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Abstract

Previous nursery experiments at Kolombangara Forest Products Ltd. have shown that nutrient deficiencies limited seedling growth in unamended coir. However, the addition of slow release fertilisers improved dry matter production approximately 20-fold.

This experiment used coir as a potting media with four commercially available slow release fertilisers added at six rates to compare shoot growth of *Cedrela odorata* L. (West Indian Cedar) seedlings.

Three of the slow release fertilisers resulted in significant increases in growth but one produced very poor growth even at the highest rate of application.

Introduction

As part of an ACIAR Forestry project we are investigating the nutrition of high-value tropical timbers for reforestation of degraded lands in the Western Pacific. With the involvement of research staff from Kolombangara Forest Products Ltd. (KFPL) in the Solomon Islands, Queensland Forestry Research Institute (QFRI) and CSIRO, we are trying to reduce the time planting stock require in the nursery and to produce better quality stock which require less maintenance following planting out in the field. Coir (composed coconut husks) is a widely used potting media in forest nurseries throughout the Asia-Pacific region and is favoured because it is locally produced, has good moisture holding characteristics and is light, making transport of planting stocking into the field easier. However, the growth of many species in coir is frequently poor, and foliar symptoms of nutrient deficiencies are often evident. The objective of this experiment was to assess the feasibility of a number of fertiliser options for overcoming these nutritional problems in coir potting media.

Methods

The experimental treatments were a factorial combination of four types of commercially available slow release fertilisers, each at six rates of application.

Experimental Design

The experiment was a split plot design with three blocks. The four slow release fertilisers were allocated to the main plots; the six rates of application were allocated to sub-plots. The treatments used were:

SLOW RELEASE FERTILISER

Nitrophoska	4 month formulation
Macrocoate	50% - 4 to 5 month and 50% - 9 month formulations
Osmocote	33% - 4 to 5 month and 33% - 6 month and 33% - 9 month formulations
Nutricote	50% - 4 to 5 month and 50% - 9 month formulations

APPLICATION RATE

(per litre of Coir)

No fertiliser added

1g slow release fertiliser + 0.5g Micromax + 0.25g FeSO₄.7H₂O

2g slow release fertiliser + 0.5g Micromax + 0.25g FeSO₄.7H₂O

4g slow release fertiliser + 0.5g Micromax + 0.25g FeSO₄.7H₂O

6g slow release fertiliser + 0.5g Micromax + 0.25g FeSO₄.7H₂O

8g slow release fertiliser + 0.5g Micromax + 0.25g FeSO₄.7H₂O

The elemental composition of the four slow release fertilisers and the micronutrient source are given as Appendix 2.

Each block contained eight 'baskets'; two baskets for each slow release fertiliser. Each basket holds ten root-trainer books comprised of five planting cells (100ml capacity). Two books were used for each application rate (sub plots) and were separated from each other by two blank books.

Potting media and fertiliser application

The coir for this experiment was obtained from standard KFPL stocks and was steam-sterilised prior to use then mixed with nutrients as above.

Plant Culture

The trial was conducted in a misthouse at KFPL Ringii nursery on Kolombangara, Solomon Islands. Seeds of *Cedrela odorata* (L.) were direct sown into each cell on the 11th November 1993. Plants were harvested after 15 weeks by cutting shoots at the base of the stem. Plant material was dried at 60°C for several days before determining dry weight.

Results

Shoot growth increased with increasing application of each of the slow release fertilisers. (Figure 1, Table 1).

Shoot growth of *Cedrela odorata* was significantly affected ($P < 0.001$, Appendix 2) by both the fertiliser type and the fertiliser rate.

With Nitrophoska the increase from no added fertiliser to 8g/L was almost three-fold. However this response was very small compared to the 65-fold and 69-fold increases achieved by adding Macrocoote and Osmocote respectively to the same rate of 8g/L. The addition of Nutricote at the maximum rate of 8g/L gave the best response of a 97-fold increase in the dry matter production.

Although this experiment resulted in substantial responses to increasing fertiliser application, it is apparent that not all nutritional constraints have been eliminated as the response was still increasing up to the highest rate. Future experiments have been established to determine the minimum rate required to achieve maximum growth in the nursery and to assess the residual value of supra-optimal nursery fertiliser to plant growth following transplanting in the field.

Table 1 : Dry matter production of shoots in response to each of the fertiliser treatments.

FERTILISER	RATE * G/L coir	BLOCK NO	DRY WT g/book	MEAN WT.	S.D	S.E
NITROPHOSKA	0	1	0.136	0.173	0.034	0.020
		2	0.179			
		3	0.205			
	1	1	0.145	0.235	0.078	0.045
		2	0.283			
		3	0.277			
	2	1	0.235	0.232	0.051	0.029
		2	0.282			
		3	0.179			
4	1	0.439	0.322	0.135	0.078	
	2	0.355				
	3	0.173				
6	1	0.345	0.434	0.227	0.131	
	2	0.693				
	3	0.266				
8	1	0.447	0.488	0.100	0.057	
	2	0.603				
	3	0.416				
MACROCOTE	0	1	0.141	0.163	0.044	0.025
		2	0.215			
		3	0.135			
	1	1	0.717	0.770	0.313	0.181
		2	0.487			
		3	1.108			
	2	1	3.960	3.663	0.287	0.165
		2	3.643			
		3	3.387			
	4	1	6.843	5.767	0.978	0.565
		2	4.930			
		3	5.528			
	6	1	9.143	8.164	1.087	0.628
		2	6.993			
		3	8.357			
	8	1	11.427	10.520	1.736	1.002
		2	11.616			
		3	8.519			

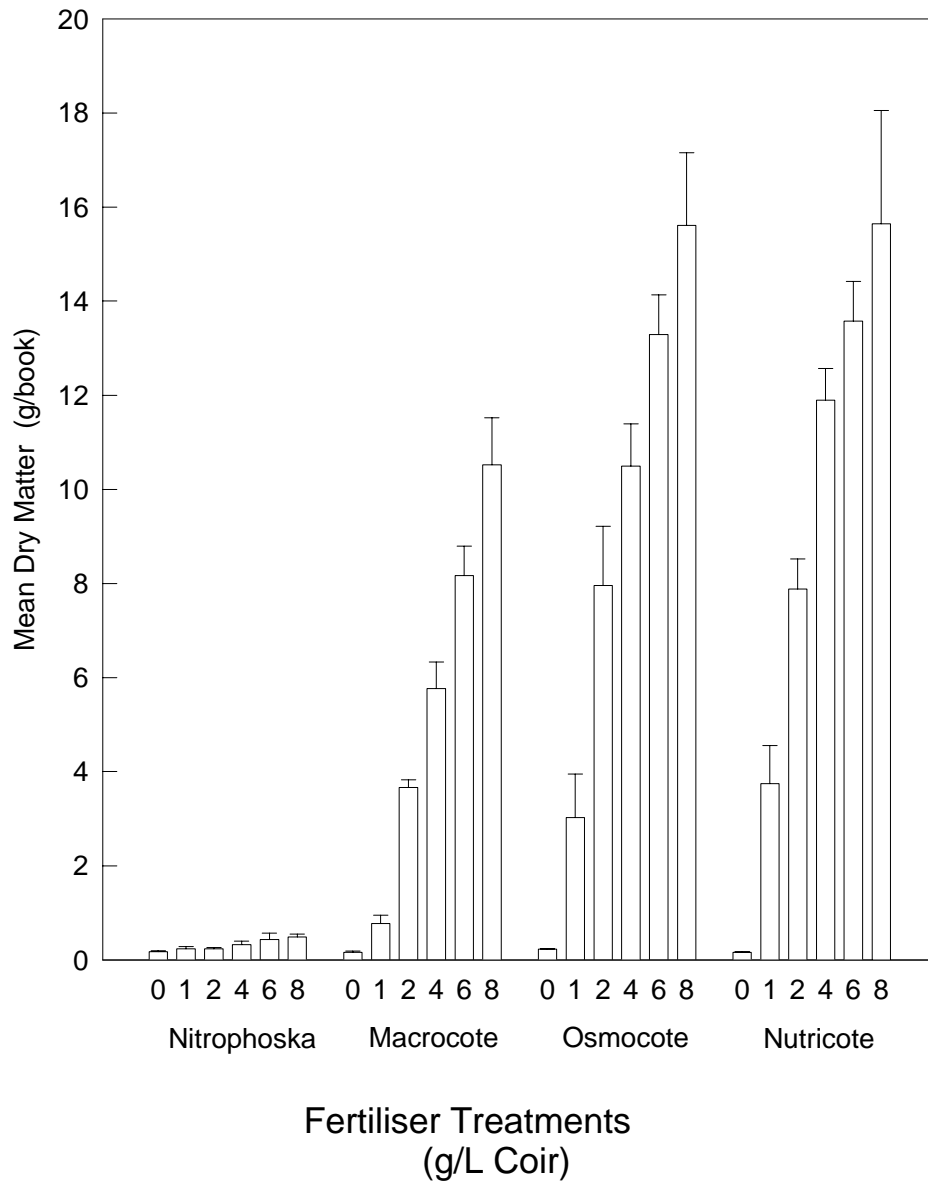
* Rates other than 0g/L also received 0.5g/L Micromax and 0.25g/L FeSO₄.7H₂O

Table 1 (cont.): Dry matter production of shoots in response to each of the fertiliser treatments.

FERTILISER	RATE * g/L coir	BLOCK NO	DRY WT g/book	MEAN	S.D	S.E
OSMOCOTE	0	1	0.239	0.225	0.013	0.007
		2	0.226			
		3	0.212			
	1	1	2.875	3.024	1.602	0.925
		2	4.696			
		3	1.501			
	2	1	5.702	7.958	2.184	1.260
		2	10.062			
		3	8.112			
4	1	9.286	10.493	1.558	0.900	
	2	9.940				
	3	12.253				
6	1	12.763	13.290	1.455	0.840	
	2	14.936				
	3	12.172				
8	1	18.698	15.609	2.679	1.546	
	2	13.914				
	3	14.216				
NUTRICOTE	0	1	0.179	0.162	0.015	0.009
		2	0.148			
		3	0.160			
	1	1	3.420	3.743	1.408	0.813
		2	5.286			
		3	2.525			
	2	1	6.664	7.886	1.096	0.633
		2	8.783			
		3	8.212			
4	1	13.249	11.896	1.171	0.676	
	2	11.233				
	3	11.208				
6	1	15.261	13.578	1.458	0.842	
	2	12.805				
	3	12.670				
8	1	14.278	15.645	4.164	2.404	
	2	20.322				
	3	12.336				

* Rates other than 0g/L also received 0.5g/L Micromax and 0.25g/L FeSO₄.7H₂O

Figure 1: The effect of different slow release fertilisers and rates of application on dry matter production of *Cedrela odorata* seedlings after 15 weeks in the nursery. (Bars represent the standard error of the mean)



Appendix 1: Elemental composition of Fertilisers

Element	Nitrophoska ¹	Macrocoté ² 4 to 5 month formulation	Macrocoté 9 month formulation	Osmocoté ³ 4 to 5 month formulation	Osmocoté 5 to 6 month formulation	Osmocoté 9 month formulation	Nutricoté ⁴ 4 to 5 month formulation	Nutricoté 9 month formulation	Micromax ³ Micro Nutrients
	%	%	%	%	%	%	%	%	%
N	15.0	15.0	12.0	18.0	17.0	17.0	13.3	13.3	
P	3.9	4.0	4.6	4.8	4.4	1.6	5.8	5.8	
K	12.4	8.0	10.0	9.1	10.0	8.7	9.7	9.7	
S	7.0	4.3	5.17	4.0	4.1	4.5	0.5	0.5	15.0
Ca	3.4			0.96	0.2		5.5	5.5	5.5
Mg	1.2	0.75	0.75						3.3
Mo									0.005
Fe	0.1	0.20	0.20						12.0
Cu		0.03	0.03						0.5
Zn	0.02	0.03	0.03						1.0
Mn	0.10	0.09	0.09						2.5
B	0.03								0.10

#	Distributors Name	Address
1	Brunnings	3/256 Jasper Road, Bentleigh. Victoria 3204
2	Defender Garden Products	52 Tarnard Dr, Braeside. Victoria 3195.
3	Grace-Sierra Aust. Pty Ltd	89 Cecil Ave, Castle Hill. New South Wales 2154
4	Yates Aust.	244 Horsley Road, Milperra. New South Wales 2214.

Appendix 2: Analysis of Variance

General Linear Model

MTB> GLM 'DRY WT' = REP FERT | RATE (FERT)

Factor	Levels	Values					
REP	3	1	2	3			
FERT	4	1	2	3	4		
RATE(FERT)	6	1	2	3	4	5	6

Analysis of Variance for DRY WT

Source	DF	Seq SS	Adj SS	Adj MS	F	P
REP	2	7.419	7.419	3.710	1.90	0.161
FERT	3	844.254	844.254	281.418	144.43	0.000
RATE(FERT)	20	1321.626	1321.626	66.081	33.91	0.000
Error	46	89.631	89.631	1.949		
Total	71	2262.931				

Unusual Observations for DRY WT

Obs.	DRY WT	Fit	Stdev.Fit	Residual	St.Resid
43	5.7020	8.0479	0.8388	-2.3459	-2.10R
52	18.6980	15.6986	0.8388	2.9994	2.69R
71	20.3220	15.9862	0.8388	4.3358	3.89R
72	12.3360	15.2152	0.8388	-2.8792	-2.58R

R denotes an obs. with a large st. resid.