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NUTRITION OF PINUS RADIATA ON WEST COASTAL SANDS

by

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ABSTRACT

Economic plantations of *Pinus radiata* are possible on west coastal sands provided suitable fertilisers are used. Superphosphate at planting is obligatory as is a foliar zinc spray at year one. This appears to provide sufficient phosphate for at least 16 years but does not provide sufficient zinc, even if zinc solids are incorporated in the phosphate. Other minor elements - manganese and iron - give growth responses in young plants but are not acutely deficient on these soils. In stands five years and older, nitrogen fertiliser is necessary and a method of providing it is suggested.

One of the areas available for planting Pinus radiata, the preferred softwood species in Western Australia, is part of the south west coastal plain. The soils in the area are of two distinct geomorphological systems - the Spearwood Dune system and the Bassendean Dune system (McArthur and Bettinay 1960). The Spearwood system is composed of leached yellow and brown sands overlying limestone at variable depth, while in the more infertile Bassendean system the soils are deep, highly leached grey sands often overlying an organic hardpan. Natural fertility of all soils in these systems is extremely low (see Hopkins 1960).

Empirical field trials have yielded techniques for satisfactory establishment of P. radiata on the yellow sands but this species has been difficult to grow on the grey sands due to inadequate nutritional research. On the other hand, Pinus pinaster has been grown successfully on the grey sands. Because the former species is much more productive and the area is close to the main market areas it is desired to extend its use on to both soil types. The present research programme was commenced in 1971 with this aim and also to place the existing techniques on a more scientific basis.

The first plantings of P. radiata on the coast were made as early as 1930, without notable success. Superphosphate was applied at rates of about 100 gm/tree for three or four years in succession but the plants still failed to thrive. In 1937 the first applications of zinc foliar sprays were carried out and it was soon clear zinc was the "missing link".

Current practise is to fertilise within a month or so of planting with a spot application of 113gm/tree of a super-copper-zinc mixture, followed by a foliar zinc sulphate spray at age one. This is based on the results given in Table 1 (below) for a field trial in the 1963 planting, measured in 1971.

Table 1. Fertiliser Trial Myalup 84

Treatment	Mean DBH (cm)	Mean Height (m)
A - Control	6.09	4.19
B - 113gm Super+zinc spray	12.17	10.31
C - 113gm Super-copper-zinc	12.75	10.83
D - 113gm Super Copper-zinc +zinc spray	14.07	12.53

The control plots have no chance of making a crop as the trees all have the hopeless multileader form typical of extreme zinc deficiency (see Stoate 1950). Early growth of stands established since 1963 using treatment D is quite acceptable and basal area increments compare will with other plantations on better soils.

Plantings made between 1952 and 1963 used a fertiliser regime very close to treatment B above, and whereas early growth was quite good, these stands clearly encounter severe nutritional problems at about age 12. Dieback is infrequent but crown density is much reduced and needles last less than two years on the tree, with consequent loss of vigour. Foliar analysis indicates adequate levels of all major elements except nitrogen and all minor elements except zinc and perhaps copper (see table 2).

Table 2 1972 Analysis of foliar nutrient content for 1957 planting (Yellow sands)

Nutrient	N%	P%	K%	Mn ppm	Zn ppm	Cu ppm
1972 Data	1.27	0.238	0.53	77.2	12.4	2.1
Probable Deficiency Level	1.20	0.120	0.30	50	20	2

Further evidence for a continuing problem of zinc availability on the yellow sands is provided by foliar analysis data from a fertiliser trial established in 1971 in an area planted in 1966 using the routine prescription (ie, treatment D in Table 1.) Foliar zinc contents in 1972 ranged from 8.9 ppm to 16.3 ppm, the latter where zinc solids as super-copper-zinc had been applied 12 months previously (6gm ZnO per tree). It is clear ZnO is not the ideal long term zinc source, so further foliar applications of zinc sulphate would seem necessary early in the rotation until a recycling pattern can be established.

Of the other minor elements, none appears acutely deficient at this stage, although several have given growth responses in a field trial laid out in 1971. Table 3 lists height data at age two years for selected treatments, all of which had received a base application of 220gm/tree superphosphate and 55gm/tree of the particular minor element.

Table 3 1973 Height Data Minor Element Screening Trial (cm)

Treatment	Grey Sands	Yellow Sands
Control	53.3	62.4
Zinc	59.7	66.5
Iron	59.8	69.9
Manganese	65.6	74.9
Mixed minor elements	63.1	77.7

The same minor elements are effective on both soil types and in each case the controls are now showing symptons of severe zinc stress. The clear response to manganese is difficult to explain in view of the naturally adequate foliar levels at age six (60-80 ppm), but the same effect has been observed on several other soil types in W.A.

Turning now to the major elements N,P and K, extensive field trials on yellow sands in stands aged five and 14 have failed to demonstrate a response to P or K, but have shown a consistent response to N. The effect is always due to N alone and no NP interaction has yet been observed. In the five year old stand (Table 4) a diameter increment increase of 20-23 percent has been obtained in the spite of apparently satisfactory foliar levels of

N in the range 1.4 - 1.6 percent.

Table 4 Mean Diameter Increments 1971-73 for P.radiata Planted 1966, Fertilised 1971

Treatment	DBHoB Inc (cm)	% Foliar N 1972
Control	3.82	1.37
Superphosphate 0.5kg/tree	4.09 NS	1.24
Agran 24-24 (N:P) 0.45 kg/tree	4.66 **	1.41
Agran 34-0 (N) 0.5 kg/tree	4.57 **	1.47
NPK (9:9:9) 1.2 kg/tree	4.31 **	1.40

Increments for all treatments containing N are significantly different from control at P=0.01. A similar level of response has been obtained in a 14-year old stand. Future work in older stands will therefore centre on ways of improving N-status of the site. However, due to the coarse nature of the soils, the ready solubility of the practical commercial fertilisers and the lack of sufficient soil organic matter to act as a reservior of N, periodic treatment with commercial N sources is likely to be inefficient.

An alternative approach might be to provide an understory of N-fixing plants under the pines, and we are now testing the feasibility of this. Under the current W.A. pine management regime stocking is kept at a very low level from age five onward, so it is anticipated there will be no serious obstacle to maintaining a crop of lupins for most of the rotation. This project raises the further possibility, if Uniwhite lupins are used, of introducing grazing under the pines. The hope is that this "agforestry" approach will accelerate and contribute usefully to the recycling system. Pine growth and health will benefit and a further profitable return from the site obtained.