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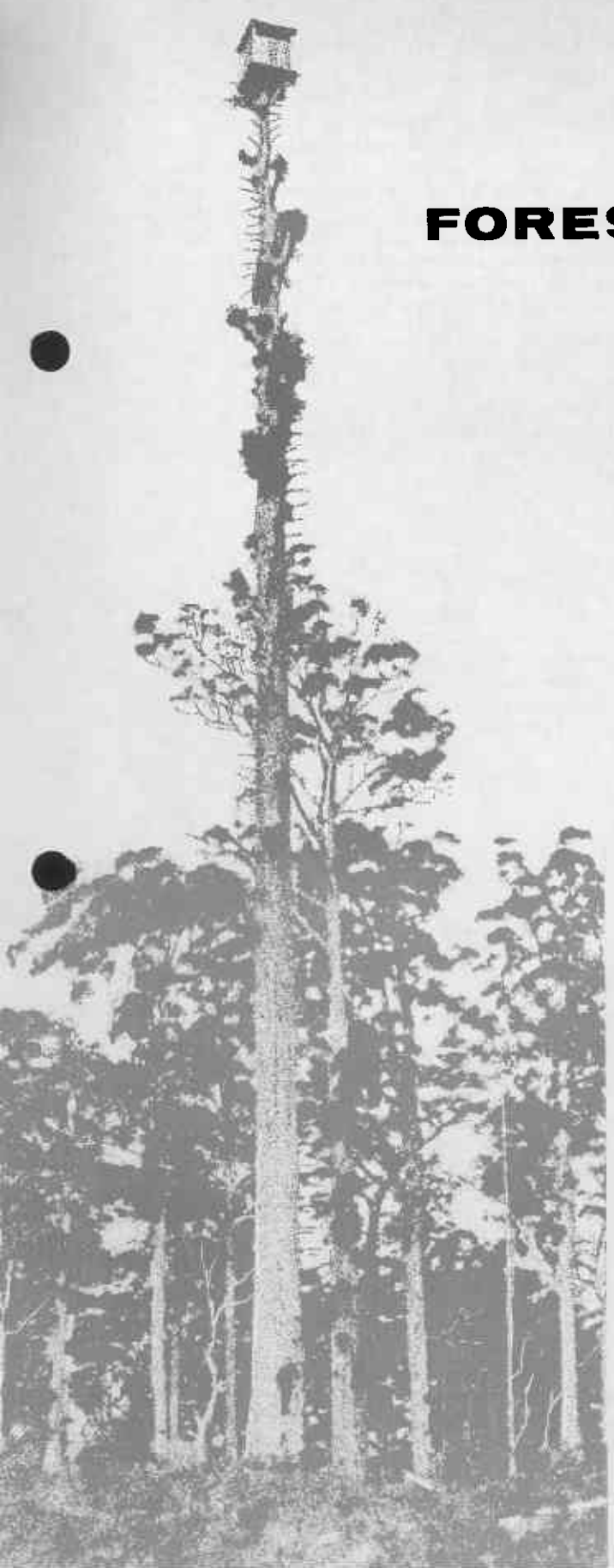

FORESTS DEPARTMENT
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RESPONSE OF OPEN-ROOTED KARRI *(Eucalyptus diversicolor)* SEEDLINGS TO NITROGEN AND PHOSPHORUS FERTILIZER

by

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SUMMARY

A field trial with phosphorus and nitrogen fertilizers indicated that phosphorus was essential to achieve good early height growth and establishment of karri (*Eucalyptus diversicolor* F. Muell.). A quick-acting nitrogenous fertilizer caused high early mortality. Higher rates of application tended to increase death rates. High rates of fertilizer application did not show significant benefit during the first year of growth.

Large reductions in current establishment costs are possible using higher phosphorus to nitrogen ratio fertilizers.

INTRODUCTION

At the present time the most promising method of artificially regenerating large areas where natural regeneration has failed is the planting of open-rooted nursery stock.

Pot trials with karri (Loneragan 1964) indicate that both phosphorus and nitrogen are necessary to give the best growth. Field trials tend to confirm this, and the NPK fertilizer Nutrifert (Wesfarmers) is in general operational use. While this fertilizer has been satisfactory for trial plot work and small scale plantings, its cost of about $115 per tonne (Jan. 1973) is prohibitive for large scale operations.

The nitrogen fraction of NP fertilizers is the most costly. Thus the higher the P to N ratio, the cheaper the fertilizer. Since it was felt that for karri, phosphorus might be the more essential of the two elements, a trial was established to determine the best P to N ratio. The effect of different rates of application was also investigated.

METHOD

The trial was designed as a factorial using a randomized block layout repeated on two separate sites, March Road and Grace Road in the Quininup area (320 km south-south-east of Perth).

The basic unit used was 20 top-trimmed wildings planted in two rows spaced at 0.6 m within rows and 0.9 m between. Each unit of 20 plants was separated by a space of 3 m. The fertilizer treatments were applied in mid June at the time of planting.

The effects of superphosphate (23 percent P) mixed with either the quick-acting nitrogenous fertilizer urea (46 percent N), or the slow-acting Nitroform (38 percent N, Amalgamated Chemicals), were compared with Nutrifert and an untreated control.

The P to N ratios used were 4:0, 3:1, 2:2, 1:3 and 0:4 for each compound. Each fertilizer mixture was applied in four multiples: 1, 2, 4 and 8. As the experiment was initiated well before conversion from the imperial to the metric system of measurement, one ounce (28 g) of superphosphate was used as basic measure. One measure of superphosphate (23 percent P) equals one ounce (28 g), whereas one measure of urea (46 percent N) with twice the active ingredient equals 0.5 ounce (14 g), and one measure of Nitroform (39 percent N) equals 0.6 ounce (17 g).

The fertilizers in different ratios were awkward to mix but this system allowed a direct comparison between the N and P fraction of the fertilizers. Thus the results are applicable not only to the brands of fertilizer used in this experiment, but also to other brands containing similar forms of nitrogen or phosphorus.

RESULTS

Extensive mortality in the Grace Road Area prohibited the use of this data in the analysis. However the results from the March Road were encouraging. Percentage mortality was recorded 5 months after establishment of the trial, and the plant heights were measured one year after establishment.

FIGURE 1: Variation of mortality with (a) phosphorus/nitrogen ratio and (b) application rate.

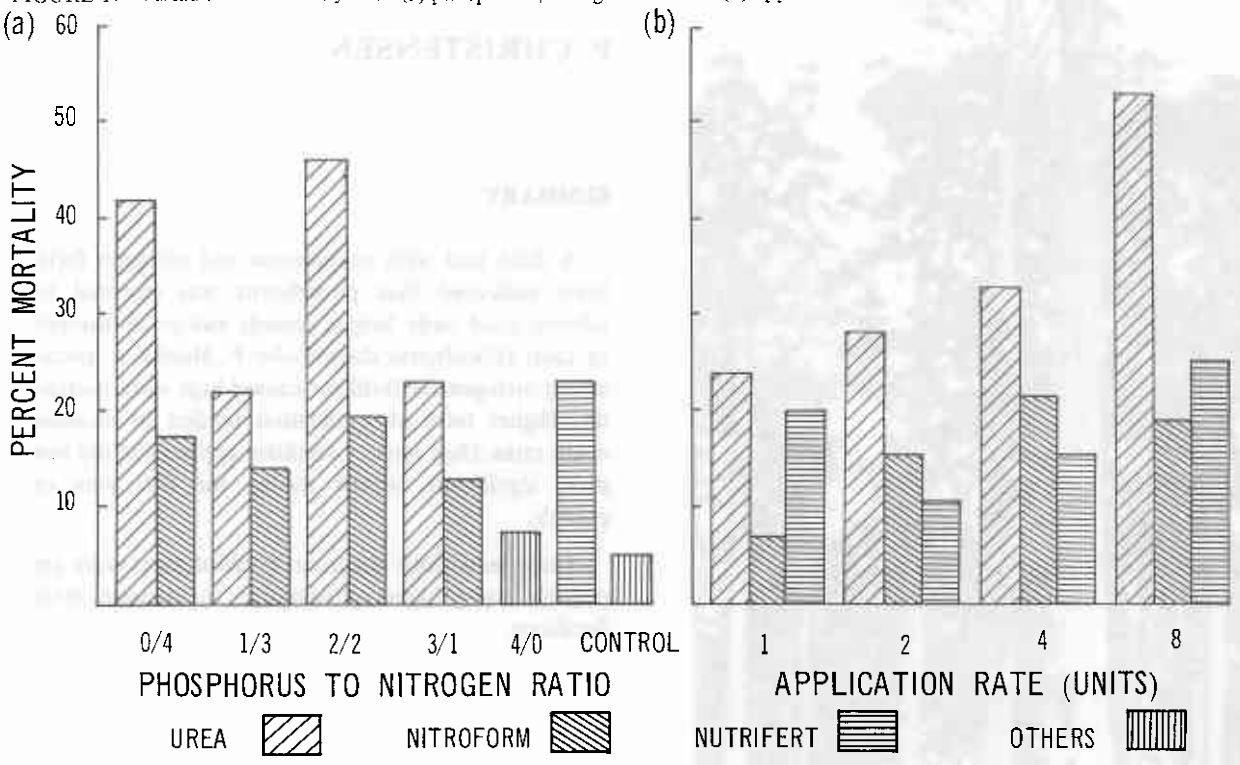
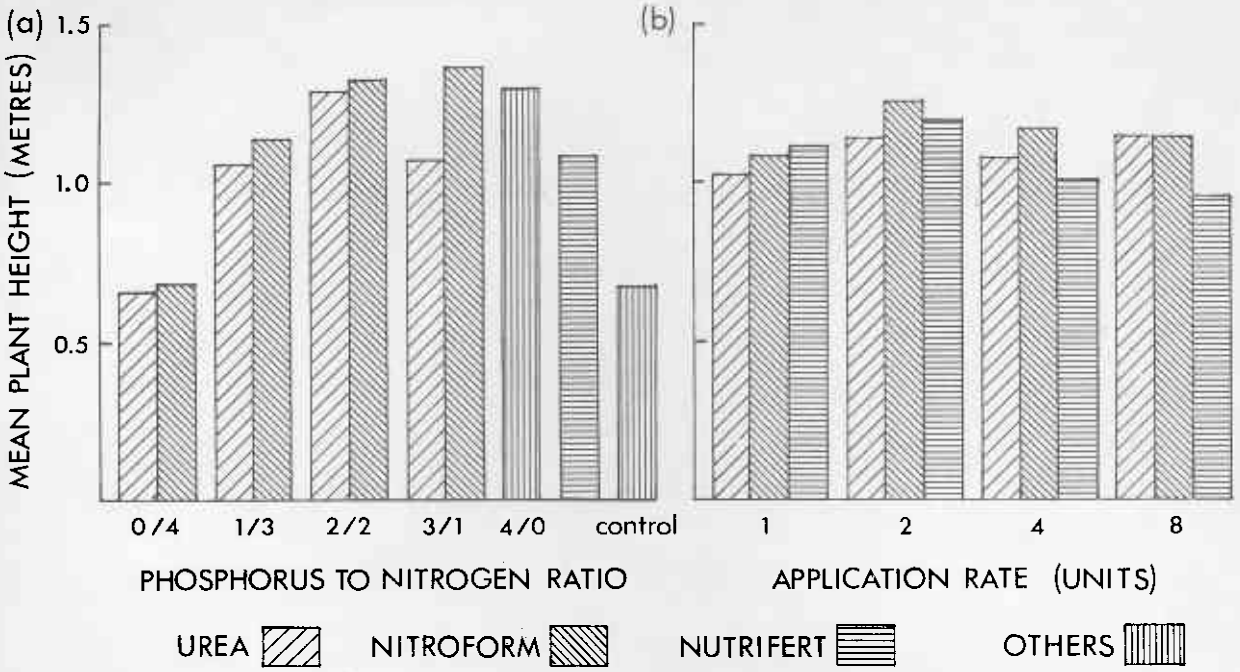


FIGURE 2: Variation in height growth with (a) phosphorus/nitrogen ratio and (b) application rate.



Mortality was highest for the treatments that received fertilizers containing nitrogen and the death rate tended to increase with increasing rates of application and decreasing P to N ratios (Figs. 1a and 1b). This was significant at the 0.01 level for the urea treatments, which gave consistently higher mortality than the slower acting Nitroform.

There appeared to be an interaction between P to N ratio and rate of application. The results were not significant, but high P to N ratios combined with low rates of application tended to lower the mortality. Low P to N ratios and high rates of application increased mortality.

All fertilizer treatments except those without phosphorus increased height growth significantly (0.01 level). The higher P to N ratios gave slightly better results than the lower ones and superphosphate alone was among the best treatments (Fig. 2a).

Application rates of Nutrifert were not adjusted for phosphorus content and, as it contained only 11.1 percent phosphorus, it was applied at about half strength, i.e. it was comparable to the 2P to 2N treatment. This partly explained its poor performance.

There appeared to be little increased growth with increasing rates of application (Fig. 2b).

Differences in height growth between the results obtained with the quick-acting and the slow-acting nitrogenous fertilizers were minimal. An interaction between the phosphorus/nitrogen ratio and rate of application was evident; high P to N ratios and high rates of application appeared to favour growth slightly more than low P to N ratios and low rates of application. This trend was not significant however.

DISCUSSION

Although the results of this trial were based on observations on one site only, several practical implications were clear. First, important early growth increases were obtained using fertilizer at the time of planting. Second, nitrogen was less important than phosphorus. Phosphorus alone gave very good height growth, but the pure nitrogen treatments were no better than the control. Moreover, high ratios and rates of nitrogen application, especially of urea, gave high mortality. There appeared to be some benefit in adding a small percentage of nitrogen, although this was not proved significant.

Third, high rates of fertilizer application provided no real benefit to early height growth and establishment. Fourth, Nutrifert gave no better results than phosphorus/nitrogen mixtures with a similar content of phosphorus. Thus in terms of cost benefit, the results could not be more satisfactory.

Good establishment and fast early growth rates should result from application of a fertilizer with a high P to N ratio applied at a fairly low rate – about one ounce (28 g) per tree if superphosphate is the phosphorus base. Apparently there is little difference between the two nitrogenous fertilizers used; growth rates are the same and, providing not too much quick-acting fertilizer is used, mortality should be low.

Superphosphate alone could be used. Very good results were obtained with it in this trial, but the area had been burnt the year before and some nitrogen may still have been present in the soil. Burning has been shown to increase the total available nitrogen content of the soil (Hatch 1960). Until further field trials have been carried out, the addition of some nitrogen seems advisable.

One metric tonne of 3P:1N mixture of superphosphate (23 percent P) and urea (46 percent N) would contain 857 kg of superphosphate and 143 kg of urea, not 750 kg of superphosphate and 250 kg of urea. At $22/t for superphosphate and $88/t for urea this mixture would cost approximately $31/t, exclusive of mixing costs. This compares with $115/t for Nutrifert, which contains only 11.1 percent phosphorus, needing double the quantity to achieve the same effect as the urea/superphosphate mixture.

The other compound used, Nitroform (38 percent N), is very costly: $450/t. However, a 3:1 mix of this compound and superphosphate would cost about $91/t, and would still be cheaper than Nutrifert.

LITERATURE CITED

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