NZ FRI/INDUSTRY
RESEARCH COOPERATIVES

THE EFFECT OF FERTILISING, WEED CONTROL AND SILVICULTURE ON THE GROWTH OF RADIATA PINE AT HUNUA FOREST

By

M.F. SKINNER, J.D. GRAHAM
J.A.C. HUNTER-SMITH, AND M.O. KIMBERLEY

REPORT No. 77 MARCH 1996

NEW ZEALAND
FOREST RESEARCH INSTITUTE
LIMITED

The effect of fertilising, weed control and silviculture on the growth of radiata pine at Hunua Forest.

by

M.F. Skinner, J.D. Graham, Jessica Hunter-Smith
and M.O Kimberley

ABSTRACT

The effect of silviculture (thinning and pruning), and nutrition (through fertiliser and weed control), on the growth of a 5-year old stand of radiata pine was assessed through to age 10 at Hunua Forest. Thinning and pruning without the addition of fertiliser improved the crop's P status, and where P fertiliser was applied, growth was improved by about 2 m^2/ha over 5 years. Where weeds were controlled, the growth gains reached a little over 5 m^2/ha.

INTRODUCTION

The period of maximum nutrient demand by the forest crop occurs approximately between the ages of 4 to 9 years old (Miller, 1981). The intensity of the demand for nutrients will also depend on the intensity of site stocking. The capacity of the site to supply nutrients will depend on the site's nutrient capital and buffering capacity, and on the competition for those nutrients by the understorey vegetation. After early tending, a recycled source of nutrients will originate from waste thinned trees and slash debris.

The aim of this trial was to assess, from the perspective of forestry operations, the effect of thinning (and pruning), nutrient addition, and both in combination with weed control on subsequent growth of the crop.

MATERIALS AND METHODS

The site

The experiment is located in Cpt 22/1 of Hunua Forest (Regional Forests Ltd) situated 30 k east of Auckland city in the Hunua Ranges. The trial faces predominantly north with an average slope of 40^{o}. The understorey vegetation consists mainly of shrubby hardwoods, gorse, pampas and ghania. The soil is moderately P deficient Te Rango clay loam/stony loam and has the following characteristics.

	Soil chemical properties				
Depth (cm)	**pH**	**total N %**	**Bray-P µg/g**	**Bray-K µg/g**	**Bray-Mg µg/g**
0 - 10	5.1	0.258	5.3	0.77	4.0
10 - 20	5.1	0.155	2.8	0.47	2.7

The site was planted with radiata pine in 1984 at a nominal stocking of 1665 sph..

The treatments

The experiment was established in 1989, and the 5 treatments (in order of increasing input) were:

- Untended, at 1665 sph (varied between 1100 and 1800 between replicates)
- Thinned to waste (T) to 375 sph and pruned (Pr) to 2.5m
- T and Pr with phosphorus (P) added at 100 kg P/ha as Longlife Superphosphate
- T, Pr, P and nitrogen (N) added at 200 kg/ha as urea

- T, Pr, P, N with complete understorey vegetation control (cutting and follow up spraying with the herbicide "Roundup").

The trial was replicated 3 times in a randomised plot design. The plots were 36 m by 36 m, with inner measurement plots of 20 m by 20 m. The growth data was assessed by analysis of covariance, and did not include the untended treatments because of the stocking difference.

Measurements

Each year tree heights and diameters (DBH) were measured and recorded during winter, and foliage sampled during late summer and analysed for nutrient concentrations.

RESULTS

Summary tables for analysis of covariance are given in Appendix 1.

In the absence of fertiliser and weed control the thinned and pruned radiata pine lagged significantly behind in basal area (Figs 1 and 2, and Table 1). Although thinning and pruning did improve tissue P nutrition (Fig 3 and Table 2) through:

- nutrient release from slash, and
- lowered between-tree competition.

The effect of these changes on productivity could not be measured as there was no experimental comparison between thinning/pruning and slash left on-site compared with removed from the site.

Phosphate fertiliser elevated tissue P concentrations through to age 10 (Fig 3) and N levels were elevated for one year following application of urea, after which all tissue N concentrations tended to similarity between ages 7 and 10 (Fig 4 and Table 3). The basal area gains to fertiliser of 2 m^2/ha after 5 years, and to fertiliser in combination with weed control at 5 m^2/ha after 5 years, although large and of practical significance (Fig 2), were, however, not statistically significant. The lack of statistical significance between the more intensive treatments is through the restraints of the experiment's design. If the pattern of divergent growth continues then statistical significance will follow.

DISCUSSION

This trial demonstrates clearly the need to take into account the effect of weeds in determining radiata pines' growth responsiveness to fertilisers. At this site the lack of weed control had an adverse effect on the response to P (and N) even where tissue P concentrations were shown to increase markedly (from 0.11% to between 0.14% and 0.17%). The potential for a growth response was present at this site, but not expressed in the presence of weeds. Further work on competition between trees and weeds for nutrients remains highly desirable.

CONCLUSIONS

At a marginally P deficient site, thinning and pruning resulted in small improvements in the P nutrition of the crop. Additional fertiliser P (and N) further improved nutrition and growth, but the full potential of the crop (in relation to soil conditions) was realised only where competing weeds were controlled.

ACKNOWLEDGMENTS

We thank the staff of the former Auckland Regional Authority for their assistance establisheing the trial and the ongoing programme of field work, and Regional Forests for continued protection and access to the trial.

REFERENCES

Miller, H.G., 1981. Forestry 54: 157 - 167

APPENDIX 1

Table 1. ANOVA summary for the effect of treatment on BA response between 1990 and 1994.

	Probability			
	BA90	BA91	BA92	BA94
Covariate BA 89	0.0001	0.0002	0.0010	0.0021
Treat (4 d.f)	0.2134	0.0634	0.0491	0.0615

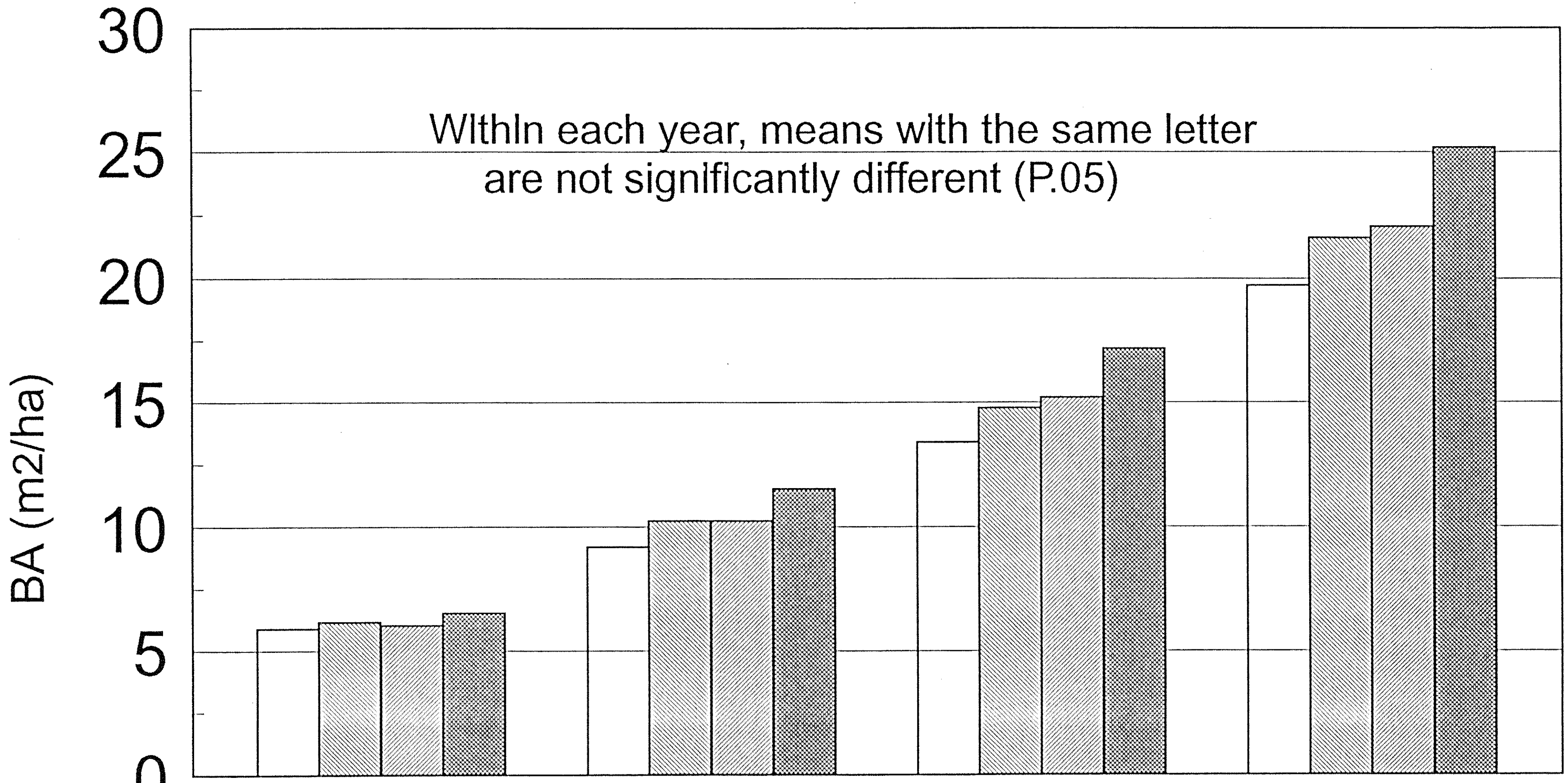
Table 2 ANOVA summary for the effect of treatment on foliar N concentrations between 1990 and 1994.

	Probability			
	N90	N91	N92	N94
Treat (4 d.f)	0.001	0.061	0.1921	0.7559

Table 3. ANOVA summary for the effect of treatment on foliar P concentrations between 1990 and 1994.

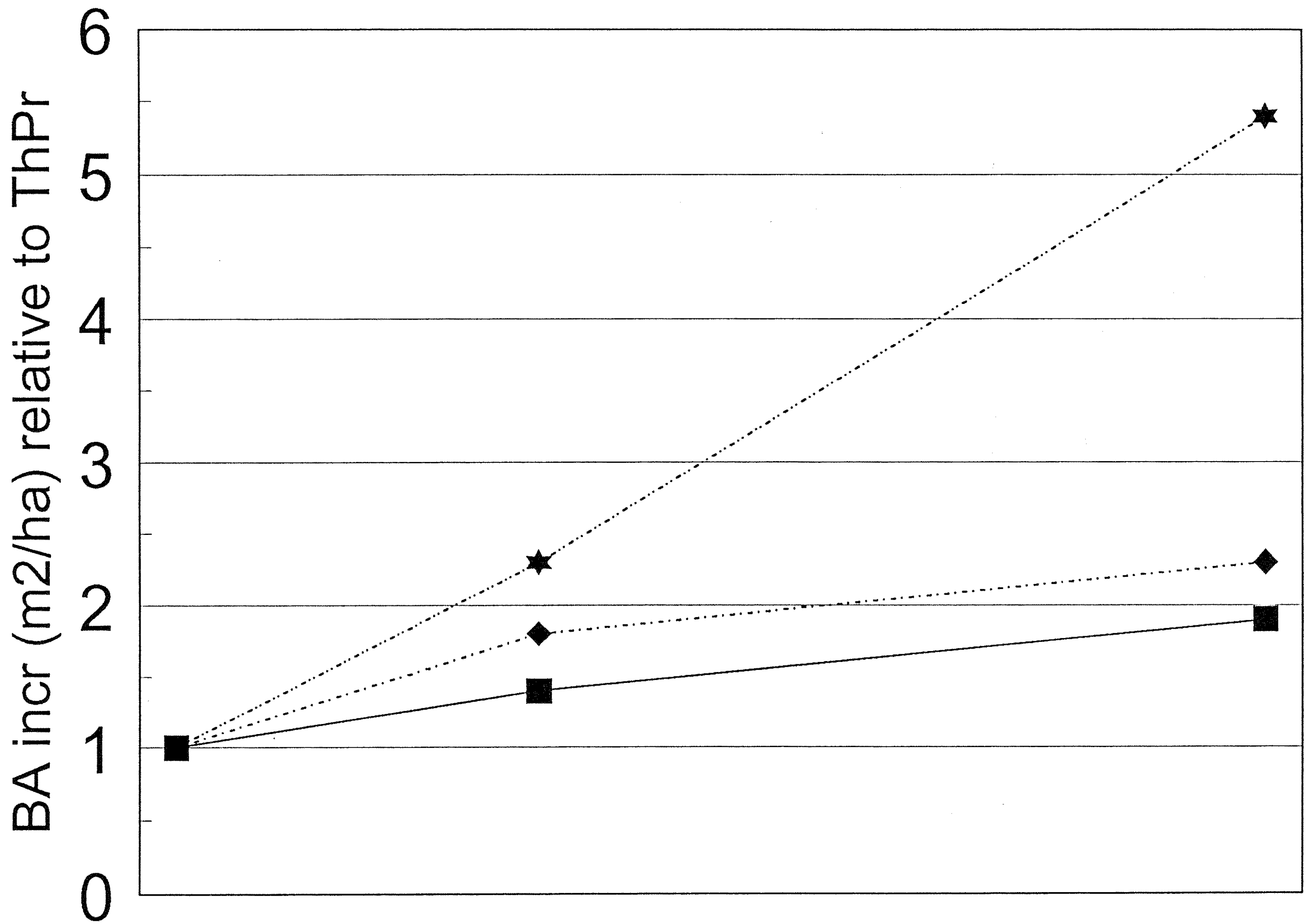
	Probability			
	P90	P91	P92	P94
Treat (4 d.f)	0.0787	0.0162	0.3724	0.0156

Figure 1. The effect of treatment on BA (m2/ha)



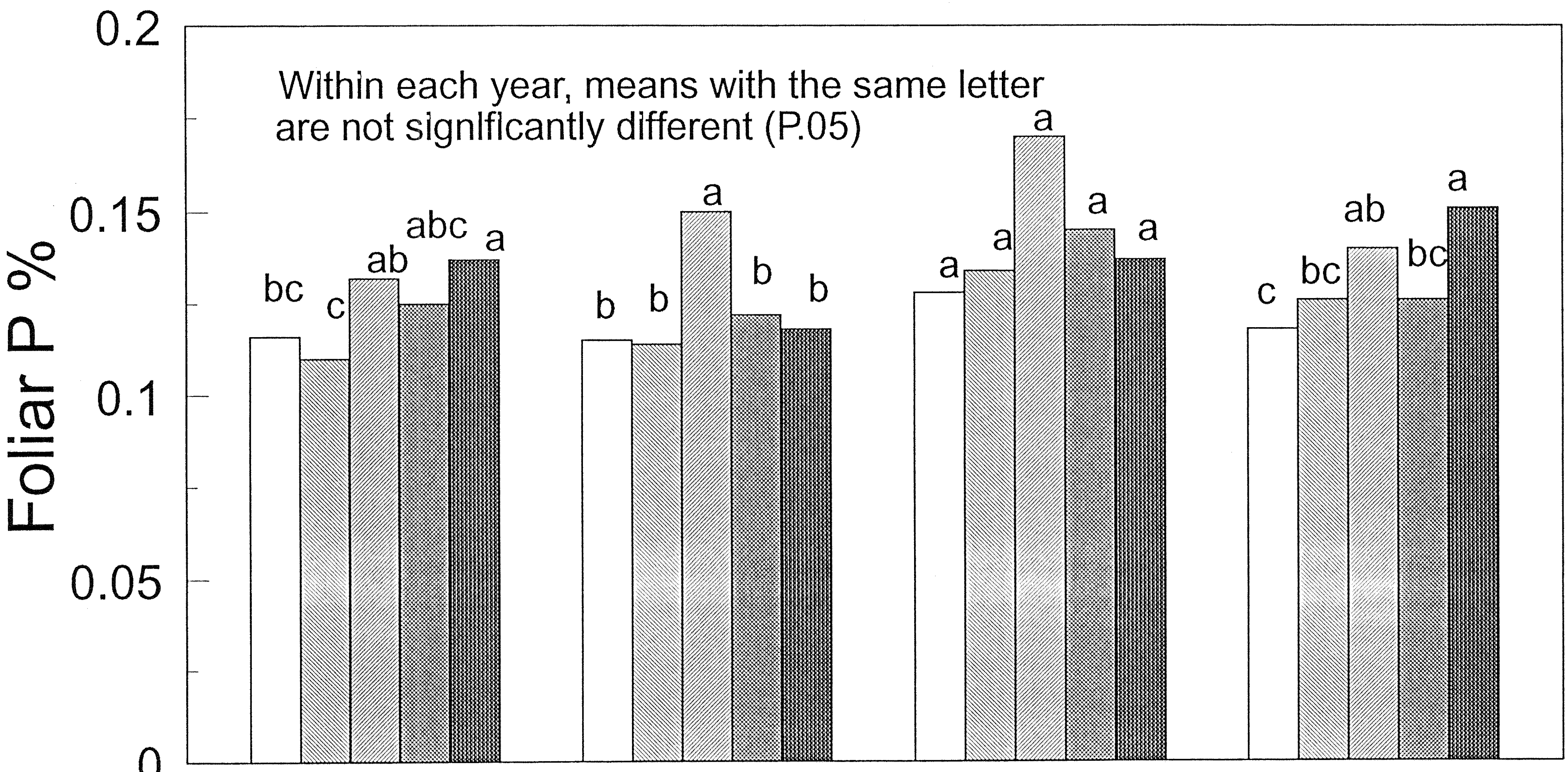
	1990	1991	1992	1994
Th*Pr	5.89 a	9.19 a	13.41 a	19.74 a
Th*Pr*P	6.17 b	10.24 b	14.78 b	21.60 b
Th*Pr*PN	6.03 b	10.26 b	15.21 b	22.06 b
Th*Pr*PNW	6.54 b	11.53 b	17.19 b	25.17 b

Fig. 2. The effect o fertiliser and weed control on BA (m2/ha) Increase over the ThPr treatment



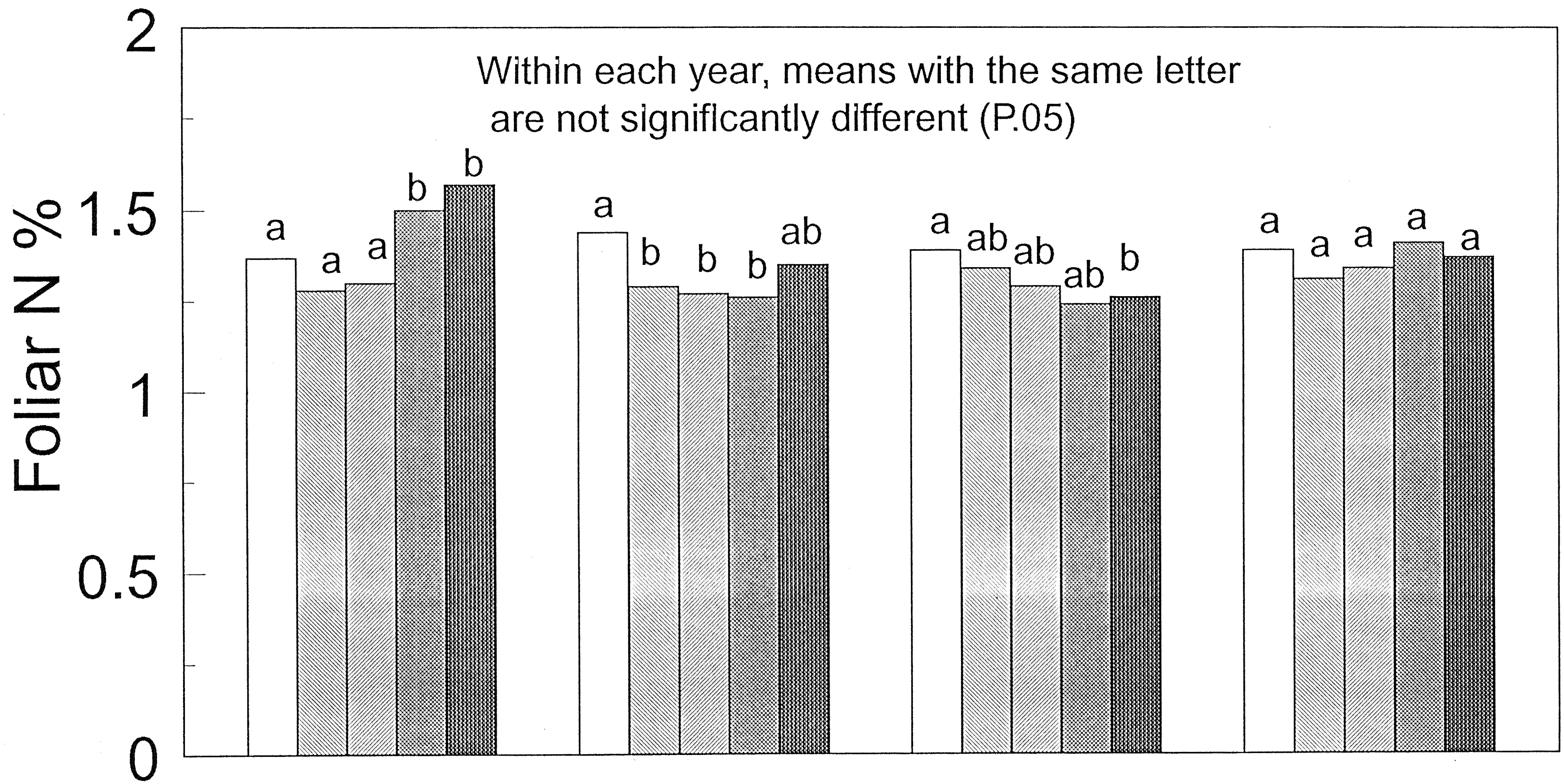
	1991	1992	1993	1994
ThPr.P ■	1.0	1.4		1.9
ThPr.PN ◆	1.0	1.8		2.3
ThPr.PN.Wc ✶	1.0	2.3		5.4

Figure 3. The effect of treatment on foliar P response



	1990	1991	1992	1994
control	0.116	0.115	0.128	0.118
Th*Pr	0.110	0.114	0.134	0.126
Th*Pr*P	0.132	0.150	0.170	0.140
Th*Pr*PN	0.125	0.122	0.145	0.126
Th*Pr*PNW	0.137	0.118	0.137	0.151

Figure 4. The effect of treatment on foliar N response



	1990	1991	1992	1994
control	1.37	1.44	1.39	1.39
Th*Pr	1.28	1.29	1.34	1.31
Th*Pr*P	1.30	1.27	1.29	1.34
Th*Pr*PN	1.50	1.26	1.24	1.41
Th*Pr*PNW	1.57	1.35	1.26	1.37