Project No. 1840

THE 1987 MEASUREMENTS OF LONG-TERM PHOSPHATE TRIALS AK286/4 AND AK286/5

by

J.D. Graham

Report No. 24 March 1988

Confidential to Participants of the National Forest Fertilising Cooperative Research Programme.
This material is unpublished and must not be cited as a literature reference.

FRI/INDUSTRY RESEARCH COOPERATIVES

EXECUTIVE SUMMARY

Two blocks of the long term phosphate trial series AK286 - in Maramarua and Glenbervie - were measured in winter 1987. The two blocks are unreplicated.

The results show that at Glenbervie, where initial foliar P concentration exceeded 0.12% and foliar N was 1.6%, there was no response to fertiliser. At Maramarua, where initial foliar P was 0.06% and foliar N was 1.1%, response appeared to be limited by lack of N.

These findings have been incorporated in management advice. We have reduced our intervention level for fertilising to 0.11% P in foliage to avoid waste of fertiliser. We advise managers with low N status forests to have their samples analysed for N as well as P and to apply both elements if both are shown to be deficient.

THE 1987 MEASUREMENTS OF
LONG TERM PHOSPHATE TRIALS AK286/4 & AK286/5

Introduction

These two trials, located in Glenbervie and Maramarua forests respectively, were remeasured in 1987.The plots are unreplicated but common treatments appear across several plots during some early phases of the life of the trials. Hunter and Graham (1982) presented data up to that time with such statistical analyses as were possible.

The broad aim of the trial series (AK286/1-7) is to determine if multiple small doses of superphosphate are more efficient at promoting growth in radiata pine than are single large doses. Other sites are in Whangapoua and Riverhead forests.

Methods

Both blocks are on clay soils. Block 4 in Glenbervie is situated on a firm clay with a strong medium blocky structure derived from recent reweathering of old deep redweathered clays. Block 5 in Maramarua is on a very firm, very coarse, structured silty clay derived from intense weathering of greywacke.

Soil and foliage samples from untreated plots have eastablished that both sites are low in available phosphorus (Maramarua more so than Glenbervie) and the trees are marginal(Glenbervie) to deficient (Maramarua) in that element. Other nutrients are in reasonable supply except that Maramarua is low in nitrogen.

The eight treatments pertinent to these blocks are presented, along with their abbreviations, in Table 1. Fertiliser was applied to block 4 in 1970 (crop age 5) and to block 5 in 1971 (crop age 8).

Table 1: Fertiliser treatments

Abbreviation	Fertiliser treatment
control	No fertiliser
625	625 kg superphosphate/ha at trial establishment
1250	1250 " " " " "
2500	2500 " " " " "
625*2	625 " " " " " and again after 10 years
625*4	625 kg superphosphate/ha at trial establishment and repeated after 5, 10, and 15 years.
625D	625 kg superphosphate/ha applied 5 years after trial establishment.
625P%	625 kg superphosphate/ha at establishment and reapplied if annual foliage samples contain less than 0.12%P or between 0.12% and 0.13% in 2 consecutive years

Results

A general comparison between treatments within blocks has been made for the paramaters of basal area and mean top height only. Data has been extracted directly from the Permanent Sample Plot computer system and is presented in Tables 2 and 3.

Table 2(a): Basal area increments, AK286/4, Glenbervie.

Treatment	Periodic Basal Area Increment (m^2/ha) 1970-1973	1973-1978	1978-1987	Total
	#	#	#	
control	17.29(112)	17.94(129)	29.98(101)	65.21
625	23.03(135)	25.99(179)	34.00(96)	83.02
1250	21.03(166)	20.09(141)	26.42(93)	67.54
2500	19.97(161)	19.26(138)	23.18(84)	62.41
625*2	19.41(142)	21.23(163)	25.78(94)	66.42
625*4	18.98(166)	20.25(137)	26.43(91)	65.66
625D	20.82(172)	23.97(163)	30.62(90)	75.41
625P%(1970 & 76)	22.54(194)	22.22(149)	32.78(110)	77.54
Mean	20.38	21.37	28.65	70.40

Percentage increase relative to B.A. at start of period.

Table 2(b): Basal area increments, AK286/5, Maramarua

Treatment	Periodic Basal Area Increment (m^2/ha) 1972-1976	1976-1987	Total
	#	#	
control	10.93(105)	27.00(209)	37.93
625	16.56(153)	33.73(258)	50.29
1250	13.83(158)	28.97(243)	42.80
2500	17.54(160)	35.04(272)	52.08
625*2	14.04(169)	31.93(288)	45.97
625*4	13.99(145)	30.13(253)	44.12
625D	9.75(128)	27.41(278)	37.16
625P% (1971 & 75)	13.29(243)	32.31(280)	45.60
Mean	13.74	30.81	44.49

The increment periods shown in these tables correspond to the periods between thinning operations in the trials. Site index has been calculated from the Burkhart & Tennent site index tables.

Table 3(a): Mean top height and site index, AK286/4 Glenbervie

Treatment	M.T.H. (m) 1970 (5yrs)	M.T.H. (m) 1987 (22yrs)	Increment	Site index(m)
control	9.4	31.2	21.8	29
625	7.6	37.8	30.2	36
1250	7.1	33.8	26.7	32
2500	7.1	35.2	28.1	33
625*2	8.3	35.4	27.1	34
625*4	8.8	32.8	24.0	31
625D	7.4	33.5	26.1	32
625P%	7.2	33.4	26.2	32

Table 3(b): Mean top height and site index, AK286/5 Maramarua

Treatment	M.T.H. (m) 1972 (9yrs)	M.T.H. (m) 1987 (24yrs)	Increment	Site index(m)
control	15.2	32.9	17.7	29
625	13.1	34.2	21.1	31
1250	13.1	33.8	20.7	30
2500	12.5	34.2	21.7	31
625*2	11.9	34.4	22.5	31
625*4	12.6	35.8	23.2	32
625D	11.2	31.7	20.5	28
625P%	9.9	32.0	22.1	28

Foliage samples have been collected and analysed for P at intervals over the years. Usually the control and 625P% treatments were sampled annually. The natural fluctuation of P levels within a stand can be followed in the control plots of Table 4.

Table 4(a): Folar P concentrations (% O.D. wt), AK286/4 Glenbervie

Year	Treatment							
	cont.	625	1250	2500	625*2	625*4	625D	625P%
1970	.119	.129¥	.134¥	.107¥	.122¥	.123¥	.124	.120¥
1971	.121	.228	.224	.263	.169	.164	.127	.156
1972	.134	.214	.202	.267	.160	.214	.121	.208
1973	.103						.096	.126
	----------Thinned----------							
1974	.106							.128
1975	.110	.158	.171	.169	.126	.152¥	.101¥	.128
{1976}	.113							.132¥
1977	.103							.163
1978	.101	.106	.135	.151	.114	.115	.109	.154
	----------Thinned----------							
1979	.106	.153	.178	.185			.156	.156
1980	.103	.157	.180	.145	.126¥	.176¥	.118	.170
1981	.140§							.150
1982	.177							.140
|								
1985	.137	.131	.165	.177	.155	.160¥	.120	.123

¥ Fertilised after this sampling

§ Suspected contamination by aerial topdressing

{} Foliar N in control = 1.64%

Table 4(b): Foliar P concentrations (% O.D. wt), AK286/5 Maramarua

Year	Treatment							
	cont.	625	1250	2500	625*2	625*4	625D	625P%
1971 ¤	.056	.056¥	.056¥	.056¥	.056¥	.056¥	.056	.056¥
1972	.100	.151	.206	.251	.164	.179	.089	.160
1973	.085							.130
1974	.080	.114	.130	.160	.153	.112	.077	.119
1975	.082							.107¥
1976	.084	.127	.136	.156	.123	.123¥	.067¥	.150
	----------Thinned----------							
1977	.086	.129	.134	.173	.131	.144	.108	.171
{1978}	.103							.186
1979	.096	.145	.148	.161	.139	.157	.132	.172
1980	.100							.182
1981	.092	.123	.146	.152	.128	.130	.126	.173
1982	.101				.138¥	.157¥		.226

¤ Average of control and 625D treatments

{} Foliar N in control = 1.09%

Conclusions

Lack of replication and the confounding effect of thinnings does not lead to a clear signal from these two trials alone.

Height response at Maramarua indicates that repeated small doses of P are better than large single applications but this effect is not strongly reflected in the basal area response. Foliar P levels were increased from .06% to .15% but the potential of the site has not been fully exploited because N has always been limiting.

From the start Glenbervie was a more variable site and not as P deficient (always about .11% in the control).Very little response would be expected here and such indeed was the case. The responses in both basal area and height can only be classified as a fertiliser / no fertiliser reaction with little regard to rates and time of application.

Management Summary

Apply P only if foliar levels are less than 0.11%.

If foliar N is also less than 1.2% it also should be applied to avoid a loss of investment in P fertiliser.

In general the repeated applications of relatively low rates of a soluble source of P have not proved to be inferior to high rates applied once early in the rotation.

The "rule-book" approach, where the low rates are applied at pre-determined intervals, may under or over fertilise a stand.

It is still recommended that regular foliage sampling, combined with local knowledge and observation, is the most cost effective way of implementing a fertiliser programme.

Reference

Hunter I.R. and Graham J.D.(1982) - Growth response of phosphorus deficient Pinus radiata to various rates of superphosphate fertiliser. N.Z.J.For.Sc.(12):49-61