PROJECT RECORD NO. 2337

UPDATE ON THE USE OF ROCKPHOSPHATE AT TIME-OF-PLANTING

by

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Report No. 44 February 1990

EXECUTIVE SUMMARY

Trials with phosphate rock applied at time-of-planting have shown:

* application rates on podzolised sands can be reduced to about 60 kg P/ha

* on soils derived from dacite, heavy (125-260 kg P/ha) applications of P are needed

* on ex-pasture clay soils P fertiliser is not required

On West Coast "pakahi" soils, phosphate rock can be applied either before or after V-blading without detriment to early tree growth.

PHOSPHATE ROCK AND THE EARLY GROWTH OF RADIATA PINE

INTRODUCTION

This report examines the 1988 results from 7 trials with phosphate rock in the Northland, Wellington and Westland Regions.

Part A examines 6 trials designed to determine the optimum rate of application for phosphate rock, and should be read in conjunction with:

> Skinner, M.F., and Robertson, E.D, 1988. Rates of phosphate rock and the early growth of radiata pine. National Forest Fertilising Cooperative Report 20.
>
> Skinner, M.F., and Robertson, E.D, 1988. Phosphate rock trials on the West Coast of the South Island of New Zealand. National Forest Fertilising Cooperative Report 22.

Part B examines WD398 installed in 1983 to accompany the AK850 series for the North Island. Early results for WD 398 are presented in Report 22.

PART A. RATES OF PHOSPHATE ROCK

Background

The AK850 series of trials, established between 1980 and 1981, with phosphate rock at time-of-planting, demonstrated that ground phosphate rock (GPR) was an alternative to the use of single superphosphate for the establishment of radiata pine on infertile soils. The rate of application of P in this trial series was high, and the optimum rate may well have been lower.

METHODS

Sites

AK925/1	Carter Holt Harvey Forests at Parengarenga Harbour on Hurewai/Te Hapua fine sandy loam. Total P is 42 ppm and available P (Bray-P) is extremely low at 0.9 ppm P.
AK925/2	Northern Pulp Ltd at Cape Karikari on Pukenamu silt loam. Total P is 44 ppm, and available P (Bray-P) is extremely low at 1.8 ppm.
AK925/3	NZ Forest Products at Opouteke West (Dargaville) on Waimatenui silty clay. Total P is 888 ppm, and available P (Bray-P) is low at 5.3 ppm.
WN356	Wellington Regional Council at Upper Hutt. Available P (Bray-P) is low at 9 ppm; subsequent tests using the sequential Bray method indicated that soil P levels were adequate.

WD403/1 Timberlands Southern at Nemona (Greymouth). Available P (single extract) concentrations are extremely low (1-2 ppm).

Fertiliser treatments

The GPR source was Christmas A/Nauru A mix (1:1 w/w) at 14.5 % P. The treatments are:

No	Rate Kg P/ha
1	0
2	25
3	56
4	125
5	280
6	Current fertiliser prescription (soluble N and P) approximating 15g P, 15g N/seedling.

Each treatment was replicated eight times to allow for refertilising of half the trial at age 3.

Trial establishment and subsequent refertilisation with N P K

The AK925 series and WN356 were established in 1983 and refertilised in 1986 at age 3. WD403/1 was established in 1984. and was refertilised in 1988 at age 4.

RESULTS

The data for growth and nutrition are presented, on a trial by trial basis, at the end of the report.

AK925/1

The response to P is essentially "flat" across the all rates from 0 to 280 kg P/ha, and there were no gains to refertilising trees with N, P and K at age 3. Currently the trees are showing foliar N concentrations of about 1.1%, and would respond to nitrogen fertiliser.

AK925/2

The response to P shows a strong "plateau" response at 125 kg P/ha by age 6. At age 4 (see Report 20) the optimum rate was 56 kg P/ha; the change in the optimum rate from year 4 to year 6 relates to the decline in foliar P concentrations with successive years. This is the only experiment established so far in NZ that shows such a strong decline in foliar P at the higher levels of PR application. These reasons for this are unknown, but may be die to interference in P uptake by Al excess, or by k deficiency inhibiting P uptake.

AK925/3 and WN356

For both trials, the response to P, as measured by growth, is essentially "flat" across all rates of P indicating that P is not growth limiting. Foliar P concentrations are between 0.14 and 0.15% (WN 356) and just above 0.10% (AK 925/3). The decline to below).11% at AK 925/3 has only just occurred. The lack of response to P on sites that are deficient according to the Bray test for "available" P can now be explained on the basis of the new sequential Bray test which indicates that these soils have strong "buffer" capacities to supply P (that is, although the extractable P is low, the soils' buffer capacity is adequate.

WD403/1

By age 4 the "plateau" for the response to P occurs at about 56 kg P/ha (growth at this rate was significantly different (P.05) to results at 125 kg P/ha. Where North Carolina phosphate rock was substituted for the Christmas/Nauru mix, at the equivalent rate of 125 kg P/ha, growth was comparable.

WD403/2: a supplementary trial to WD403/1

WD403/2 was established alongside WD403/1 to test the effect of the components of DAP if applied in the presence of phosphate rock. The trial was extended to compare Christmas/ Nauru rock with North Carolina. The results show that if a starter dose is used at time-of-planting, nitrogen (as urea) will suffice. There is no benefit to including P in the starter dose.

PART B. WD 398: AN EARLY TRIAL TO TEST THE PHOSPHATE ROCK STRATEGY

Background

WD398 was installed 2 years after the establishment of AK850/1,2 in Northland. On the West Coast, V-blading is routinely used on "pakahi" soils for drainage of excess water. Trees responded well to soluble fertiliser at time-of-planting, but the effect was short-lived. Rock P was seen as possible way of maintaining the plantation P status.

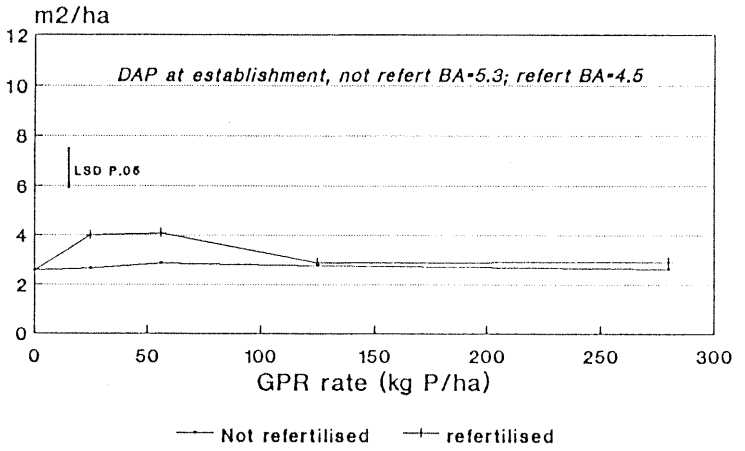
METHODS

The site was Cpt 59, Nemona State Forest. Phosphate rock at 100 kg P/ha was applied as a broadcast fertiliser both prior to and after V-blading. Control areas were left unfertilised. The design was a split plot factorial with rock timing as the main plots,and the sub-plots being the presence of soluble fertiliser (100 g pellet). Half of each sub-plot was refertilised at age 3 with N P K.

RESULTS

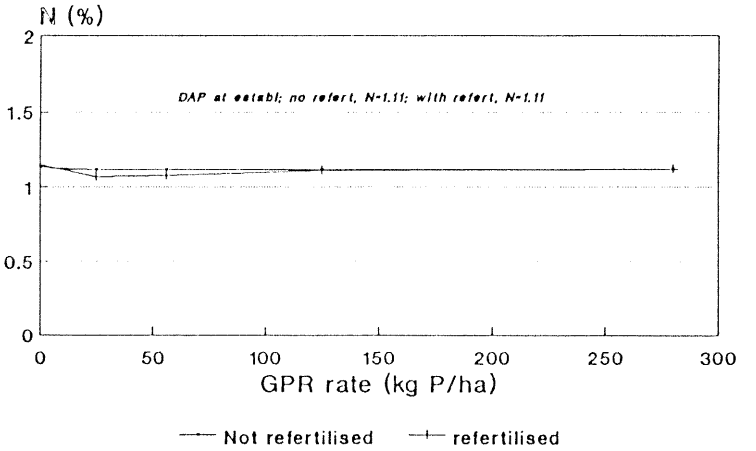
By age 4 the basal areas in the rock phosphate treated plots were comparable between the "before" and "after" applications. Foliar P concentrations 5 years after the application of phosphate rock are still at 0.12% or better. The starter fertiliser had a dramatic effect on growth in the controls, but nutritionally the effect of this application has now passed. The response to refertilisation 2 years following application appears to be variable between the 2 rock application strategies.

AK 925/1
Basal area (m2/ha)



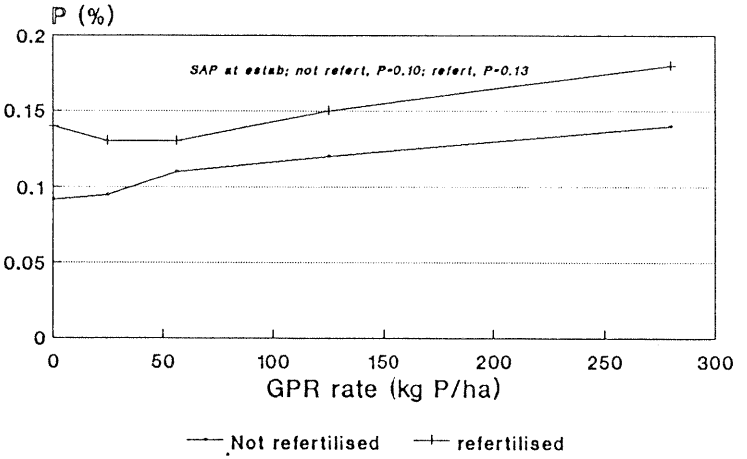
Est 1983; refertilised NPK 1986

AK 925/1
Foliar N concentrations



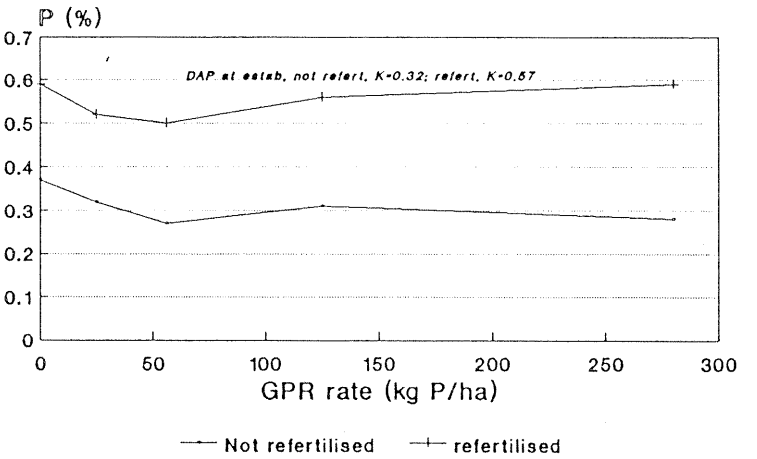
Est 1983; refertilised NPK 1986

AK 925/1
Foliar P concentrations



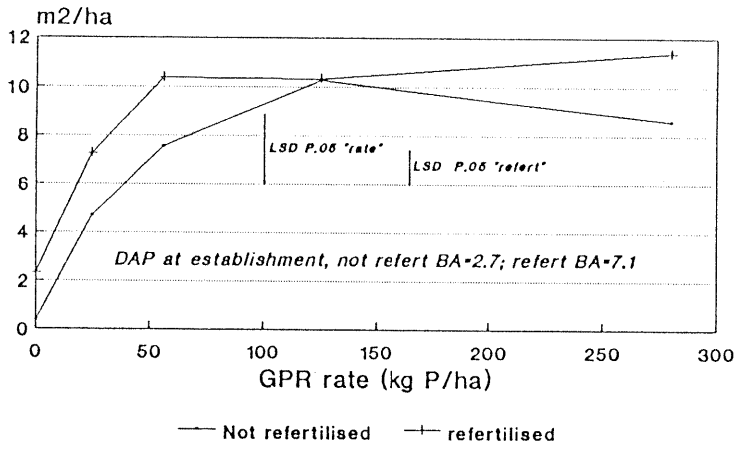
Est 1983; refertilised NPK 1986

AK 925/1
Foliar K concentrations



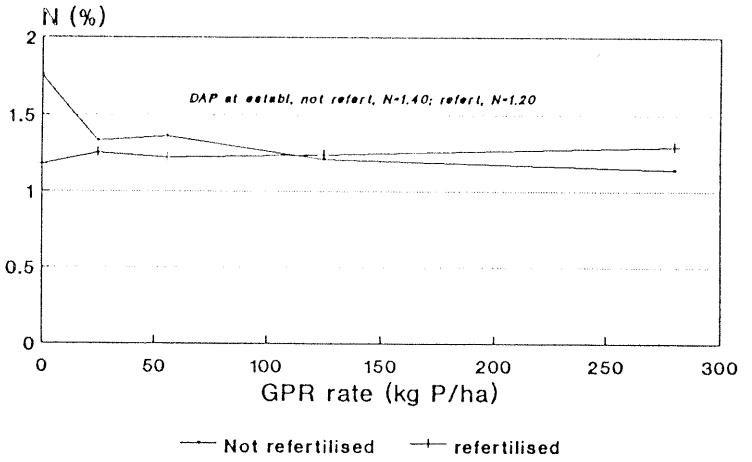
Est 1983; refertilised NPK 1986

AK925/2
Basal area (m2/ha) age 5



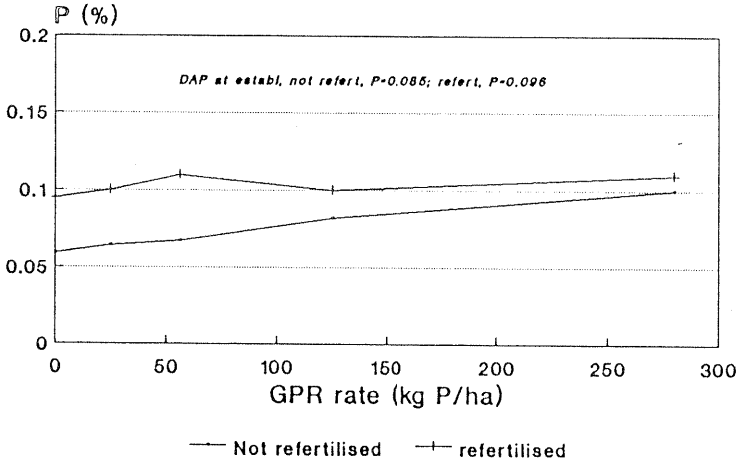
Est 1983; refertilised NPK 1986

AK925/2
Foliar N concentrations 1988 (age 5)



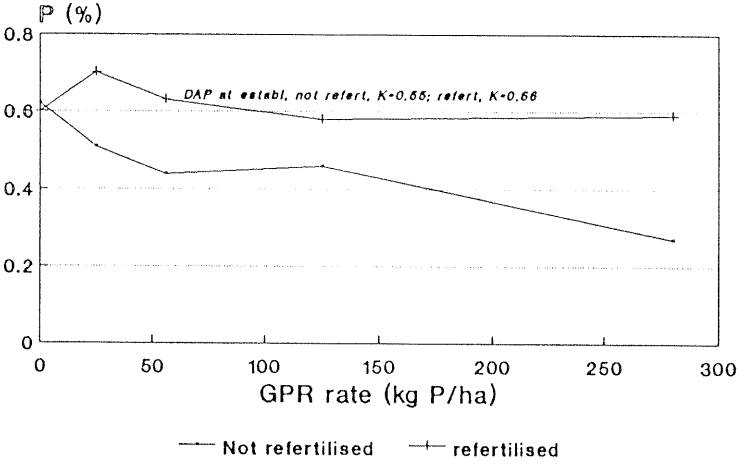
Est 1983; refertilised NPK 1986

AK925/2
Foliar P concentrations 1988 (age 5)



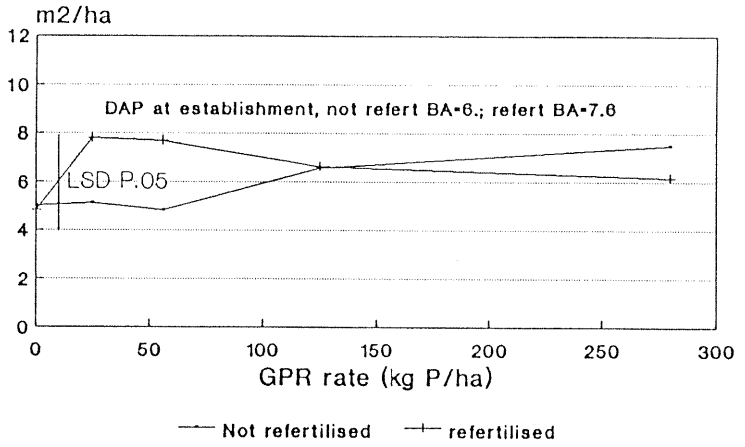
Est 1983; refertilised NPK 1986

AK925/2
Foliar K concentrations 1988 (age 5)



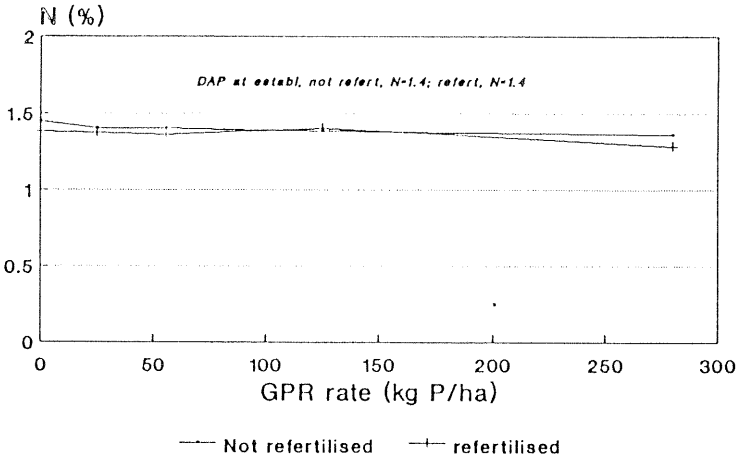
Est 1983; refertilised NPK 1986

AK925/3
Basal area (m2/ha) age 5



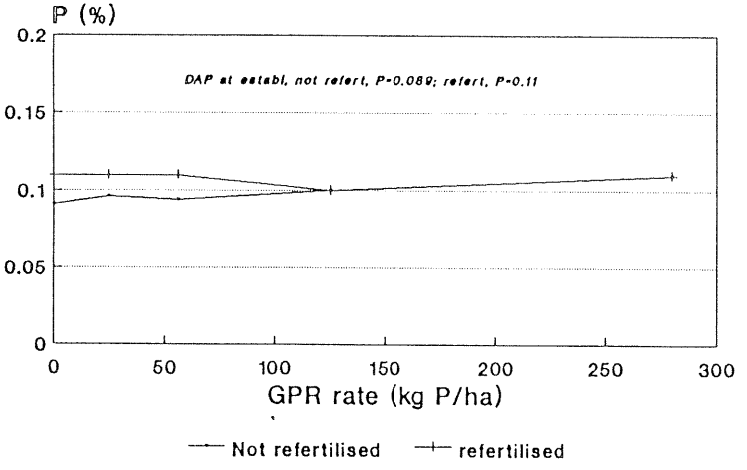
Est 1983; refertilised NPK 1986

AK925/3
Foliar N concentrations 1988 (age 5)



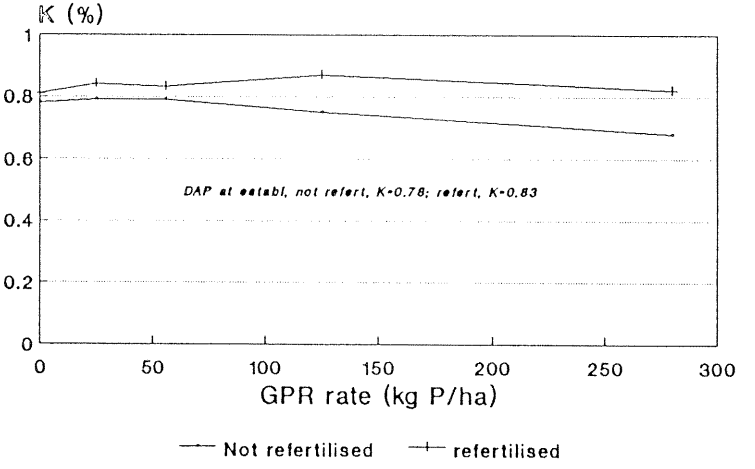
Est 1983; refertilised NPK 1986

AK925/3
Foliar P concentrations 1988 (age 5)



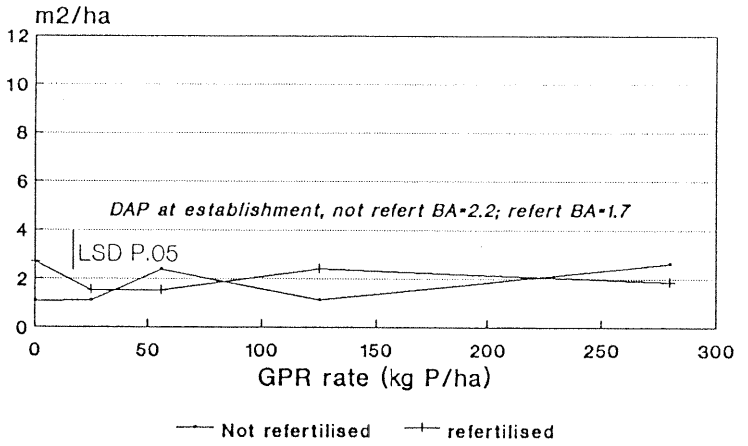
Est 1983; refertilised NPK 1986

AK925/3
Foliar K concentrations 1988 (age 5)



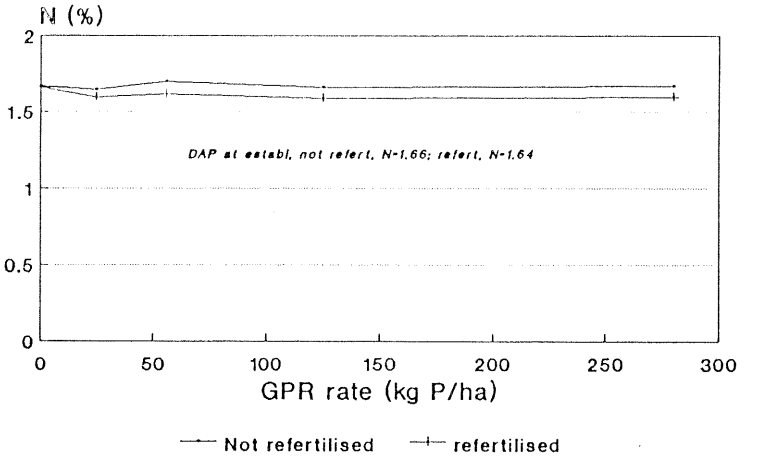
Est 1983; refertilised NPK 1986

WN356
Basal area (m2/ha) age 5



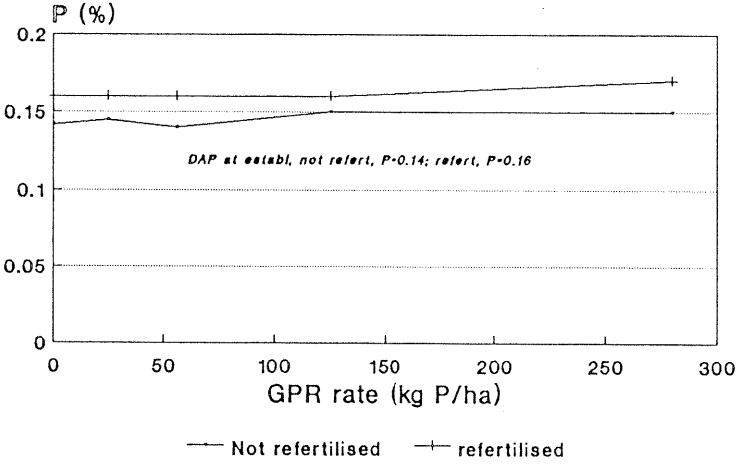
Est 1983; refertilised NPK 1986

WN356
Foliar N concentrations 1988 (age 5)



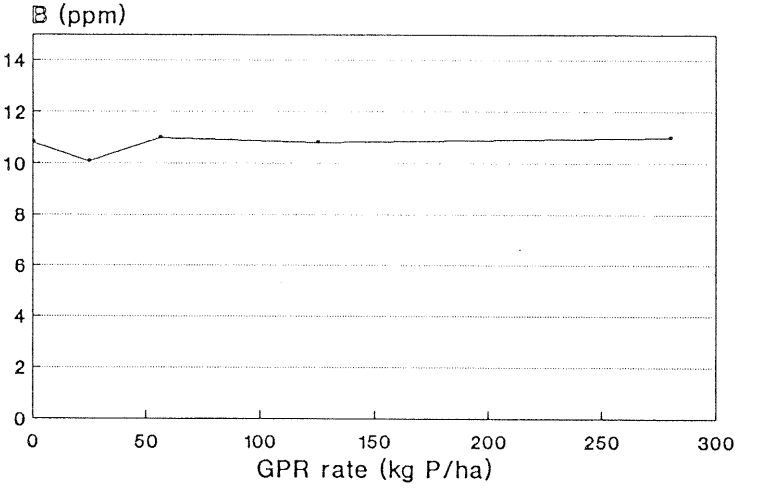
Est 1983; refertilised NPK 1986

WN356
Foliar P concentrations 1988 (age 5)



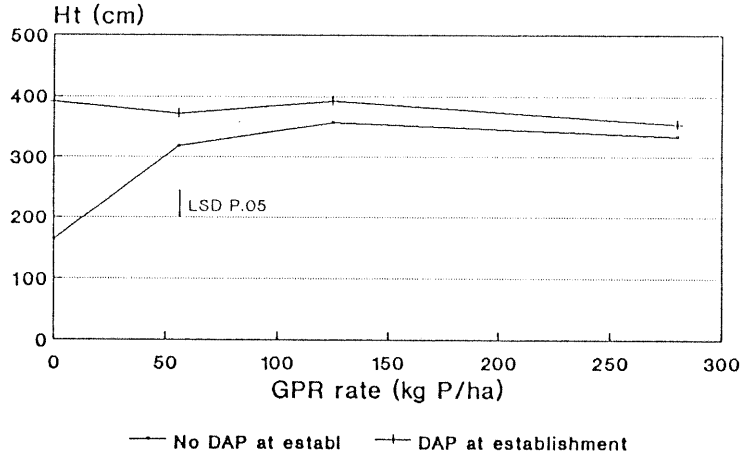
Est 1983; refertilised NPK 1986

WN356
Foliar B concentrations 1988 (age 5)



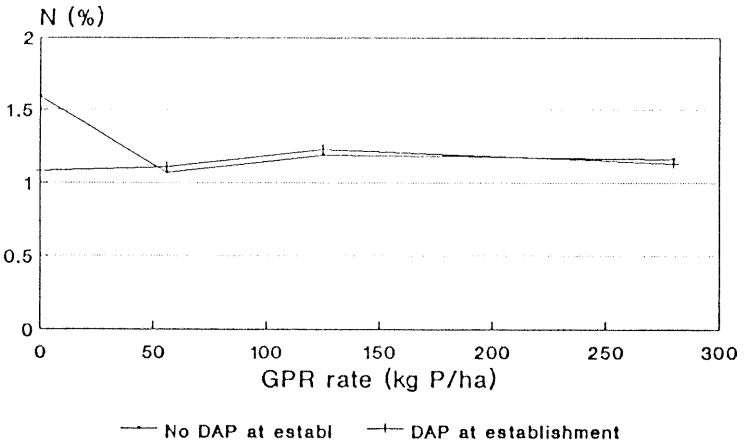
Est 1983; refertilised NPK 1986

WD403/1
Heights (cm) 1988 (age 4)



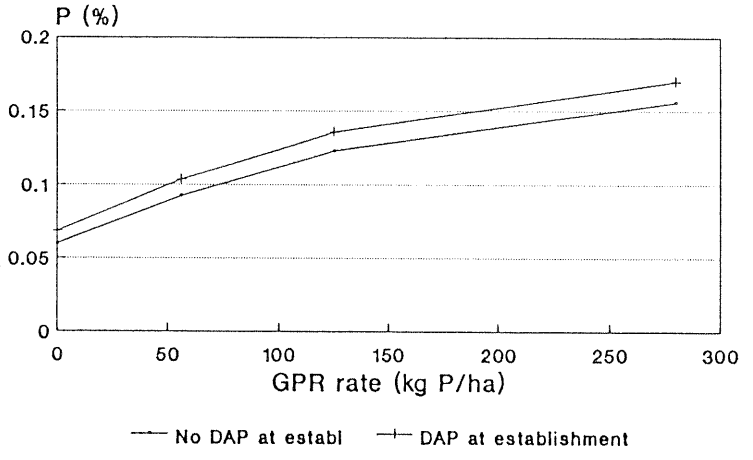
Est 1984; refertilised NPK 1988

WD403/1
Foliar N 1988



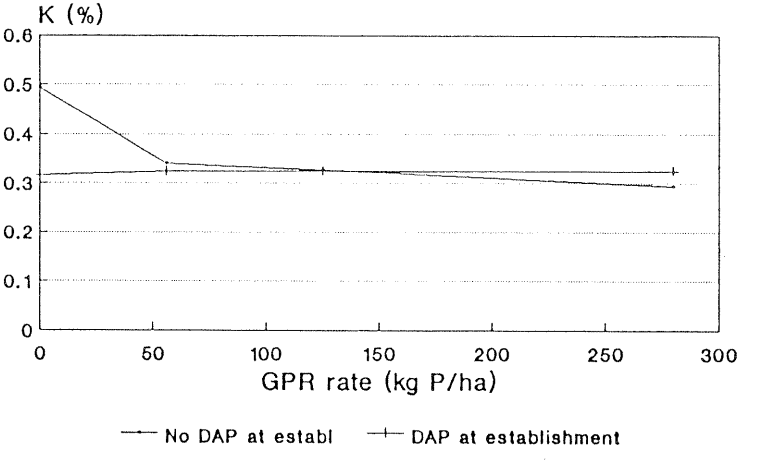
Est 1984; refertilised NPK 1988

WD403/1
Foliar P 1988



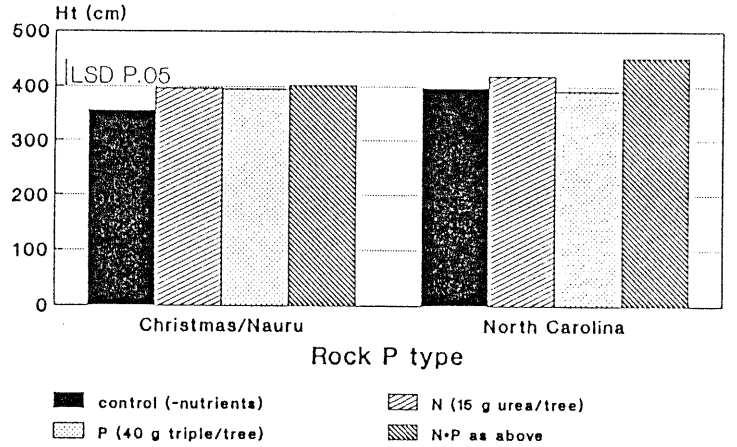
Est 1984; refertilised NPK 1988

WD403/1
Foliar K 1988



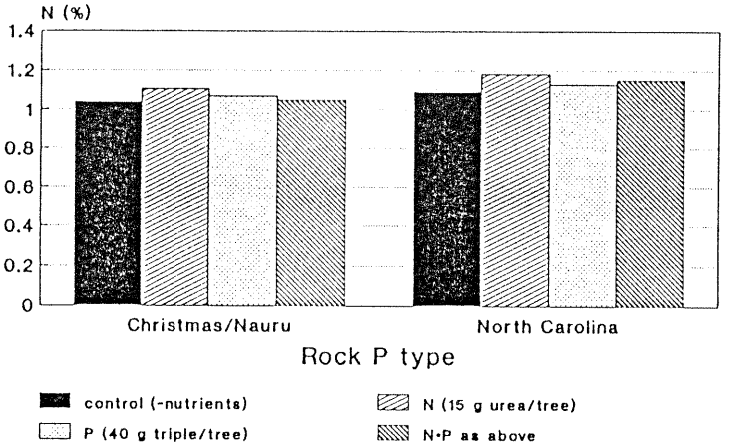
Est 1984; refertilised NPK 1988

WD 403/2 Age 4
Effect of Rock type/starter nutrients



Established 1984

WD 403/2 compares 2 types of Rock P
Starter nutrient and foliar N at age 4



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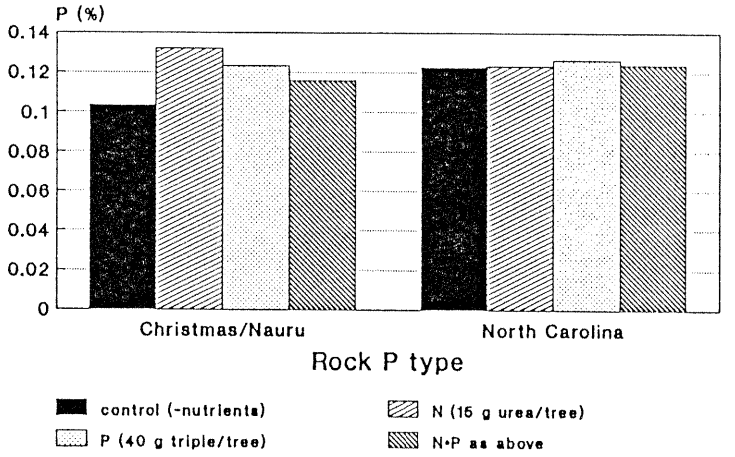
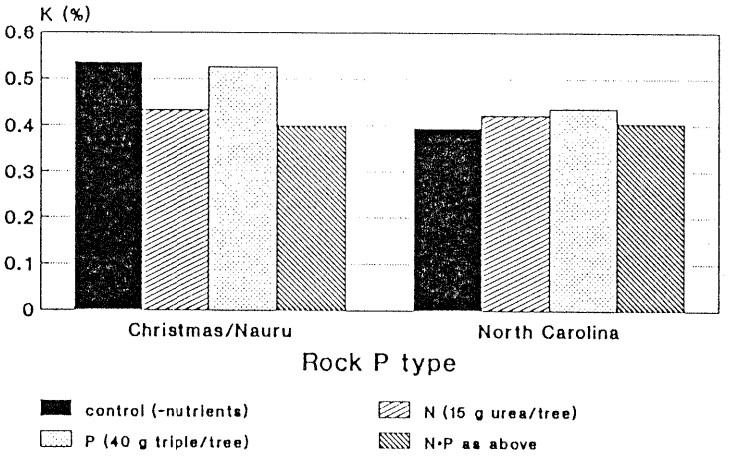
Starter nutrient and foliar P at age 4



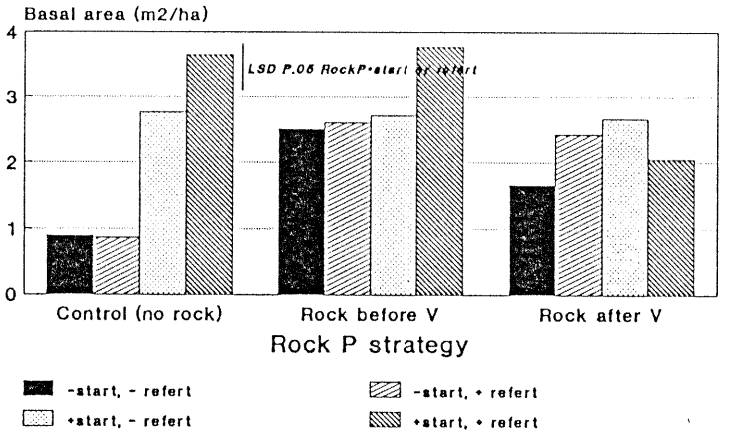
Established 1984

WD 403/2 compares 2 types of Rock P
Starter nutrient and foliar K at age 4



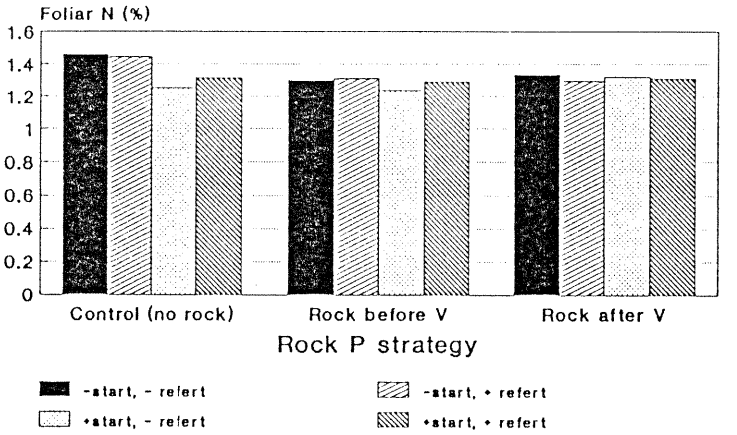
Established 1984

WD 398 age 5
Rock P timing/starter fert/refert



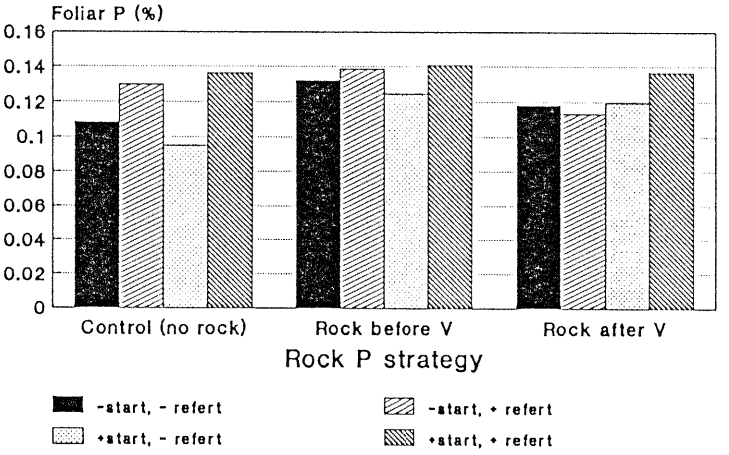
Refertilised age 3 (1987) with N P K

WD 398
Foliar N (%) age 5



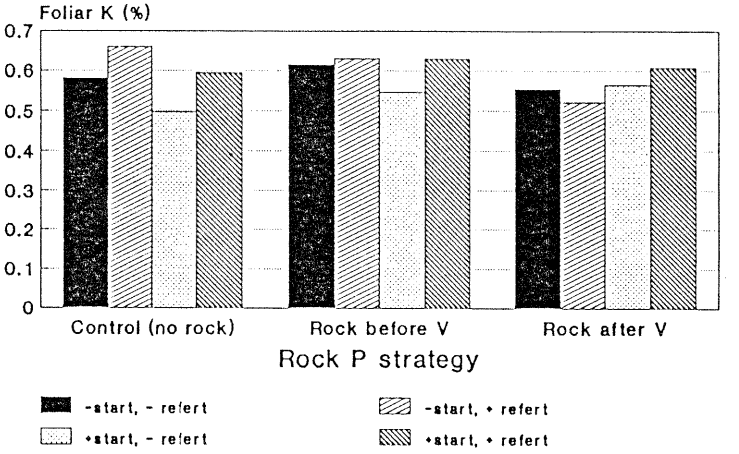
Refertilised age 3 (1986) with N P K

WD 398
Foliar P (%) age 5



Refertilised age 3 (1986) with N P K

WD 398
Foliar K (%) (age 5)



Refertilised age 3 (1986) with N P K