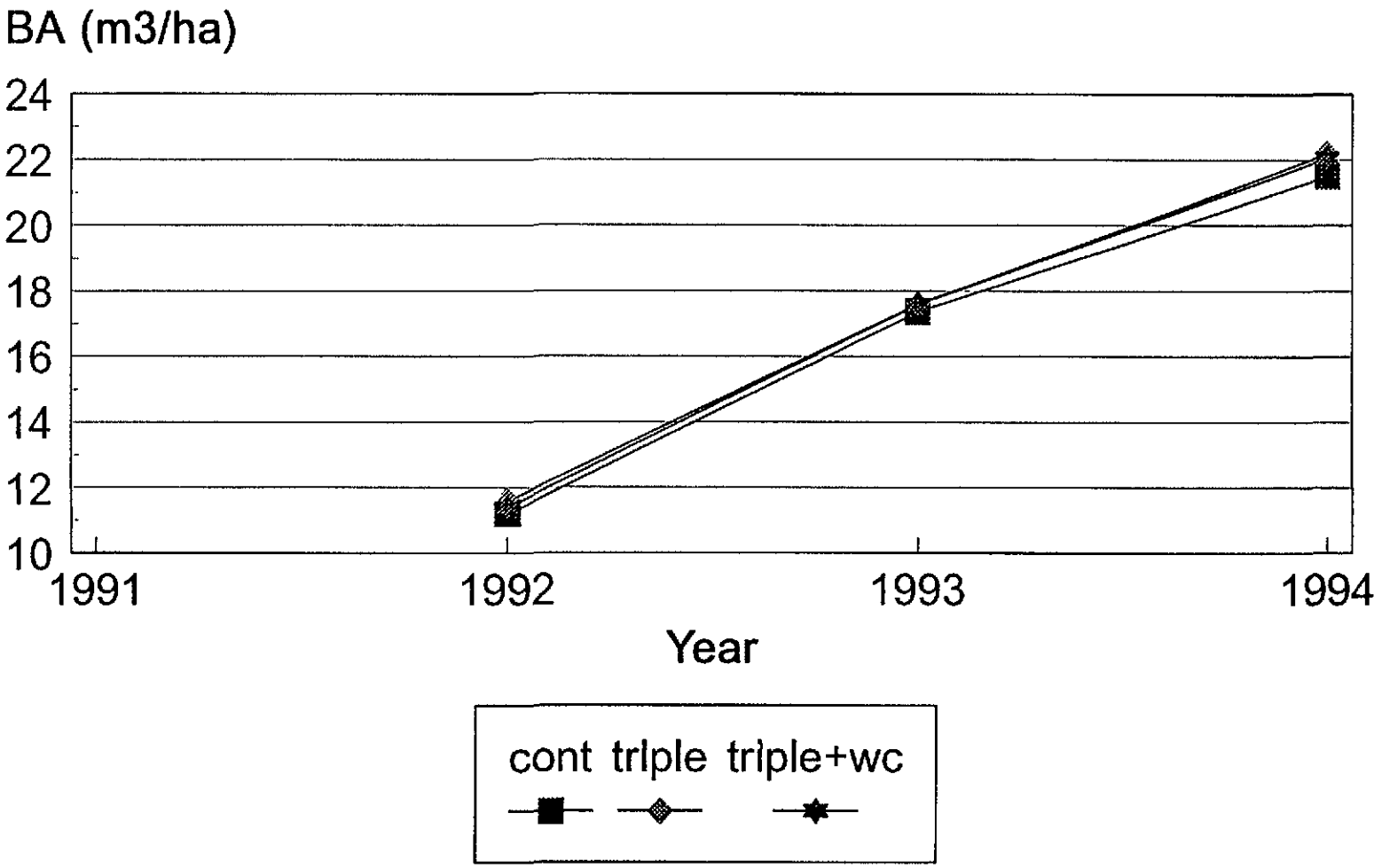


FR68/2 at Tairua - effect of P and WC on foliar P and N

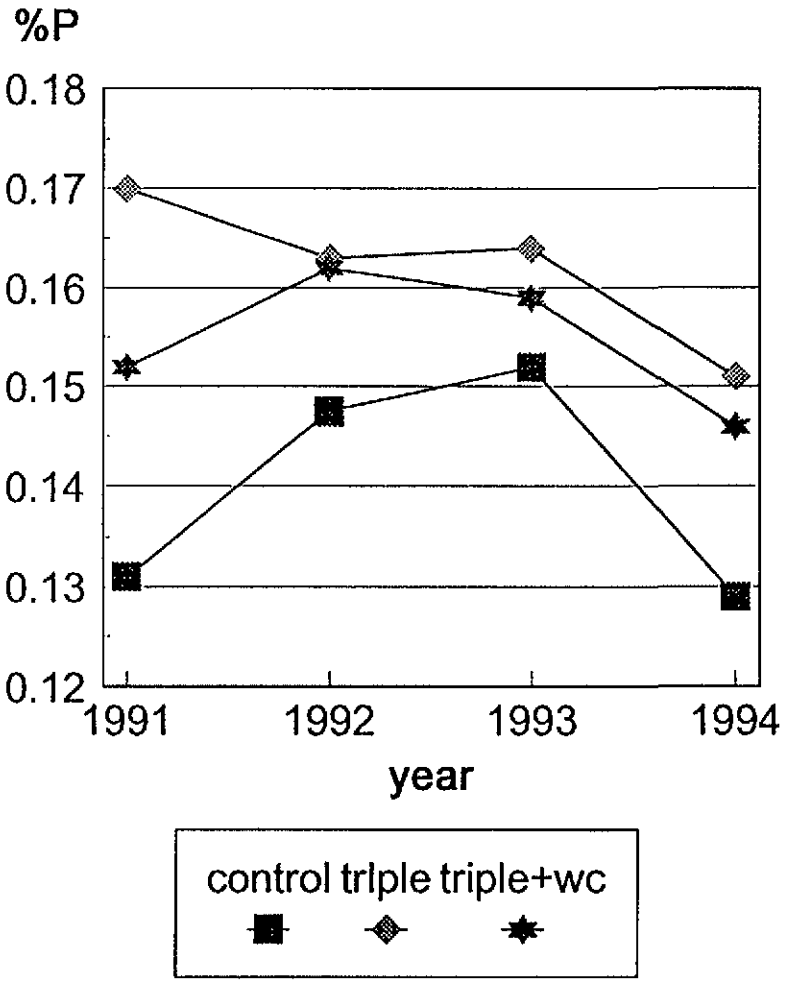


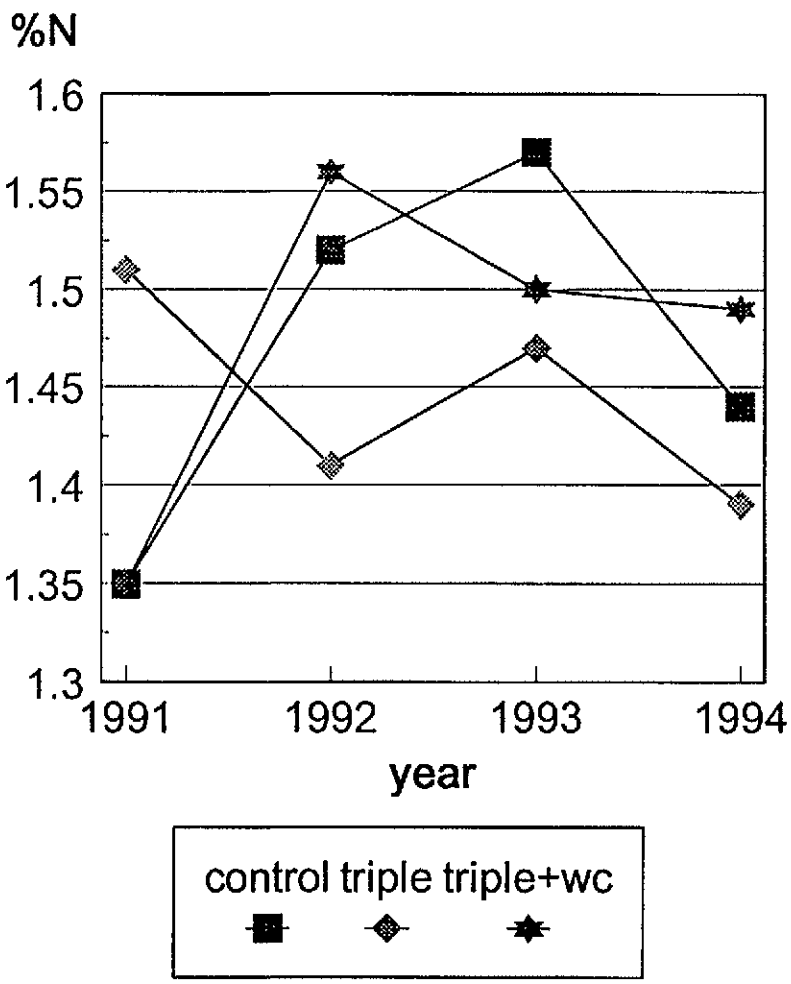


FR68/3 at Mangakahia - effect of P and WC on basal area



FR68/3 at Mangakahia - effect of WC and P on foliar P and N





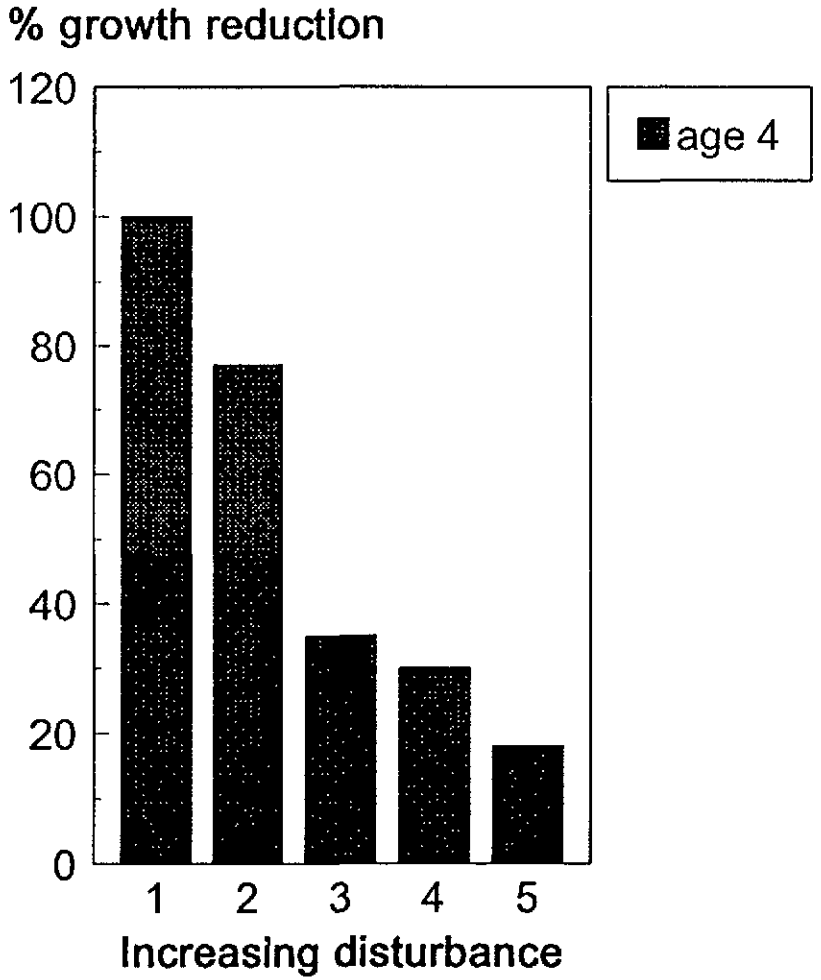
NOTES FROM THE SOIL DISTURBANCE TRIAL MARAMARUA FOREST

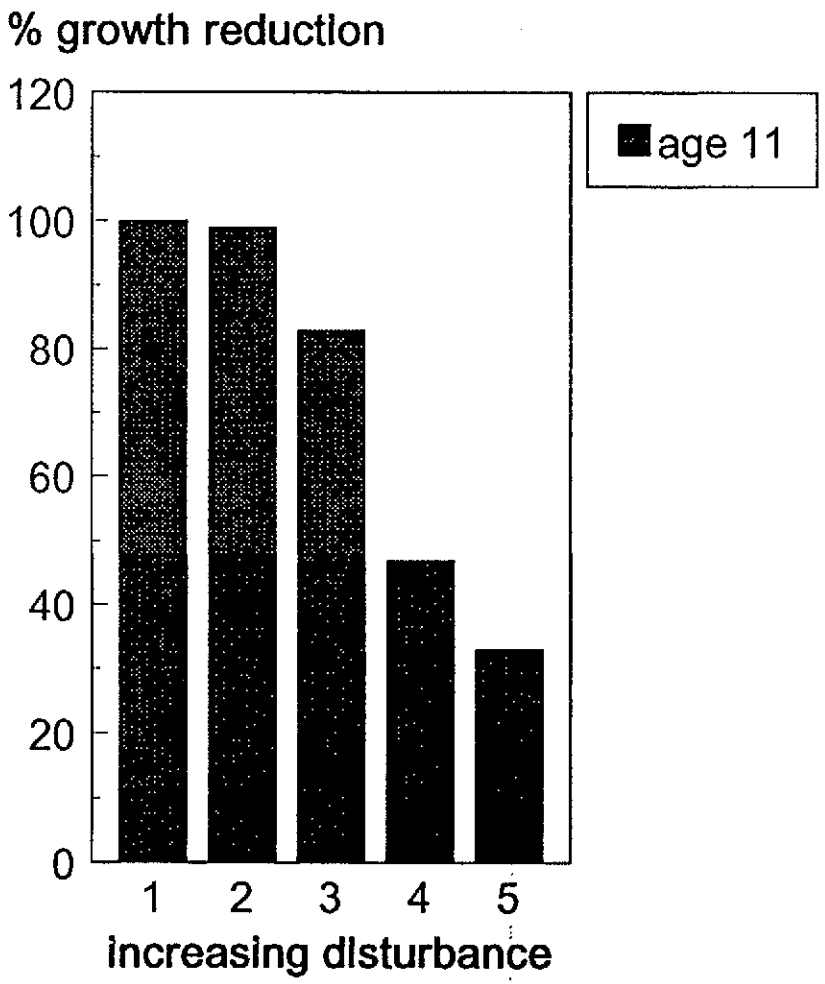
MALCOLM SKINNER

Soil disturbance trial at Maramarua Forest - trial information

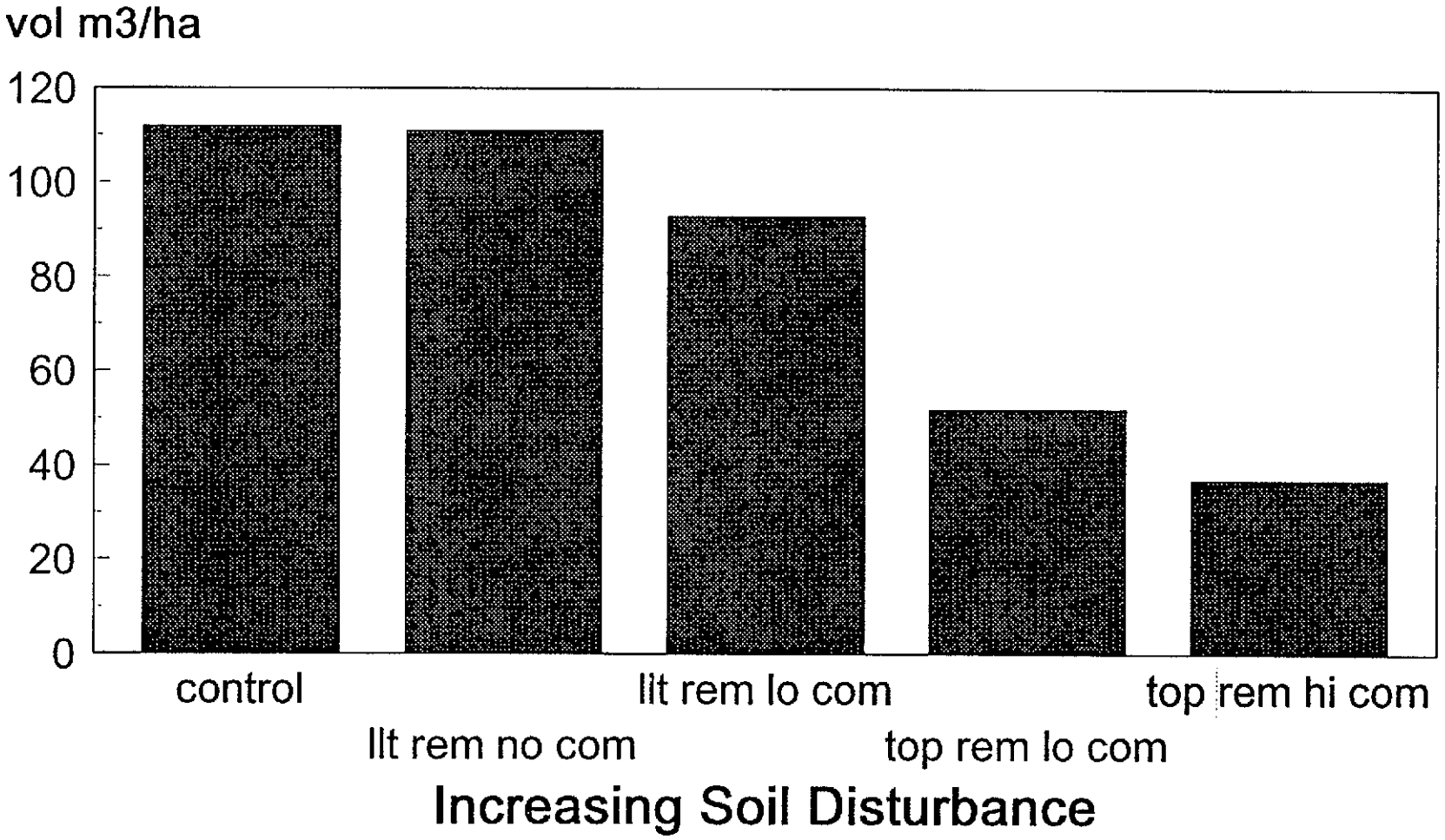
- control; litter removed no compaction; litter removed by light tractor; top-soil removed, 8 passes; top soil removed 16 passes
- planted 1982 at 1500 sph
- pre-plant Velpar (5 kg active/ha)
- plots 30 m by 20 m
- 26 kg P/ha at t-o-p; 67 kg P/ha & 75 kg N/ha at age 1
- trees thinned age 5 (1 in 2); pruned to half height
- final thinning 250 sph age 6

Soil disturbance trial Maramarua Forest - growth reductions as proportion of the control



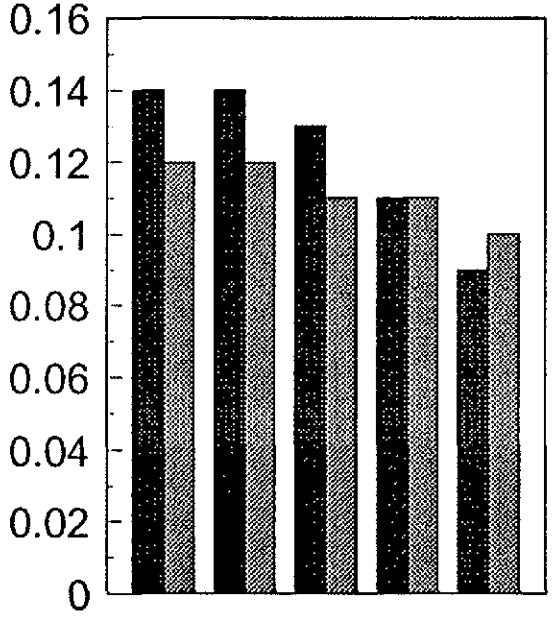


Soil disturbance trial Maramarua Forest - volume growth (m3/ha) at age 11



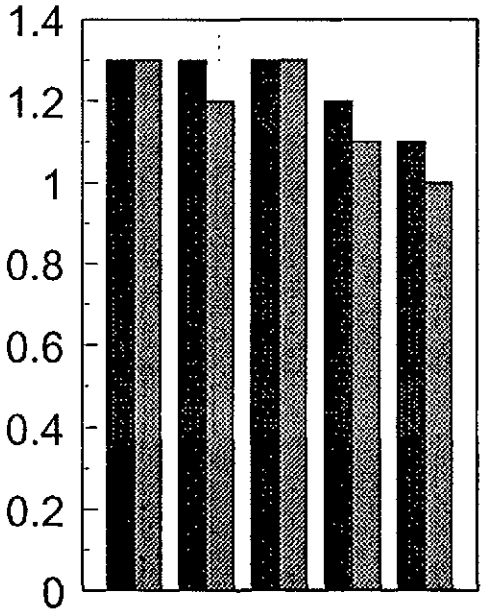
Soil disturbance trial Maramarua Forest - changes in tree nutrition

Changes in foliar P (%)



	1	2	3	4	5
Follar P age 4	0.14	0.14	0.13	0.11	0.09
Follar P age 11	0.12	0.12	0.11	0.11	0.10

Changes in foliar N(%)



	1	2	3	4	5
Foliar N age 4	1.3	1.3	1.3	1.2	1.1
Foliar N age 11	1.3	1.2	1.3	1.1	1.0